FCC Test Report

Equipment	:	**Keyboard**
Brand Name	:	**ZAGGKeys**
Model No.	:	**Cover-Fit , N12PKZKCF, MT1913812** for marketing difference
FCC ID	:	**2AAIL-1913812**
Standard	:	**47 CFR FCC Part 15.247**
Operating Band	:	**2400 MHz – 2483.5 MHz**
FCC Classification	:	**DSS**
Applicant **Manufacturer**	:	**Mae tay Precision Co., Ltd** **6F., No.99, Ruihu St., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)**

The product sample received on Nov. 19, 2013 and completely tested on Nov. 27, 2013. We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2009 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

James Fan / Assistant Manager

Testing Laboratory
1190

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APPENDIX A. TEST PHOTOS A1

Summary of Test Result

Conformance Test Specifications					
Report Clause	**Ref. Std. Clause**	**Description**	**Measured**	**Limit**	**Result**
1.1.2	15.203	Antenna Requirement	Antenna connector mechanism complied	FCC 15.203	Complied
3.1	15.207	AC Power-line Conducted Emissions	[dBuV]:0.477MHz 38.67 (Margin 8.26dB) - AV 42.18 (Margin 14.75dB) - QP	FCC 15.207	Complied
3.2	15.247(a)	20dB Bandwidth	BR:1.02609 MHz	N/A	Complied
3.2	15.247(a)	Carrier Frequency Separation (ChS)	BR:1.0029 MHz	ChS ≥ BW_{20dB} x2/3.	Complied
3.3	15.247(a)	Number of Hopping Frequencies (N)	79	N ≥ 15	Complied
3.4	15.247(a)	Time of Occupancy (Dwell Time)	BR:0.318 sec	0.4 s within 0.4 x N	Complied
3.5	15.247(b)	RF Output Power (Maximum Peak Conducted Output Power)	Power [dBm] BR:0.13	Power [dBm] BR:21 EDR:21	Complied
3.6	15.247(c)	Emissions in non-restricted frequency bands	Out-of -band emissions are 20dB below the highest power	Non-Restricted Bands: > 20 dBc Restricted Bands: FCC 15.209	Complied
3.7	15.247(c)	Transmitter Unwanted Emissions	Restricted Bands [dBuV/m at 3m]:797.27MHz 42.89 (Margin 3.11dB) - PK	Non-Restricted Bands: > 20 dBc Restricted Bands: FCC 15.209	Complied

Revision History

Report No.	Version	Description	Issued Date
FR3N1937	Rev. 01	Initial issue of report	Dec. 06, 2013

1 General Description

1.1 Information

1.1.1 RF General Information

RF General Information					
Frequency Range (MHz)	**Bluetooth Mode**	**Ch. Frequency (MHz)**	**Channel Number**	**RF Output Power (dBm)**	**Co-location**
2400-2483.5	BR V3.0	2402-2480	0-78 [79]	0.13	N/A
Note 1: Only GFSK (1Mbps) modulation is used for the device. Note 2: RF output power specifies that Maximum Peak Conducted Output Power.					

1.1.2 Antenna Information

Antenna Category			
☒	Integral antenna (antenna permanently attached)		
	☐	Temporary RF connector provided	
	☒	No temporary RF connector provided Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path.	
☐	External antenna (dedicated antennas)		
	☐	RF connector provided	
		☐	Unique antenna connector. (e.g., MMCX, U.FL, IPX, and RP-SMA, RP-N type…)
		☐	Standard antenna connector. (e.g., SMA, N, BNC, and TNC type…)

Antenna General Information			
No.	**Ant. Cat.**	**Ant. Type**	**Gain (dBi)**
1	Integral	Printed	2.78

1.1.3 Type of EUT

Identify EUT	
EUT Serial Number	N/A
Presentation of Equipment	☐ Production ; ☒ Pre-Production ; ☐ Prototype

Type of EUT	
☒	Stand-alone
☐	Combined (EUT where the radio part is fully integrated within another device) Combined Equipment - Brand Name / Model No.: …
☐	Plug-in radio (EUT intended for a variety of host systems) Host System - Brand Name / Model No.: …
☐	Other:

1.1.4 Test Signal Duty Cycle

Operated Mode for Worst Duty Cycle	
☒ Operated normally hopping mode for worst duty cycle	
☐ Operated test mode for worst duty cycle	
Test Signal Duty Cycle (x)	**Power Duty Factor [dB] – (10 log 1/x)**
☒ 79.54% - test mode single channel - DH5	0.99
Bluetooth ACL packets can be 1, 3, or 5 time slots. The DH1 packet can cover a single time slot. The DH3 packet can cover up to 3 time slots. The DH5 packet can cover up to 5 time slots. Operate DH5 at maximum dwell time and maximum duty cycle.	

1.1.5 EUT Operational Condition

Supply Voltage	☐ AC mains	☒ DC 3.7Vdc	
Type of DC Source	☐ Internal DC supply	☐ External DC adapter	☒ Battery

1.2 Accessories and Support Equipment

Accessories				
No.	**Equipment**	**Brand Name**	**Model Name**	**Remarks**
1	Li-ion, lithium-ion rechargeable polymer battery pack	HYB	J391	Rating: 3.7Vdc, 500mAh

Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**Serial No.**
1	Notebook	DELL	Latitude E6430	---

1.3 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 15
- ANSI C63.10-2009
- FCC Public Notice DA 00-705
- FCC KDB 412172

1.4 Testing Location Information

Testing Location								
☒	HWA YA	ADD	:	No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.				
		TEL	:	886-3-327-3456	FAX	:	886-3-318-0055	
☒	ICC Lab	ADD	:	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsein 333, Taiwan (R.O.C.)				
		TEL	:	886-3-271-8666	FAX	:	886-3-318-0155	

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
RF Conducted	TH01-HY	Aaron Liang	22°C / 61%	Nov. 22, 2013
*AC Conduction	CO01-WS	Skys Huang	20°C / 660%	Nov. 27, 2013
*Radiated Emission	03CH02-WS	Jack Li	18°C / 65%	Nov. 26, 2013

Note: * Sporton Lab subcontracts this test item to ICC lab (TAF:2732).

ICC lab is a TAF accreditation test firm and also is an approved provider of Sporton Lab.

1.5 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			
Test Item		**Uncertainty**	**Limit**
AC power-line conducted emissions		±2.26 dB	N/A
Emission bandwidth, 6dB bandwidth		±1.42 %	N/A
RF output power, conducted		±0.63 dB	N/A
Power density, conducted		±0.81 dB	N/A
Unwanted emissions, conducted	30 – 1000 MHz	±0.51 dB	N/A
	1 – 18 GHz	±0.67 dB	N/A
	18 – 40 GHz	±0.83 dB	N/A
	40 – 200 GHz	N/A	N/A
All emissions, radiated	30 – 1000 MHz	±2.56 dB	N/A
	1 – 18 GHz	±3.59 dB	N/A
	18 – 40 GHz	±3.82 dB	N/A
	40 – 200 GHz	N/A	N/A
Temperature		±0.8 °C	N/A
Humidity		±3 %	N/A
DC and low frequency voltages		±3 %	N/A
Time		±1.42 %	N/A
Duty Cycle		±1.42 %	N/A

2 Test Configuration of EUT

2.1 The Worst Case Modulation Configuration

Worst Modulation Used for Conformance Testing					
Bluetooth Mode	**Transmit Chains (N_{TX})**	**Data Rate**	**Modulation Mode**	**RF Output Power (dBm)**	**Worst Mode**
BR	1	1 Mbps	BR-1Mbps	**0.13**	BT-1M
Note 1: Only GFSK (1Mbps) modulation is used for the device. Note 2: RF output power specifies that Maximum Peak Conducted Output Power.					

2.2 The Worst Case Power Setting Parameter

The Worst Case Power Setting Parameter			
Test Software Version	Broadcom blue tool ver 1.4.4.9		
Modulation Mode	**2402 MHz**	**2440 MHz**	**2480 MHz**
BR,1Mbps	0	0	0

2.3 The Worst Case Measurement Configuration

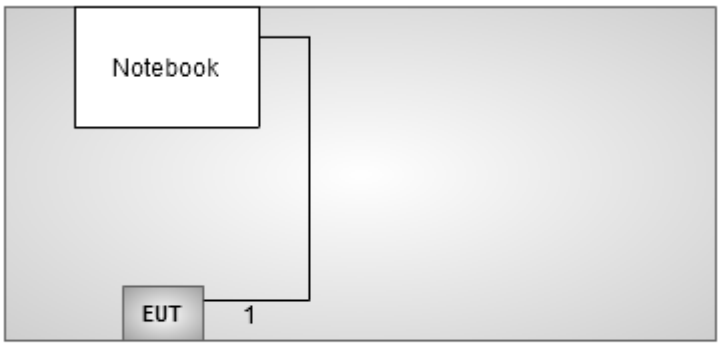
The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral Test Voltage: 120Vac / 60Hz
Operating Mode	Operating Mode Description
1	Radio link

The Worst Case Mode for Following Conformance Tests	
Tests Item	RF Output Power, 20dB Bandwidth, Carrier Frequency Separation (ChS) Number of Hopping Frequencies (N), Time of Occupancy (Dwell Time)
Test Condition	Conducted measurement at transmit chains
Modulation Mode	BR-1Mbps

The Worst Case Mode for Following Conformance Tests			
Tests Item	Transmitter Radiated Unwanted Emissions Transmitter Radiated Bandedge Emissions		
Test Condition	Radiated measurement		
User Position	☒ EUT will be placed in fixed position.		
	☐ EUT will be placed in mobile position and operating multiple positions. EUT shall be performed two orthogonal planes. The worst planes is X.		
	☐ EUT will be a hand-held or body-worn battery-powered devices and operating multiple positions. EUT shall be performed two or three orthogonal planes. The worst planes is X.		
Operating Mode	☒ 1. Transmit		
Modulation Mode	BR-1Mbps		
Orthogonal Planes of EUT	**X Plane**	**Y Plane**	**Z Plane**

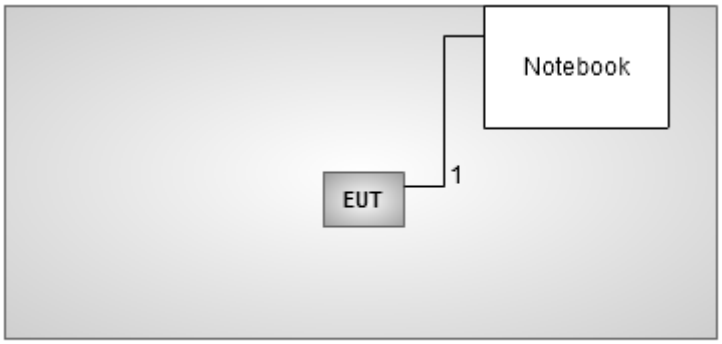
2.4 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



1. USB, 1m shielded

Test Setup Diagram - Radiated Test



1. USB, 1m shielded

3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line 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 Measuring Instruments

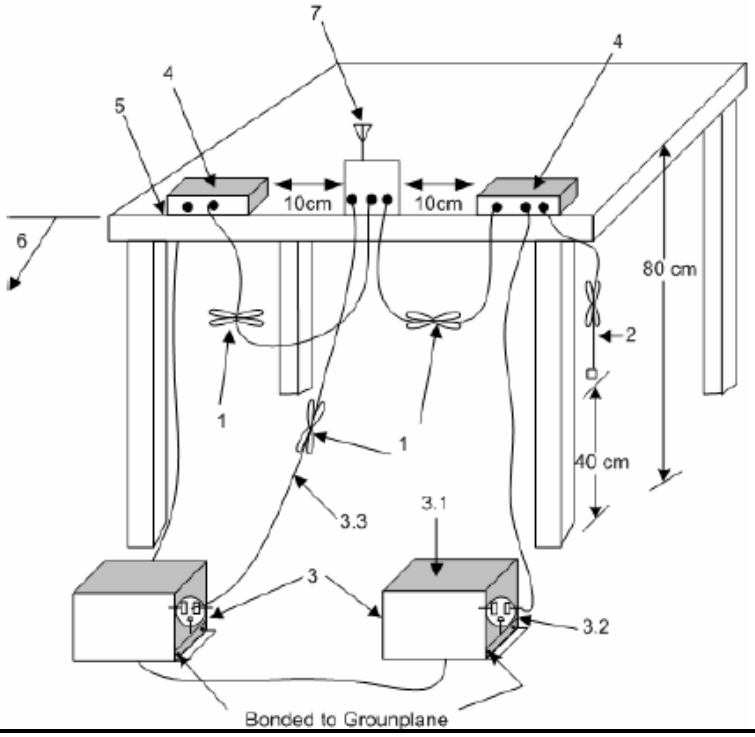
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method
☒ Refer as ANSI C63.10-2009, clause 6.2 for AC power-line conducted emissions.

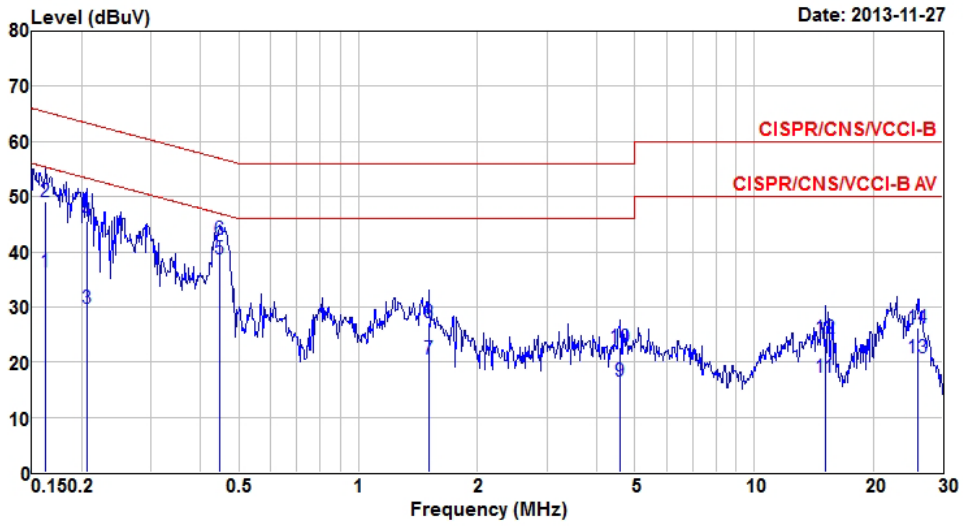
3.1.4 Test Setup

AC Power-line Conducted Emissions



3.1.5 Test Result of AC Power-line Conducted Emissions

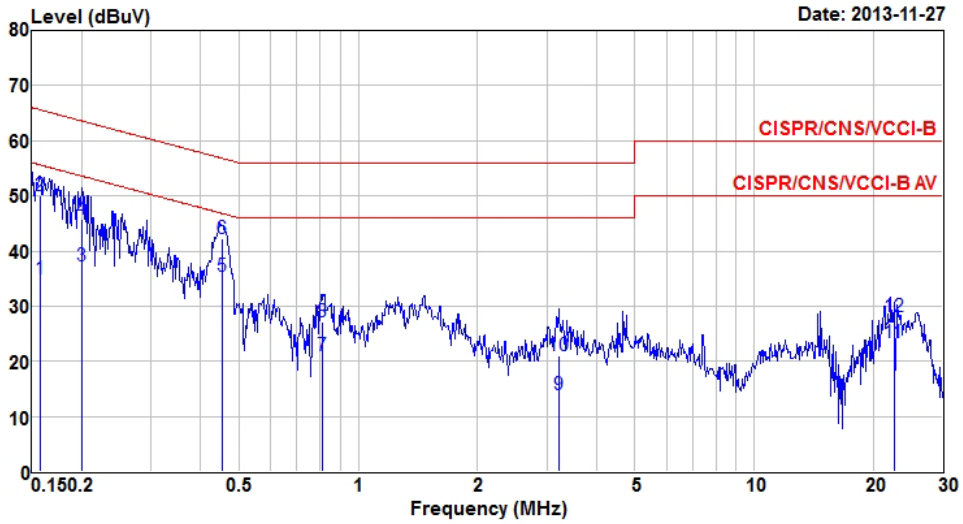
AC Power-line Conducted Emissions Result			
Operating Mode	1	**Power Phase**	Neutral
Operating Function	Radio link		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.162	36.42	55.34	-18.92	36.28	0.05	0.09	Average
2	0.162	49.13	65.34	-16.21	48.99	0.05	0.09	QP
3	0.206	29.70	53.36	-23.66	29.48	0.05	0.17	Average
4	0.206	45.45	63.36	-17.91	45.23	0.05	0.17	QP
5	0.447	38.67	46.93	-8.26	38.54	0.08	0.05	Average
6	0.447	42.18	56.93	-14.75	42.05	0.08	0.05	QP
7	1.503	20.61	46.00	-25.39	20.33	0.17	0.11	Average
8	1.503	27.22	56.00	-28.78	26.94	0.17	0.11	QP
9	4.598	16.59	46.00	-29.41	16.19	0.18	0.22	Average
10	4.598	22.72	56.00	-33.28	22.32	0.18	0.22	QP
11	15.146	17.29	50.00	-32.71	16.18	0.98	0.13	Average
12	15.146	24.28	60.00	-35.72	23.17	0.98	0.13	QP
13	26.001	20.75	50.00	-29.25	18.97	1.28	0.50	Average
14	26.001	26.27	60.00	-33.73	24.49	1.28	0.50	QP

Note 1: “>20dB” means emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found emissions (No emissions were detected.)

AC Power-line Conducted Emissions Result			
Operating Mode	1	**Power Phase**	Line
Operating Function	Radio link		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.157	35.00	55.60	-20.60	34.87	0.05	0.08	Average
2	0.157	50.10	65.60	-15.50	49.97	0.05	0.08	QP
3	0.200	37.37	53.62	-16.25	37.15	0.04	0.18	Average
4	0.200	45.71	63.62	-17.91	45.49	0.04	0.18	QP
5	0.453	35.49	46.82	-11.33	35.36	0.08	0.05	Average
6	0.453	42.20	56.82	-14.62	42.07	0.08	0.05	QP
7	0.809	20.90	46.00	-25.10	20.73	0.13	0.04	Average
8	0.809	27.16	56.00	-28.84	26.99	0.13	0.04	QP
9	3.207	13.86	46.00	-32.14	13.48	0.17	0.21	Average
10	3.207	21.01	56.00	-34.99	20.63	0.17	0.21	QP
11	22.535	23.44	50.00	-26.56	21.56	1.52	0.36	Average
12	22.535	28.10	60.00	-31.90	26.22	1.52	0.36	QP

Note 1: “>20dB” means emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found emissions (No emissions were detected.)

3.2 20dB Bandwidth and Carrier Frequency Separation

3.2.1 20dB Bandwidth and Carrier Frequency Separation Limit

20dB Bandwidth and Carrier Frequency Separation Limit for Frequency Hopping Systems	
☒	2400-2483.5 MHz Band:
	☐ N ≥ 75 and ChS ≥ MAX (20 dB bandwidth, 25 kHz).
	☒ N ≥ 15 and ChS ≥ MAX (20 dB bandwidth x 2/3, 25 kHz).
N: Number of Hopping Frequencies; **ChS**: Hopping Channel Separation	

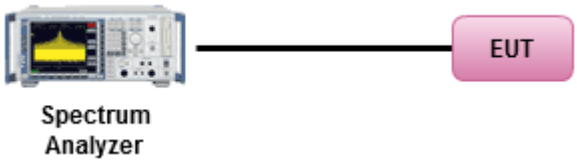
3.2.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.2.3 Test Procedures

Test Method	
☒	Refer as ANSI C63.10, clause 6.9.1 for 20 dB bandwidth measurement.
☒	Refer as ANSI C63.10, clause 7.7.2 for carrier frequency separation measurement.
☒	For conducted measurement.
	☒ The EUT supports single transmit chain and measurements performed on this transmit chain.
	☐ The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.

3.2.4 Test Setup

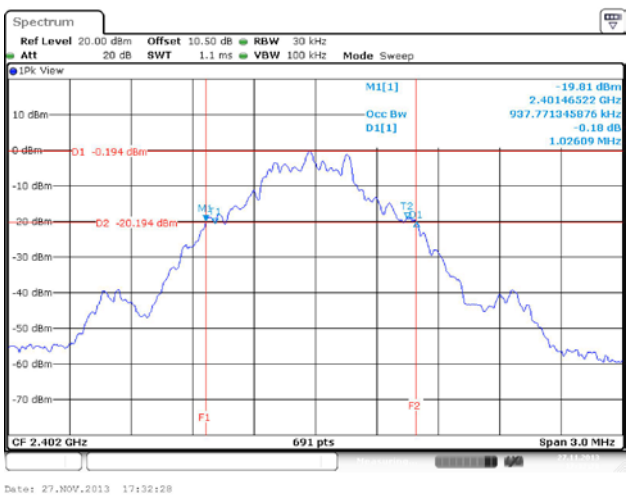
20dB Bandwidth and Carrier Frequency Separation


3.2.5 Test Result of 20dB Bandwidth and Carrier Frequency Separation

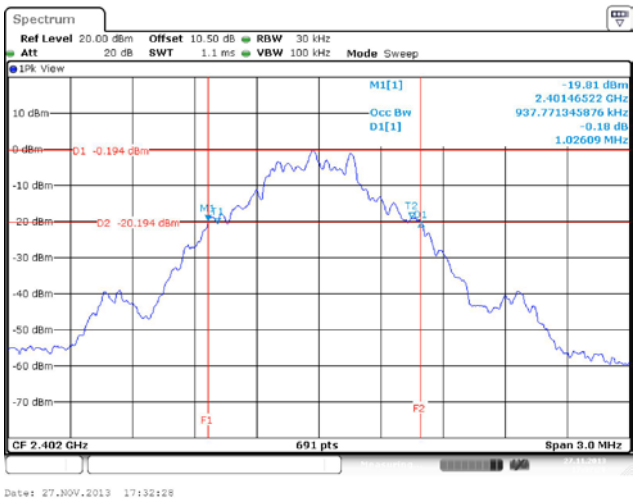
20dB Bandwidth and Carrier Frequency Separation Result					
Modulation Mode	**Freq. (MHz)**	**20dB Bandwidth (MHz)**	**99% Bandwidth (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**
BR-1Mbps	2402	1.02609	0.93777	1.0029	0.6841
BR-1Mbps	2440	1.02609	0.93777	1.0029	0.6841
BR-1Mbps	2480	1.02609	0.92908	1.0029	0.6841
Result		**Complied**			

Worst Bandwidth Plots

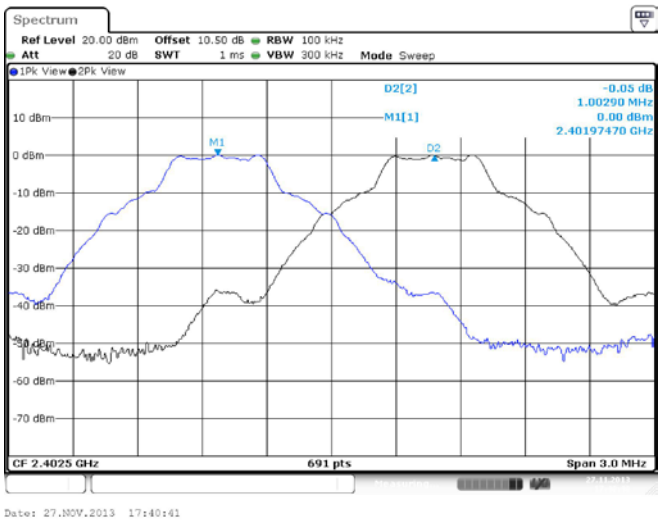
20dB Bandwidth (MHz)



99% Bandwidth(MHz)



Worst Carrier Frequency Separation Plots



3.3 Number of Hopping Frequencies

3.3.1 Number of Hopping Frequencies Limit

Number of Hopping Frequencies Limit for Frequency Hopping Systems	
☒	2400-2483.5 MHz Band:
	☐ N ≥ 75 and ChS ≥ MAX (20 dB bandwidth, 25 kHz).
	☒ N ≥ 15 and ChS ≥ MAX (20 dB bandwidth x 2/3, 25 kHz).
N: Number of Hopping Frequencies; **ChS**: Hopping Channel Separation	

3.3.2 Measuring Instruments

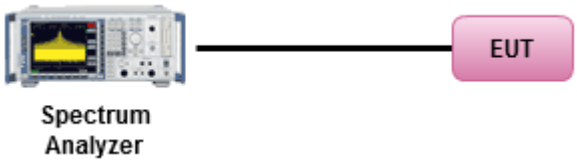
Refer a test equipment and calibration data table in this test report.

3.3.3 Test Procedures

Test Method	
☒	Refer as ANSI C63.10, clause 7.7.3 for number of hopping frequencies measurement.
☒	For conducted measurement.
	☒ The EUT supports single transmit chain and measurements performed on this transmit chain.
	☐ The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.

3.3.4 Test Setup

Number of Hopping Frequencies

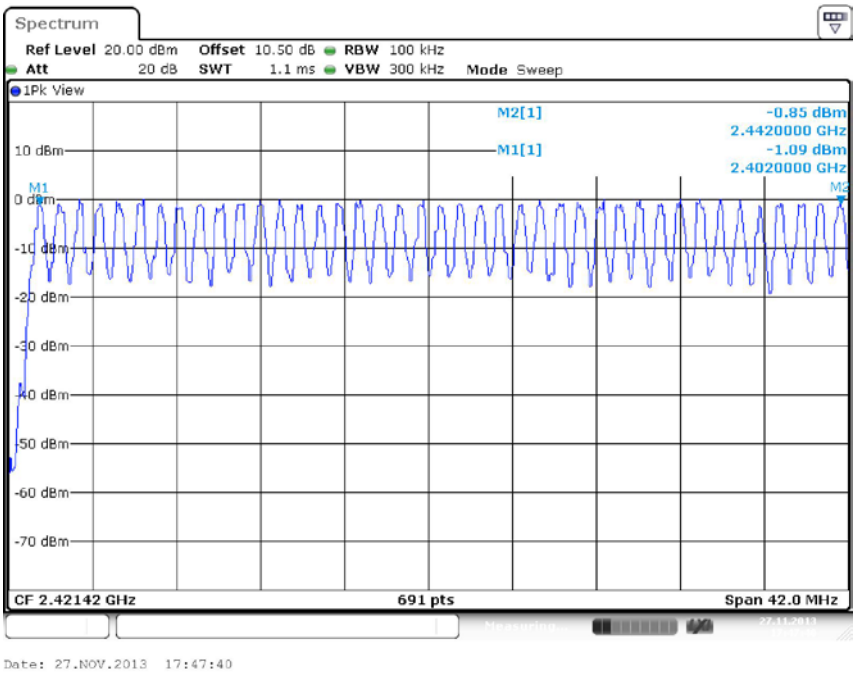


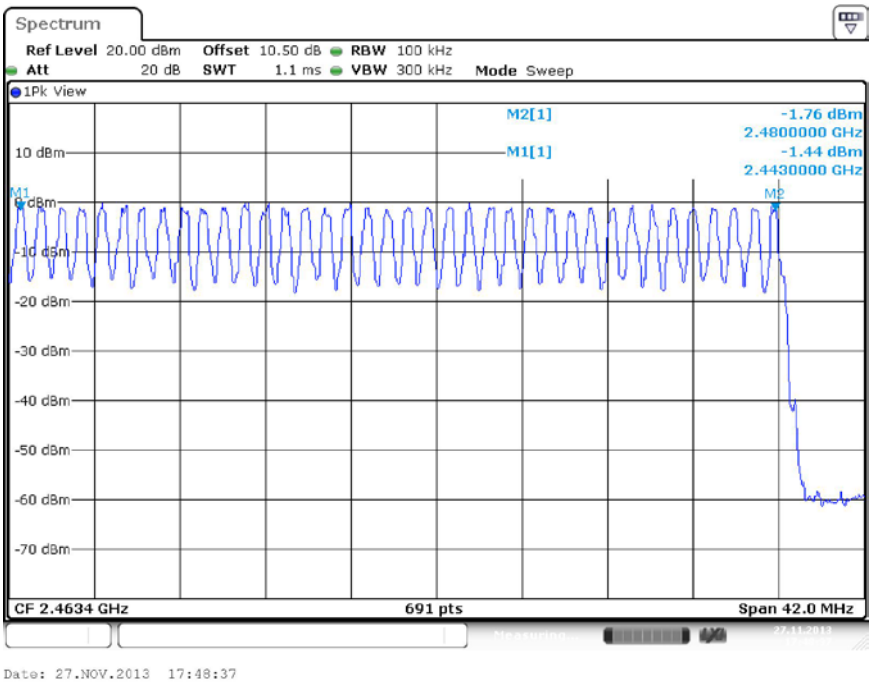
3.3.5 Test Result of Number of Hopping Frequencies

Number of Hopping Frequencies Result			
Modulation Mode	**Freq. (MHz)**	**Hopping Channel Number (N)**	**Hopping Channel Number Limits**
BR-1Mbps	2402-2480	79	15
Result	**Complied**		

Number of Hopping Frequencies Plots

BR-1Mbps





3.4 Time of Occupancy (Dwell Time)

3.4.1 Time of Occupancy (Dwell Time) Limit

Time of Occupancy (Dwell Time) Limit for Frequency Hopping Systems
☒ 2400-2483.5 MHz Band: Dwell time ≤ 0.4 second within 0.4 x N
N: Number of Hopping Frequencies

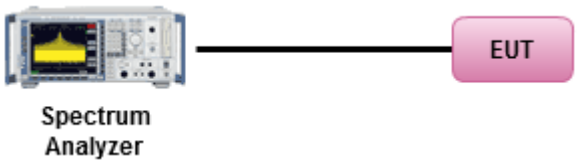
3.4.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.4.3 Test Procedures

Test Method		
☒	Refer as ANSI C63.10, clause 7.7.4 for dwell time measurement.	
☒	Bluetooth ACL packets can be 1, 3, or 5 time slots. Following as dwell time. Operate DH5 at maximum dwell time and maximum duty cycle.	
	☒	The DH1 packet can cover a single time slot. A maximum length packet has duration of 1 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 1/1600 seconds, or 0.625ms. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.
	☒	The DH3 packet can cover up to 3 time slots. A maximum length packet has duration of 3 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 3/1600 seconds, or 1.875ms. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.
	☒	The DH5 packet can cover up to 5 time slots. Operate DH5 at maximum dwell time and maximum duty cycle. A maximum length packet has duration of 5 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 5/1600 seconds, or 3.125ms. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds
☒	For conducted measurement.	
	☒	The EUT supports single transmit chain and measurements performed on this transmit chain.
	☐	The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.

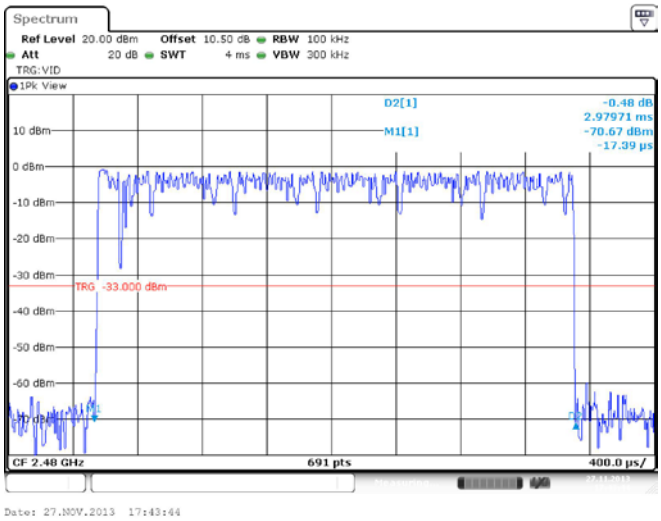
3.4.4 Test Setup

Time of Occupancy (Dwell Time)


3.4.5 Test Result of Time of Occupancy (Dwell Time)

Time of Occupancy (Dwell Time) Result					
Modulation Mode	**Freq. (MHz)**	**Pulse Time per Hop (ms)**	**Number of Pulse in [0.4 x N sec]**	**Dwell Time in [0.4 x N sec] (s)**	**Dwell Time Limits (s)**
BR-1Mbps	2480	2.97971	106.7	0.318	0.4
Result		**Complied**			
Bluetooth ACL packets can be 1, 3, or 5 time slots. The DH1 packet can cover a single time slot. The DH3 packet can cover up to 3 time slots. The DH5 packet can cover up to 5 time slots. Operate DH5 at maximum dwell time and maximum duty cycle. A maximum length packet has duration of 5 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 5/1600 seconds, or 3.125ms.					

Worst Pulse Time per Hop Plots
BR-1Mbps



3.5 RF Output Power

3.5.1 RF Output Power Limit

RF Output Power Limit for Frequency Hopping Systems			
Maximum Peak Conducted Output Power Limit			
☒	2400-2483.5 MHz Band:		
	☐	For Hopping Channel: N ≥ 75	
		☐	If G_{TX} ≤ 6 dBi, then P_{Out} ≤ 30 dBm (1 W)
		☐	If G_{TX} > 6 dBi, then P_{Out} = 30 – (G_{TX} – 6) dBm
	☒	For Hopping Channel: N ≥ 15	
		☒	If G_{TX} ≤ 6 dBi, then P_{Out} ≤ 21 dBm (0.125 W)
		☐	If G_{TX} > 6 dBi, then P_{Out} = 21 – (G_{TX} – 6) dBm
e.i.r.p. Power Limit:			
☒	2400-2483.5 MHz Band:		
	☐	For Hopping Channel: N ≥ 75 - P_{eirp} ≤ 36 dBm (4 W)	
	☒	For Hopping Channel: 75 > N ≥ 15 - P_{eirp} ≤ 27 dBm (0.5 W)	
G_{TX} = the maximum transmitting antenna directional gain in dBi. **P_{eirp}** = e.i.r.p. Power in dBm. **N:** Number of Hopping Frequencies **ChS**: Hopping Channel Separation			

3.5.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.5.3 Test Procedures

Test Method		
☒	Maximum Peak Conducted Output Power	
	☐	Refer as FCC DA 00-0705, spectrum analyzer for peak power.
	☒	Refer as FCC DA 00-0705, peak power meter for peak power.
	☐	Refer as ANSI C63.10, clause 6.10.2.1 a) for peak power meter.
	☐	Refer as ANSI C63.10, clause 6.10.2.1 a) for spectrum analyzer - (RBW ≥ EBW).
☒	For conducted measurement.	
	☒	The EUT supports single transmit chain and measurements performed on this transmit chain.
	☐	The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.

3.5.4 Test Setup

RF Output Power (Peak Power Meter)

3.5.5 Test Result of Maximum Peak Conducted Output Power

Maximum Peak Conducted Output Power Result						
Condition		RF Output Power (dBm)				
Modulation Mode	Freq. (MHz)	RF Output Power	Power Limit	Antenna Gain (dBi)	EIRP Power	EIRP Limit
BR-1Mbps	2402	0.13	21	2.78	2.91	27
BR-1Mbps	2440	0.10	21	2.78	2.88	27
BR-1Mbps	2480	-0.13	21	2.78	2.65	27
Result		Complied				

Maximum Average Conducted Output Power Result						
Condition		RF Output Power (dBm)				
Modulation Mode	Freq. (MHz)	RF Output Power	Power Limit	Antenna Gain (dBi)	EIRP Power	EIRP Limit
BR-1Mbps	2402	0.10	21	2.78	2.88	27
BR-1Mbps	2440	0.06	21	2.78	2.84	27
BR-1Mbps	2480	-0.16	21	2.78	2.62	27
Result		Complied				

Note: Average power is for reference only.

3.6 Emissions in non-restricted frequency bands

3.6.1 Emissions in non-restricted frequency bands limit

Peak power 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 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.6.3 Test Procedures

Reference level measurement

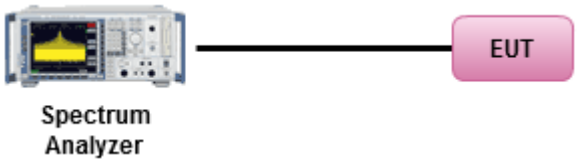
1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Use the peak marker function to determine the maximum PSD level

Emission level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Scan Frequency range is up to 25GHz
4. Use the peak marker function to determine the maximum amplitude level

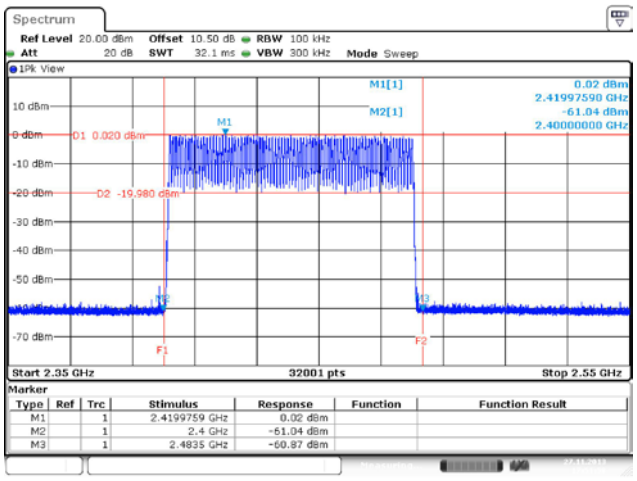
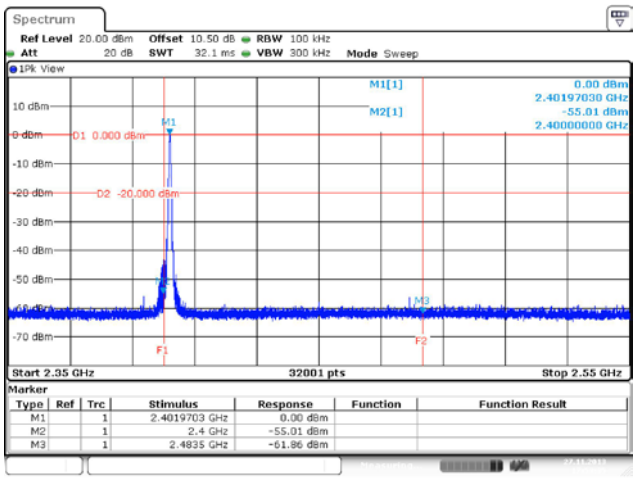
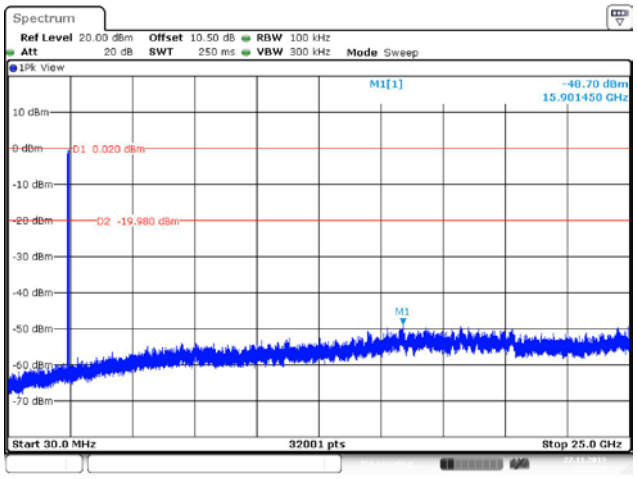
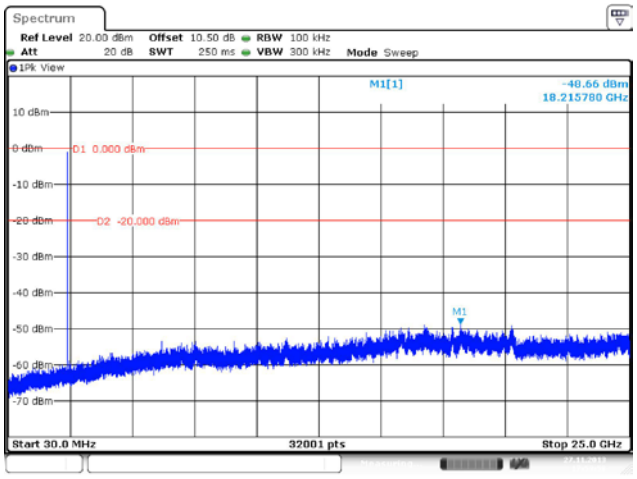
3.6.4 Test Setup

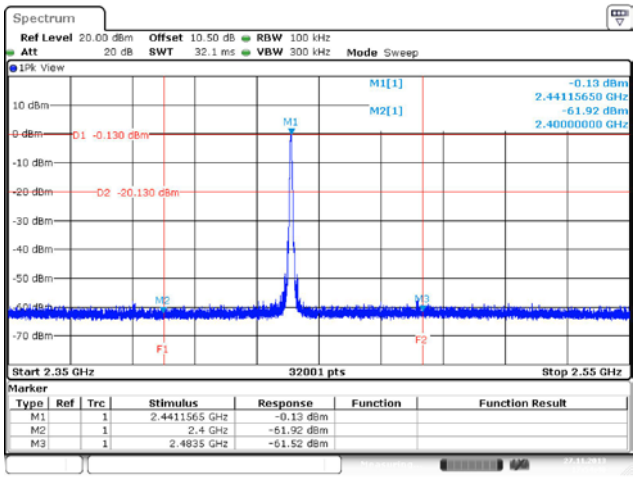
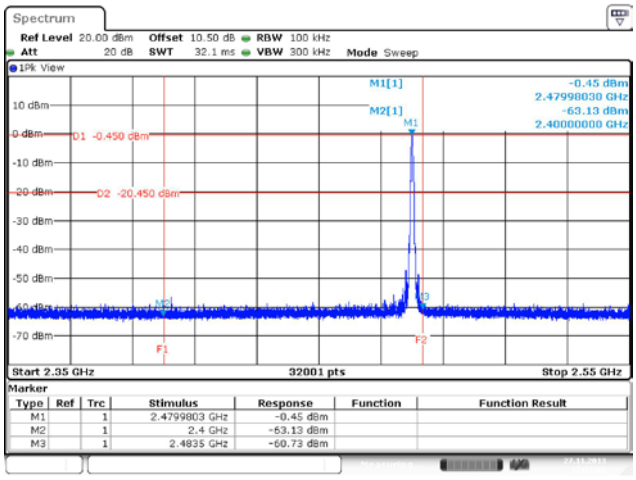
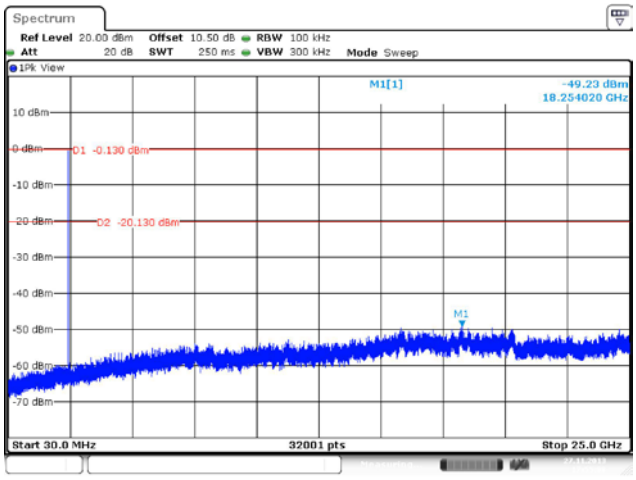
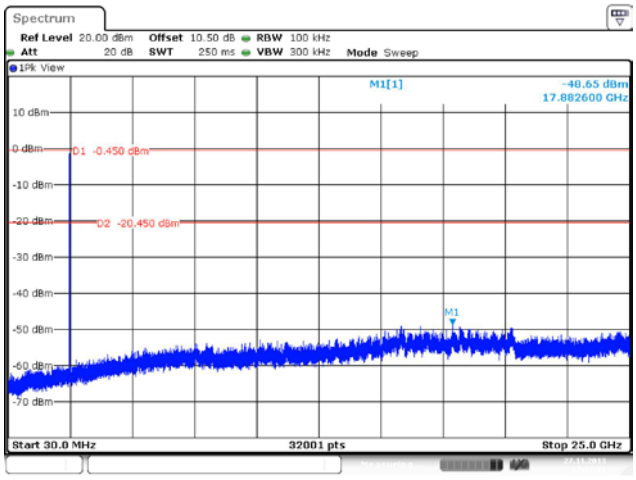
Transmitter Radiated Bandedge Emissions



3.6.5 Test Result of Emissions in non-restricted frequency bands

GFSK

Hopping on	Hopping off
30MHz~25GHz (down 20dBc)	**TX Freq 2402MHz / 30MHz~25GHz (down 20dBc)**
	
	

Hopping off	Hopping off
TX Freq 2441MHz / 30MHz~25GHz (down 20dBc)	TX Freq 2480MHz / 30MHz~25GHz (down 20dBc)
	
	

3.7 Transmitter Unwanted Emissions

3.7.1 Transmitter Radiated Unwanted Emissions Limit

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: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Un-restricted Band Emissions Limit	
RF output power procedure	**Limit (dB)**
Peak output power procedure	20
Average output power procedure	30

Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

Note 2: If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

3.7.2 Measuring Instruments

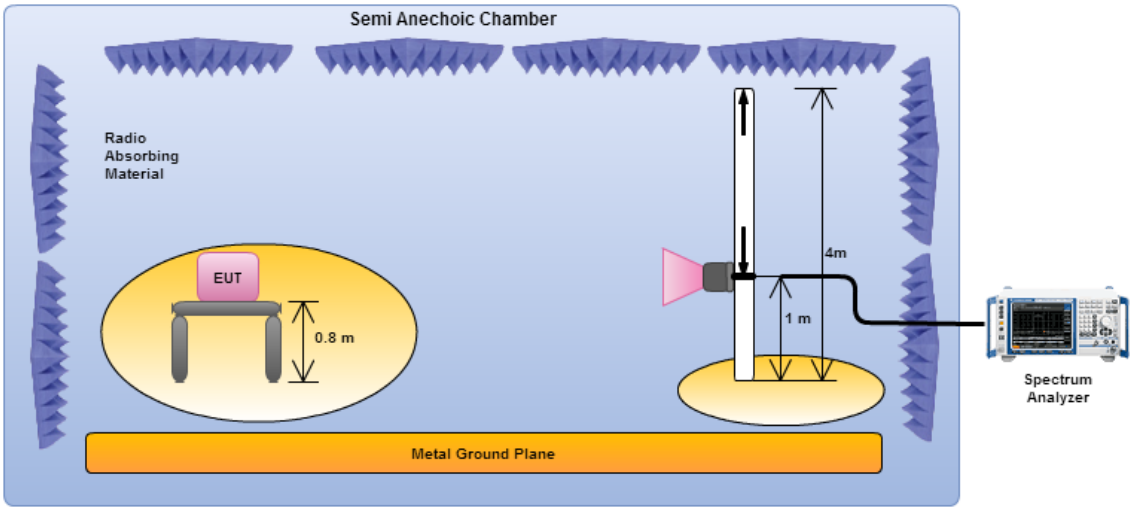
Refer a test equipment and calibration data table in this test report.

3.7.3 Test Procedures

Test Method – General Information			
☒	Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).		
☒	For the transmitter unwanted emissions shall be measured using following options below:		
	☒	Refer as FCC DA 00-0705, for spurious radiated emissions. The dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log (dwell time/100 ms)	
	☒	For unwanted emissions into non-restricted bands. Peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.	
	☒	For unwanted emissions into restricted bands.	
		☐	Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). VBW ≥ 1/T, where T is pulse time.
		☒	Refer as ANSI C63.10, clause 4.2.3.2.4 average value of pulsed emissions.
		☒	Refer as ANSI C63.10, clause 4.2.3.2.2 measurement procedure peak limit.
☒	For radiated measurement.		
	☒	Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz.	
	☒	Refer as ANSI C63.10, clause 6.5 for radiated emissions from 30 MHz to 1000 MHz.	
	☒	Refer as ANSI C63.10, clause 6.6 for radiated emissions from above 1 GHz.	

3.7.4 Test Setup

Transmitter Radiated Unwanted Emissions



Magnetic field tests shall be performed in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna. Electric field tests shall be performed in the frequency range of 30 MHz to 1000 MHz using a calibrated bi-log antenna and the frequency range of 1 GHz to 40 GHz using a calibrated horn antenna.

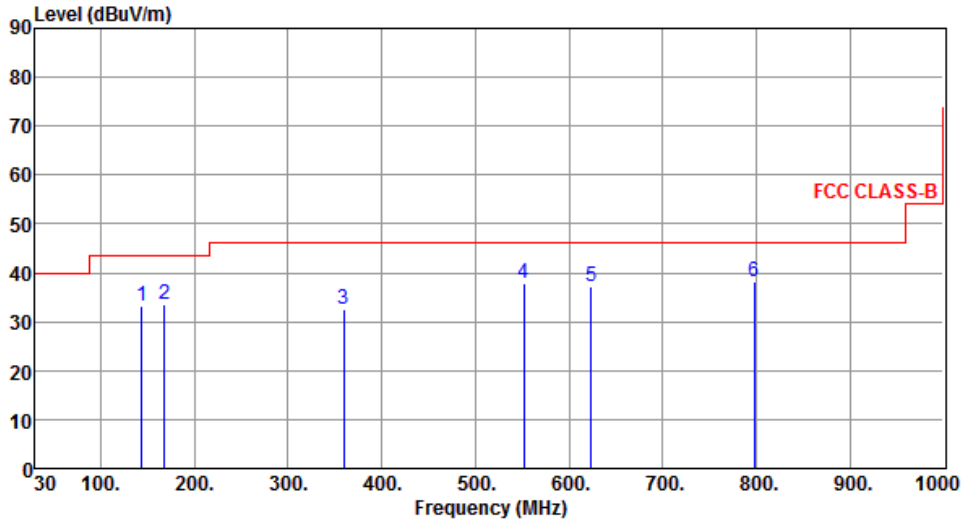
Note: Test distance is 3 m.

3.7.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)

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

3.7.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)

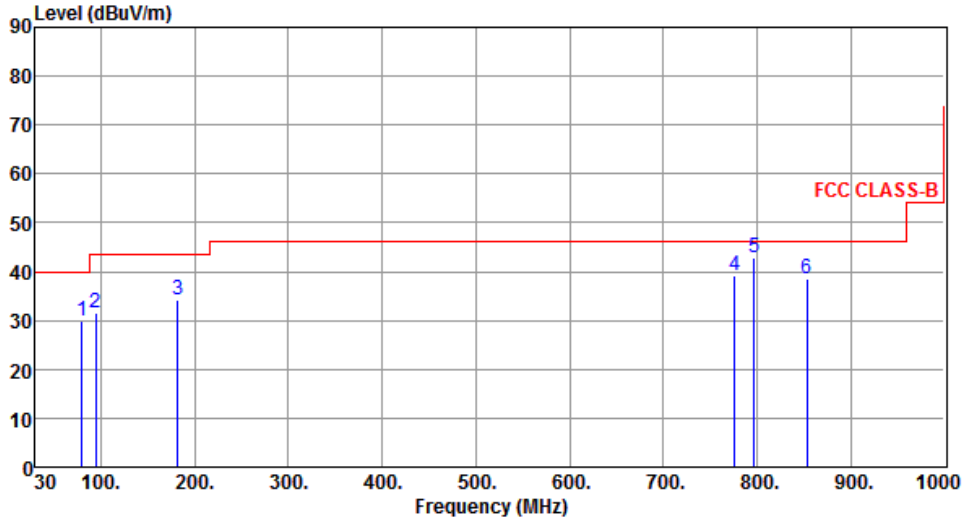
Transmitter Radiated Unwanted Emissions (Below 1GHz)			
Modulation Mode	BR-1Mbps	**Test Freq. (MHz)**	2480
Operating Function	Transmit	**Polarization**	V



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	143.49	33.21	43.50	-10.29	49.80	-16.59	Peak	---	---
2	167.74	33.59	43.50	-9.91	50.27	-16.68	Peak	---	---
3	359.80	32.41	46.00	-13.59	46.54	-14.13	Peak	---	---
4	551.86	37.80	46.00	-8.20	47.97	-10.17	Peak	---	---
5	623.64	37.14	46.00	-8.86	45.74	-8.60	Peak	---	---
6	798.24	38.17	46.00	-7.83	44.27	-6.10	Peak	---	---

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Transmitter Radiated Unwanted Emissions (Below 1GHz)			
Modulation Mode	BR-1Mbps	**Test Freq. (MHz)**	2480
Operating Function	Transmit	**Polarization**	H

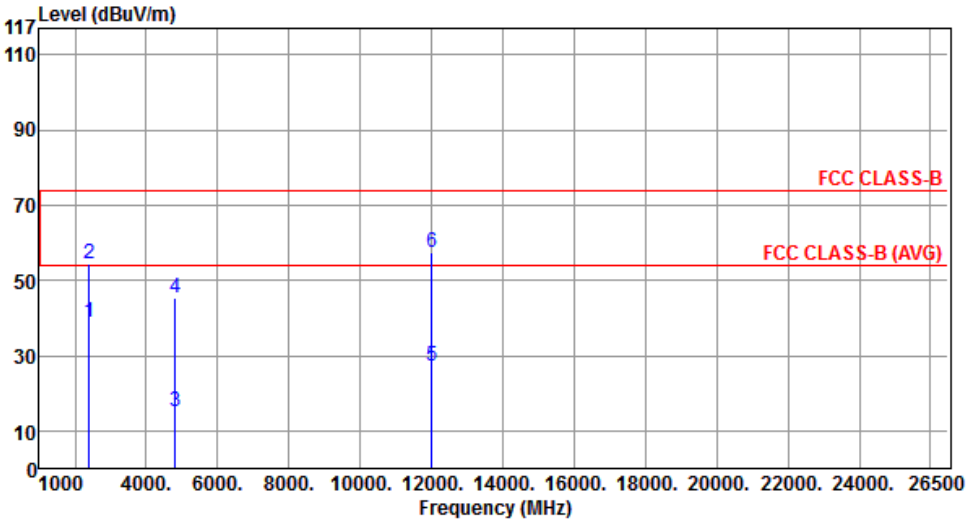


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	79.47	29.77	40.00	-10.23	50.72	-20.95	Peak	---	---
2	94.02	31.62	43.50	-11.88	53.54	-21.92	Peak	---	---
3	182.29	34.05	43.50	-9.45	52.43	-18.38	Peak	---	---
4	775.93	39.10	46.00	-6.90	45.44	-6.34	Peak	---	---
5	797.27	42.89	46.00	-3.11	49.00	-6.11	Peak	---	---
6	853.53	38.54	46.00	-7.46	43.92	-5.38	Peak	---	---

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

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

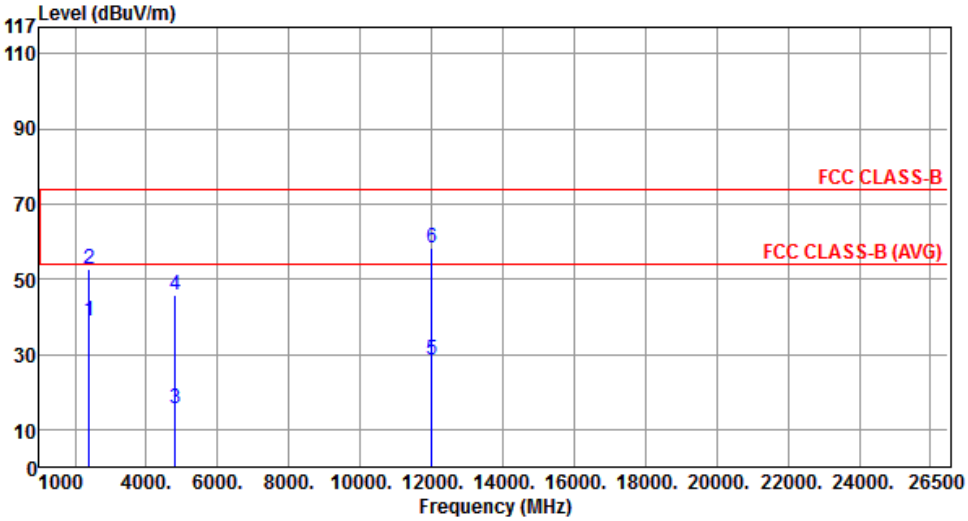
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	BR-1Mbps	**Test Freq. (MHz)**	2402
Operating Function	Transmit	**Polarization**	V



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	38.82	54.00	-15.18	41.70	-2.88	Average	---	---
2	2390.00	54.54	74.00	-19.46	57.42	-2.88	Peak	---	---
3	4804.00	15.06	54.00	-38.94	10.41	4.65	Average	---	---
4	4804.00	45.16	74.00	-28.84	40.51	4.65	Peak	---	---
5	12010.00	27.17	54.00	-26.83	13.20	13.97	Average	---	---
6	12010.00	57.27	74.00	-16.73	43.30	13.97	Peak	---	---

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 3: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 4: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level.
Note 5: Average emission obtained from the worst average correction factor = 20 log ((1s/1600x5)/100ms) = -30.1dB or Average emission setting: RBW=1MHz; VBW ≥ 1/T, where T is “Pulse On Time”, e.g., DH5 VBW≥1/3.125ms, VBW=1kHz.

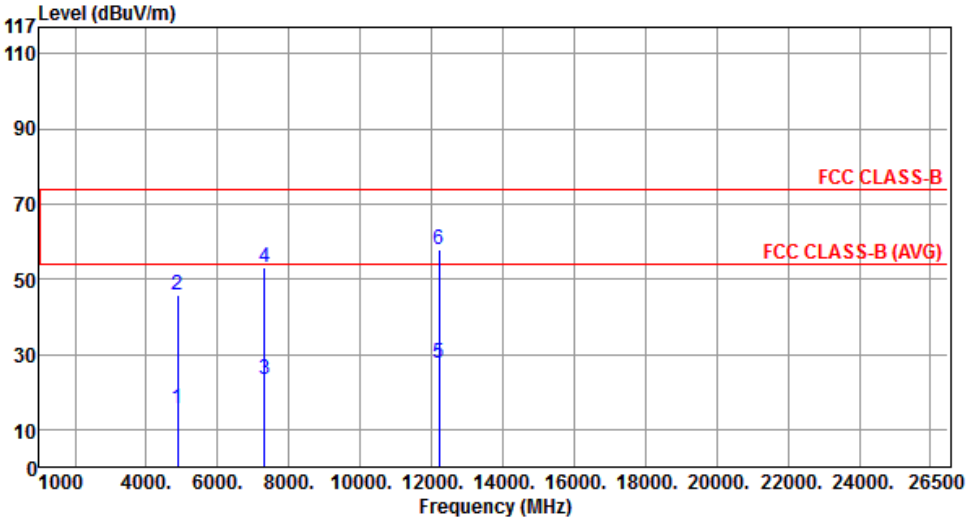
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	BR-1Mbps	**Test Freq. (MHz)**	2402
Operating Function	Transmit	**Polarization**	H



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	38.64	54.00	-15.36	41.52	-2.88	Average	---	---
2	2390.00	52.72	74.00	-21.28	55.60	-2.88	Peak	---	---
3	4804.00	15.65	54.00	-38.35	11.00	4.65	Average	---	---
4	4804.00	45.75	74.00	-28.25	41.10	4.65	Peak	---	---
5	12010.00	28.37	54.00	-25.63	14.40	13.97	Average	---	---
6	12010.00	58.47	74.00	-15.53	44.50	13.97	Peak	---	---

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 3: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 4: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level.
Note 5: Average emission obtained from the worst average correction factor = 20 log ((1s/1600x5)/100ms) = -30.1dB or Average emission setting: RBW=1MHz; VBW ≥ 1/T, where T is “Pulse On Time”, e.g., DH5 VBW≥1/3.125ms, VBW=1kHz.

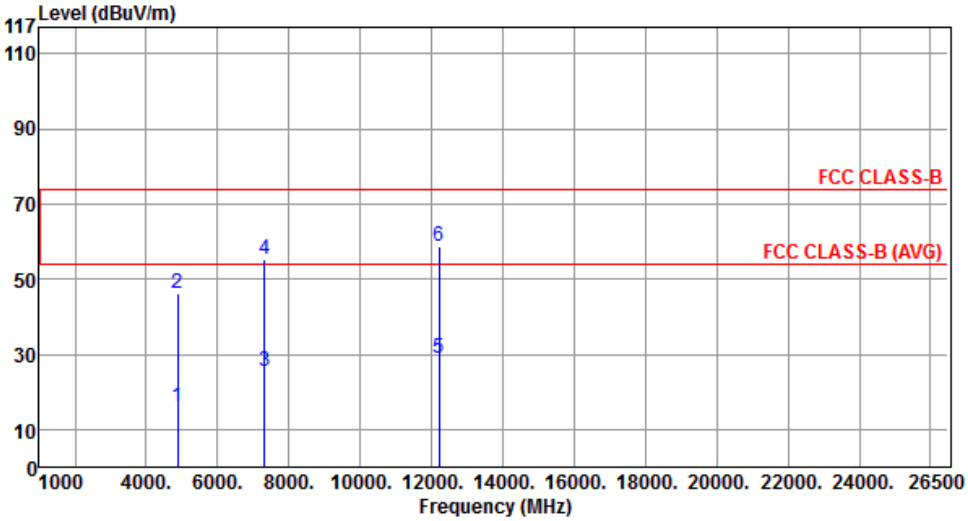
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	BR-1Mbps	**Test Freq. (MHz)**	2440
Operating Function	Transmit	**Polarization**	V



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	4882.00	15.48	54.00	-38.52	10.70	4.78	Average	---	---
2	4882.00	45.58	74.00	-28.42	40.80	4.78	Peak	---	---
3	7323.00	23.18	54.00	-30.82	13.60	9.58	Average	---	---
4	7323.00	53.28	74.00	-20.72	43.70	9.58	Peak	---	---
5	12205.00	27.66	54.00	-26.34	13.53	14.13	Average	---	---
6	12205.00	57.76	74.00	-16.24	43.63	14.13	Peak	---	---

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 3: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 4: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level.
Note 5: Average emission obtained from the worst average correction factor = 20 log ((1s/1600x5)/100ms) = -30.1dB or Average emission setting: RBW=1MHz; VBW ≥ 1/T, where T is “Pulse On Time”, e.g., DH5 VBW≥1/3.125ms, VBW=1kHz.

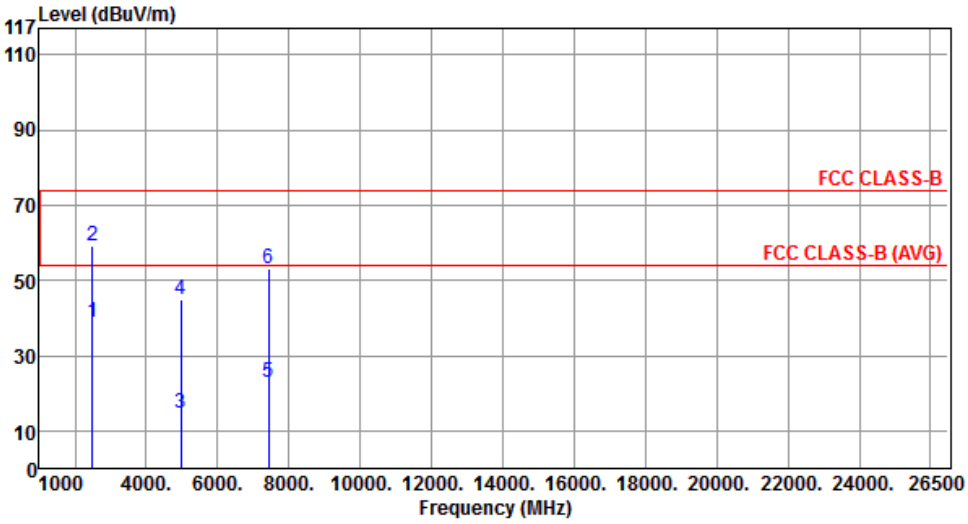
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	BR-1Mbps	**Test Freq. (MHz)**	2440
Operating Function	Transmit	**Polarization**	H



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	4882.00	15.98	54.00	-38.02	11.20	4.78	Average	---	---
2	4882.00	46.08	74.00	-27.92	41.30	4.78	Peak	---	---
3	7323.00	25.28	54.00	-28.72	15.70	9.58	Average	---	---
4	7323.00	55.38	74.00	-18.62	45.80	9.58	Peak	---	---
5	12205.00	28.75	54.00	-25.25	14.62	14.13	Average	---	---
6	12205.00	58.85	74.00	-15.15	44.72	14.13	Peak	---	---

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 3: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 4: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level.
Note 5: Average emission obtained from the worst average correction factor = 20 log ((1s/1600x5)/100ms) = -30.1dB or Average emission setting: RBW=1MHz; VBW ≥ 1/T, where T is “Pulse On Time”, e.g., DH5 VBW≥1/3.125ms, VBW=1kHz.

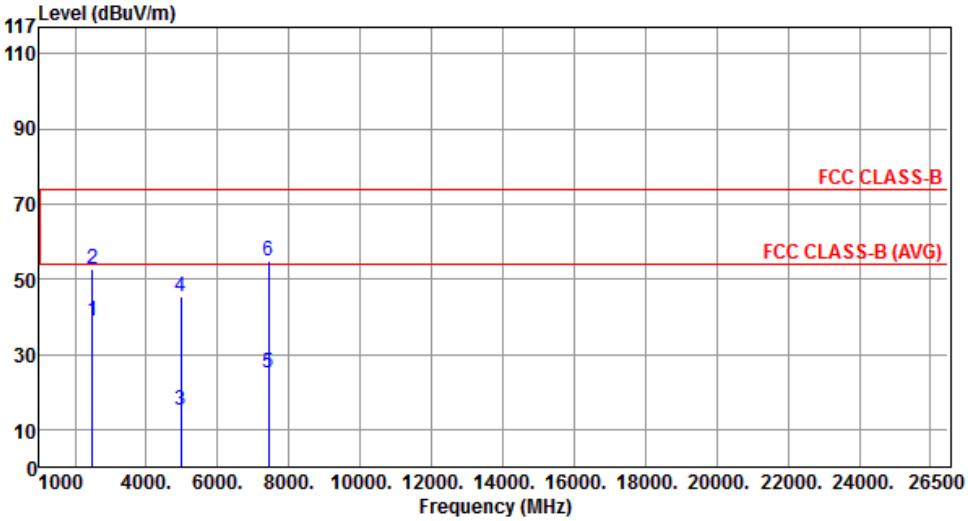
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	BR-1Mbps	**Test Freq. (MHz)**	2480
Operating Function	Transmit	**Polarization**	V



	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	39.00	54.00	-15.00	41.43	-2.43	Average	---	---
2	2483.50	59.16	74.00	-14.84	61.59	-2.43	Peak	---	---
3	4960.00	14.84	54.00	-39.16	9.93	4.91	Average	---	---
4	4960.00	44.94	74.00	-29.06	40.03	4.91	Peak	---	---
5	7440.00	22.84	54.00	-31.16	13.08	9.76	Average	---	---
6	7440.00	52.94	74.00	-21.06	43.18	9.76	Peak	---	---

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 3: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 4: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level.
Note 5: Average emission obtained from the worst average correction factor = 20 log ((1s/1600x5)/100ms) = -30.1dB or Average emission setting: RBW=1MHz; VBW ≥ 1/T, where T is “Pulse On Time”, e.g., DH5 VBW≥1/3.125ms, VBW=1kHz.

Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	BR-1Mbps	**Test Freq. (MHz)**	2480
Operating Function	Transmit	**Polarization**	H



	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	38.91	54.00	-15.09	41.34	-2.43	Average	---	---
2	2483.50	52.72	74.00	-21.28	55.15	-2.43	Peak	---	---
3	4960.00	15.31	54.00	-38.69	10.40	4.91	Average	---	---
4	4960.00	45.41	74.00	-28.59	40.50	4.91	Peak	---	---
5	7440.00	24.94	54.00	-29.06	15.18	9.76	Average	---	---
6	7440.00	55.04	74.00	-18.96	45.28	9.76	Peak	---	---

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 3: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 4: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level.
Note 5: Average emission obtained from the worst average correction factor = 20 log ((1s/1600x5)/100ms) = -30.1dB or Average emission setting: RBW=1MHz; VBW ≥ 1/T, where T is “Pulse On Time”, e.g., DH5 VBW≥1/3.125ms, VBW=1kHz.

4 Test Equipment and Calibration Data

Test Item	RF Conducted				
Test Site	OVEN room / (TH01-HY)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSP 40	100305	Mar. 20, 2013	Mar. 19, 2014
AC Power Source	G.W	APS-9102	EL920581	Jul. 16, 2013	Jul. 15, 2014
Temp. and Humidity Chamber	Giant Force	GTH-225-20-SP-SD	MAA1112-007	Nov. 21, 2013	Nov. 20, 2014
Signal Generator	R&S	SMR40	100116	Jun. 27, 2013	Jun. 26, 2014
Power Sensor	Anritsu	MA2411B	0917017	Feb. 02, 2013	Feb. 01, 2014
Power Meter	Anritsu	ML2495A	0949003	Feb. 02, 2013	Feb. 01, 2014
RF Cable-2m	HUBER+SUHNER	SUCOFLEX_104	SN 345675/4	Dec.04, 2012	Dec.03, 2013
RF Cable-3m	HUBER+SUHNER	SUCOFLEX_104	SN 345669/4	Dec.04, 2012	Dec.03, 2013
DC Power Source	G.W.	GPC-6030D	C671845	Jun. 19, 2013	Jun. 18, 2014
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
EMC Receiver	R&S	ESCS 30	100169	Oct. 15, 2013	Oct. 14, 2014
LISN	SCHWARZBECK MESS-ELEKTRONIK	Schwarzbeck 8127	8127-667	Nov. 23, 2013	Nov. 22, 2014
LISN (Support Unit)	SCHWARZBECK MESS-ELEKTRONIK	Schwarzbeck 8127	8127-666	Dec. 04, 2012	Dec. 03, 2013
ISN	TESEQ	ISN T800	34406	Apr. 08, 2013	Apr. 07, 2014
ISN	TESEQ	ISN T200A	30494	Apr. 09, 2013	Apr. 08, 2014
ISN	TESEQ	ISN ST08	22589	Jan. 24, 2013	Jan. 23, 2014
RF Current Probe	FCC	F-33-4	121630	Nov. 29, 2013	Nov, 28, 2014
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Apr. 24, 2013	Apr. 23, 2014
ESH3-Z6 V-Network(+)	R&S	ESH3-Z6	100920	Nov. 29, 2013	Nov. 28, 2014
ESH3-Z6 V-Network(-)	R&S	ESH3-Z6	100951	Jan. 30, 2013	Jan. 29, 2014
Two-Line V-Network	R&S	ENV216	101579	Jan. 07, 2013	Jan. 06, 2014
50 ohm terminal	NA	50	01	Apr. 22, 2013	Apr. 21, 2014
50 ohm terminal	NA	50	02	Apr. 22, 2013	Apr. 21, 2014
50 ohm terminal	NA	50	03	Apr. 22, 2013	Apr. 21, 2014
50 ohm terminal (Support Unit)	NA	50	04	Apr. 22, 2013	Apr. 21, 2014
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission above 1GHz				
Test Site	966 chamber1 / (03CH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
3m semi-anechoic chamber	CHAMPRO	SAC-03	03CH01-WS	Jan. 04, 2013	Jan. 03, 2014
Spectrum Analyzer	R&S	FSV40	101498	Jan. 24, 2013	Jan. 23, 2014
Receiver	ROHDE&SCHWARZ	ESR3	101658	Jan. 28, 2013	Jan. 27, 2014
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jan. 11, 2013	Jan. 10, 2014
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Feb. 18, 2013	Feb. 17, 2014
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Jan. 14, 2013	Jan. 13, 2014
Amplifier	Burgeon	BPA-530	100219	Nov. 28, 2012	Nov. 27, 2013
Amplifier	Agilent	83017A	MY39501308	Dec. 18, 2012	Dec. 17, 2013
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Dec. 25, 2012	Dec. 24, 2013
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Dec. 25, 2012	Dec. 24, 2013
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16139/4	Dec. 25, 2012	Dec. 24, 2013
RF Cable-R03m	Woken	CFD400NL-LW	CFD400NL-001	Dec. 25, 2012	Dec. 24, 2013
RF Cable-R10m	Woken	CFD400NL-LW	CFD400NL-002	Dec. 25, 2012	Dec. 24, 2013
control	EM Electronics	EM1000	60612	N/A	N/A
Note: Calibration Interval of instruments listed above is one year.					

Loop Antenna	R&S	HFH2-Z2	100330	Nov. 15, 2012	Nov. 14, 2014
Amplifier	MITEQ	AMF-6F-260400	9121372	Apr. 19, 2013	Apr. 18, 2015
Note: Calibration Interval of instruments listed above is two year.					