EMC TEST REPORT for Intentional Radiator

No. 141000645SHA-001

Applicant	:	ZHEJIANG HENGLIN CHAIR INDUSTRY CO., LTD. 3 Block, Sunlight Industry Zone, Anji County, Zhejiang Province, China
Manufacturer	:	ZHEJIANG HENGLIN CHAIR INDUSTRY CO., LTD. 3 Block, Sunlight Industry Zone, Anji County, Zhejiang Province, China
Product name	:	Massage chair
Type/Model	:	HL-8800
TEST RESULT	**:**	**PASS**

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2013): Radio Frequency Devices

ANSI C63.4 (2003): American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Date of issue: November 21, 2014

Prepared by: Reviewed by:

Nemo Li (*Project Engineer*) Daniel Zhao (*Reviewer*)

Description of Test Facility

Name: Intertek Testing Services Limited Shanghai
Address: Building No.86, 1198 Qinzhou Road(North), Shanghai 200233, P.R. China

FCC Registration Number: 236597
IC Assigned Code: 2042B-1

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Content

1. General Information

1.1 Applicant Information

Applicant:	ZHEJIANG HENGLIN CHAIR INDUSTRY CO., LTD. 3 Block, Sunlight Industry Zone, Anji County, Zhejiang Province, China
Name of contact:	Qinqing Zhu
Tel:	86 572-5227051
Fax:	86 572-5227380-8620
Manufacturer:	ZHEJIANG HENGLIN CHAIR INDUSTRY CO., LTD. 3 Block, Sunlight Industry Zone, Anji County, Zhejiang Province, China
Sample received date:	November 3, 2014
Date of test:	November 3, 2014 ~ November 20, 2014

1.2 Identification of the EUT

Equipment:	Massager Chair
Type/model:	HL8800
FCC ID:	2ADIW-HL8800

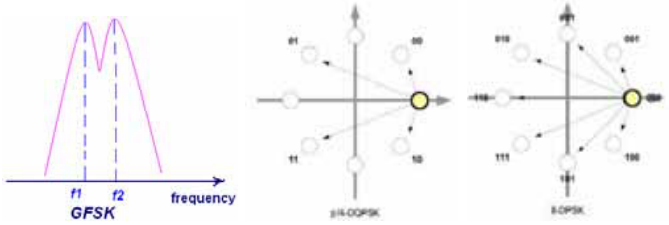
1.3 Technical specification

Operation Frequency Band: 2402 - 2480 MHz

Protocol: BT 3.0 + EDR

Modulation: GFSK, π/4 DQPSK, 8DPSK

Technology:



GFSK is different from π/4DQPSK and 8DPSK. 8DPSK is similar with π/4DQPSK but more complex, and with a bigger data rate. So all the tests were performed with GFSK modulation and 8DPSK modulation for representative.

Antenna Designation: PCB antenna

Gain of Antenna: 1.0dBi

Rating: 110-120V AC, 50/60Hz, 2.0A

Description of EUT: EUT is a massager chair, and has only one model.

Channel Description: There are 79 channels in all. The designed channel spacing is 1MHz.

Channel Identifier	Frequency (MHz)
low	2402
middle	2441
high	2480

1.4 Mode of operation during the test / Test peripherals used

While testing the transmitter mode of the EUT, the engineering mode is applied.
All the functions of the host device except the BT module were set on stand-by mode.

EUT was tested with software BlueTest3 which was provided by the customer.

After pre-scan, the packet of DH1 was the worst case, and chosen to perform the radiated emission test and conduct emission test.

2. Test Specification

2.1 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESCS 30	R&S	EC 2107	2014-10-21	2015-10-20
Test Receiver	ESIB 26	R&S	EC 3045	2014-10-20	2015-10-19
Test Receiver	ESCI 7	R&S	EC4501	2013-12-25	2014-12-24
Voltage Probe	ESH2-Z3	R&S	EC 3405	2014-01-12	2015-01-11
Voltage Probe	TK9420	Schwarzbeck	EC 4888	2014-06-07	2015-06-06
A.M.N.	ESH2-Z5	R&S	EC 3119	2014-01-09	2015-01-08
A.M.N.	ENV 216	R&S	EC 3393	2014-08-09	2015-08-08
A.M.N.	ENV 216	R&S	EC 3394	2014-08-09	2015-08-08
A.M.N.	ENV4200	R&S	EC3558	2014-08-09	2015-08-08
Click meter	CL55C	AFJ	EC 2253	2014-08-20	2015-08-19
I.S.N.	FCC-TLISN -T2-02	FCC	EC3754	2014-01-09	2015-01-08
I.S.N.	FCC-TLISN -T4-02	FCC	EC3755	2014-01-09	2015-01-08
I.S.N.	FCC-TLISN -T8-02	FCC	EC3756	2014-01-09	2015-01-08
Current probe	EZ-17	R&S	EC 3221	2014-01-11	2015-01-10
Absorbing clamp	MDS 21	R&S	EC 2108	2014-01-12	2015-01-11
Tri-loop	HXYZ 9170	Schwarzbeck	EC 3384	2014-06-19	2015-06-18
Harmonic-flicker system	5001ix-PACS-1	CI	EC 2110	2014-01-09	2015-01-08
Conduct immunity system	UCS 500M6B	EM TEST	EC 2958	2014-04-08	2015-04-07
Automatic transformer	MV2616	EM TEST	EC 2957	Not required	Not required
Capacity clamp	HFK	EM TEST	EC 2959	Not required	Not required
ESD generator	ditto	EM TEST	EC 2956	2014-05-21	2015-05-20
ESD generator	NSG 437	TESEQ	EC 4792-4	2014-02-21	2015-02-20
Surge generator	TSS 500M2F	EM TEST	EC 2960	2014-09-24	2015-09-23
Surge generator	TSS 500M4	EM TEST	EC 2961	2014-01-10	2015-01-09
Surge Coupling network	CNV 504M	EM TEST	EC 2958-2	2014-01-09	2015-01-08
Surge Coupling network	CNV 504S1	EM TEST	EC 2958-1	2014-01-09	2015-01-08
Signal generator	SML 01	R&S	EC 2338	2014-04-12	2015-04-11
Power amplifier	75A250	AR	EC 3043-1	2014-08-16	2015-08-15
CDN	CDN M216	Schaffner	EC 2113-2	2014-08-02	2015-08-01
CDN	CDN M316	Schaffner	EC 2113-1	2014-09-30	2015-09-29
CDN	CDN T2	EM TEST	EC 4970	2014-10-24	2015-10-23

CDN	CDN T4	EM TEST	EC 3043-4	2014-01-09	2015-01-08
CDN	CDN M1/16A	EM TEST	EC 4792-6	2014-02-18	2015-02-17
CDN	CDN M1/16A	EM TEST	EC 4792-7	2014-02-18	2015-02-17
CDN	CDN M1/32A	EM TEST	EC 4792-10	2014-02-18	2015-02-17
CDN	CDN M3N/16A	EM TEST	EC 4792-12	2014-02-18	2015-02-17
CDN	CDN M3N/32A	EM TEST	EC 4792-13	2014-02-18	2015-02-17
CDN	CDN T8-RJ45	EM TEST	EC 4792-15	2014-02-18	2015-02-17
Calibration Impedance	50	AR	EC 4792-17	2014-02-18	2015-02-17
Calibration Impedance	100	AR	EC 4792-16	2014-02-18	2015-02-17
EM clamp	EM 101	EM TEST	EC 3043-6	2014-10-20	2015-10-19
Power meter	PM2002	AR	EC3043-7	2014-10-18	2015-10-17
Power sensor	PH2000	AR	EC3043-8	2014-10-18	2015-10-17
Attenuator	ATT6/75	EM TEST	EC 3043-3	2014-01-09	2015-01-08
Attenuator	68-6-44	Weinschel	EC 3043-9	2014-01-09	2015-01-08
DDC	DC 2600	AR	EC 3043-5	2014-01-09	2015-01-08
DDC	DC 6180A	AR	EC 3044-5	2014-08-06	2015-08-05
DDC	DC 7144A	AR	EC 3044-6	2014-01-09	2015-01-08
Calibration Impedance	50	AR	EC 3043-12	2014-01-09	2015-01-08
Calibration Impedance	R100	AR	EC 3043-10	2014-01-09	2015-01-08
Calibration Impedance	R100	AR	EC 3043-11	2014-01-09	2015-01-08
Calibration Impedance	CAL U100A	Schaffner	EC 2113-3	2014-01-09	2015-01-08
Calibration Impedance	TRA U150	Schaffner	EC 2113-4	2014-01-09	2015-01-08
Ultra-broadband antenna	HL 562	R&S	EC 3046-1	2014-05-16	2015-05-14
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2014-04-28	2015-04-27
Horn antenna	HF 906	R&S	EC 3049	2014-04-28	2015-04-27
Horn antenna	3117	ETS	EC 4792-1	2014-04-17	2015-04-16
Horn antenna	HAP18-26W		EC 4792-3	2014-04-10	2015-04-09
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2014-04-12	2015-04-11
Pre-amplifier	Tpa0118-40	R&S	EC 4792-2	2014-04-12	2015-04-11
Log-period antenna	AT 1080	AR	EC 3044-7	2014-04-28	2015-04-27
Biconical antenna	3109PX	ETS	EC3564	2014-08-23	2015-08-22
Horn antenna	AT 4002	AR	EC 3044-8	2014-04-28	2015-04-27
Signal generator	SMR 20	R&S	EC 3044-1	2014-08-16	2015-08-15
Power amplifier	150W1000	AR	EC 3044-2	2014-08-16	2015-08-15
Power amplifier	25S1G4	AR	EC 3044-4	2014-08-16	2015-08-15

Field meter	FM 5004	AR	EC 3044-3	2014-10-21	2015-10-20
Field sensor	FP 6001	AR	EC 3044-9	2014-10-21	2015-10-20
Semi-anechoic chamber	-	Albatross project	EC 3048	2014-05-12	2015-05-11
Fully-anechoic chamber	-	Albatross project	EC 3047	2014-05-12	2015-05-11
Digital illuminance meter	TES 1332	TES	EC 2451	2014-06-05	2015-06-04
Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3323	2014-04-14	2015-04-13
Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3324	2014-04-14	2015-04-13
Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2014-01-09	2015-01-08
Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3326	2014-03-10	2015-03-09
Pressure meter	YM3	Shanghai Mengde	EC 3320	2014-06-12	2015-06-13
Pressure meter	YM3	Shanghai Mengde	EC 3306	2014-07-26	2015-07-25
Pressure meter	YM3	Shanghai Mengde	EC 4620	2014-07-31	2015-07-30
Isolation transformer	-	Intertek	EC 2100	Not required	Not required
TV generator	TG39	ShibaSoku	EC3555	2014-04-17	2015-04-16
Stable power source	APS 11020	APC	EC 3209	Not required	Not required
Freq. Variable power source	AFC 11010	APC	EC 3210	Not required	Not required
Freq. Variable power source	AFC 33020	APC	EC 3211	Not required	Not required
Multi-meter	179	FLUKE	EC 3226	2014-09-11	2015-09-10
Shielded room	-	Zhongyu	EC 2838	2014-01-10	2019-01-09
Shielded room	-	Zhongyu	EC 2839	2014-01-10	2019-01-09
Gomb generator	CG-515	com-power	EC3974	2014-10-21	2015-10-20
Oscilloscope	DPO 4504	Tektronix	EC 3515	2014-01-05	2015-01-04
DC Power supply（SIMT）		Yufan	EC3561	Not required	Not required
Variable Voltage Transformer（SIMT）	TSGC2J-20		EC4740	Not required	Not required
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2014-01-08	2015-01-07
High Pass Filter	WHKX 2.8/18G-12SS	Wainwright	EC4297-2	2014-01-08	2015-01-07
High Pass Filter	WHKX 7.0/1.8G-8SS	Wainwright	EC4297-3	2014-01-08	2015-01-07
Band Reject Filter	WRCGV 2400/2483-2390/2493-35/10SS	Wainwright	EC4297-4	2014-01-08	2015-01-07
Power sensor / Power meter	N1911A/N1921A	Agilent	EC4318	2014-04-11	2015-04-10
Spectrum analyzer	E7402A	Agilent	EC2254	2014-08-16	2015-08-15

GPS	A-10		EC4658	2013-08-13	2015-08-12
EMF meter	ELT-400	NARDA	EC2928	2014-08-05	2015-08-04
Protection Network	VDHH 9502	SCHWARZBECK	EC4631	2014-07-09	2015-07-08
Attenuator	GKTS2-2-90-8-A6	Huaxiang	EC4503	2013-12-21	2014-12-20
Attenuator	GKTS2-2-90-8-A6	Huaxiang	EC4504	2013-12-21	2014-12-20
Pulse Engine Tachometer	PET-20000XR	OPPAMA	EC4782	2013-12-09	2014-12-08
Harmonic generator	ES2000U	NF	EC 4793-1	2014-03-20	2015-03-19
Harmonic generator	ES2000B	NF	EC 4793-2	2014-03-20	2015-03-19
Function Generator	WF1974	NF	EC 4793-3	2014-03-31	2015-03-30
Function Generator	WF1974	NF	EC 4793-4	2014-03-31	2015-03-30
Function Generator	WF1974	NF	EC 4793-5	2014-03-13	2015-03-12
Function Generator	WF1974	NF	EC 4793-6	2014-03-31	2015-03-30
Time relay	-	-	EC4186-1	2014-05-05	2015-05-04
Load Resistor Box	-	-	EC4186-2	Not required	Not required
Load Resistor Box	-	-	EC4186-3	Not required	Not required
Step-up Transformer	BJZ-5KVA	Sangke	EC3268	Not required	Not required
Variable Transformer	TDGC2-2KVA	Sangke	EC3455	Not required	Not required
DIPs generator	SKS-1130GT	SANKI	EC 5033	2014-01-06	2015-01-05
Ring wave generator	SKS-1206GB	SANKI	EC 5033-1	2014-02-21	2015-02-20
EFT generator	SKS-0404IB	SANKI	EC 5033-2	2014-01-07	2015-01-06
Surge generator	SKS-0506GB-30	SANKI	EC 5033-3	2014-02-06	2015-02-05
Vector Signal Generator	N5182B	Agilent Technologies	EC5175	2013-12-31	2014-12-30

2.2 Test Standard

47CFR Part 15 (2013)
ANSI C63.4: 2003

2.3 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	RESULT
20 dB Bandwidth	15.247(a)(1)	Tested
Carrier Frequency Separation	15.247(a)(1)	Pass
Output power	15.247(b)(1)	Pass
Radiated Spurious Emissions	15.205 & 15.209	Pass
Conducted Spurious Emissions & Band Edge	15.247(d)	Pass
Power line conducted emission	15.207	Pass
Number of Hopping Frequencies	15.247(a)(1)(iii)	Pass
Dwell time	15.247(a)(1)(iii)	Pass

3. 20 dB Bandwidth

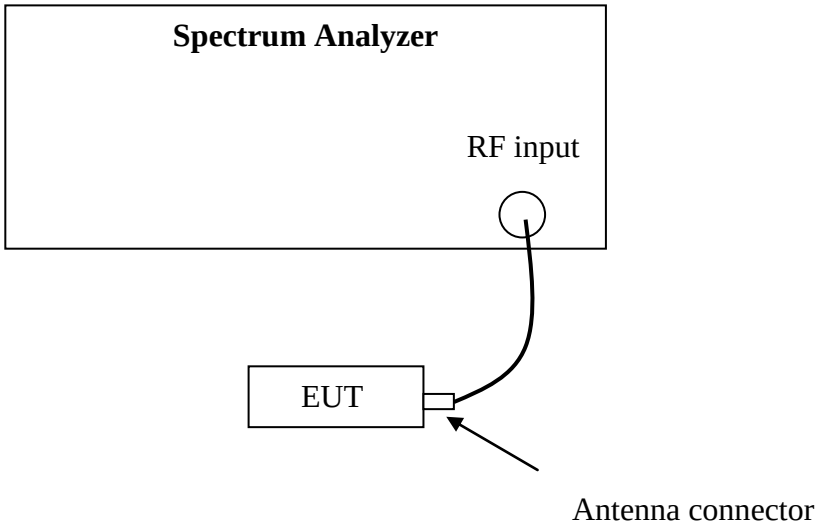
Test result: Tested

3.1 Limit

☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

3.2 Test Configuration



3.3 Test Procedure and test setup

The 20 bandwidth per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span = 2 to 3 times the 20 dB bandwidth, RBW≥1% of the 20 dB bandwidth, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

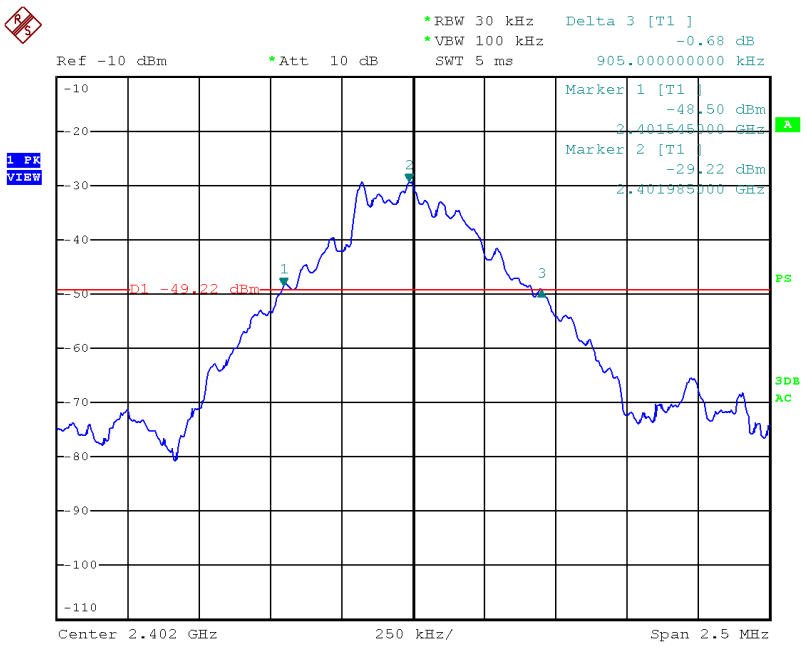
3.4 Test Protocol

Temperature : 22°C

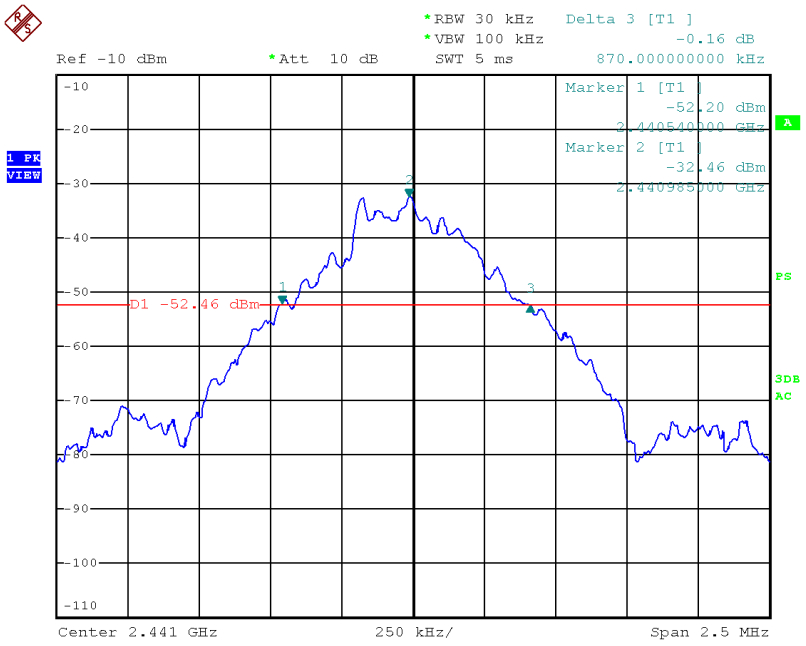
Relative Humidity : 52 %

Modulation	CH	Bandwidth (kHz)	Two-thirds of Bandwidth (kHz)
GFSK	L	905.00	603.33
	M	870.00	580.00
	H	860.00	573.33

Channel L



Channel M



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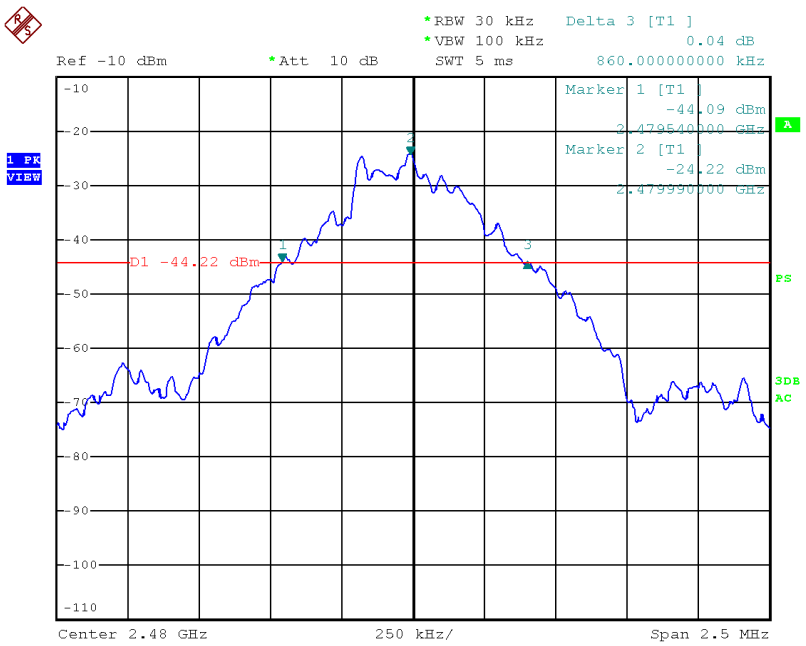
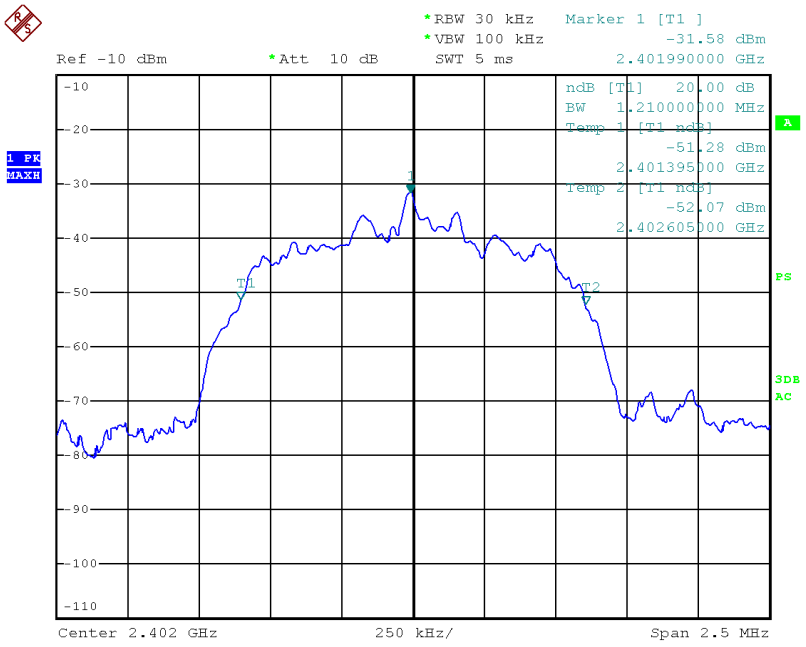
Channel H



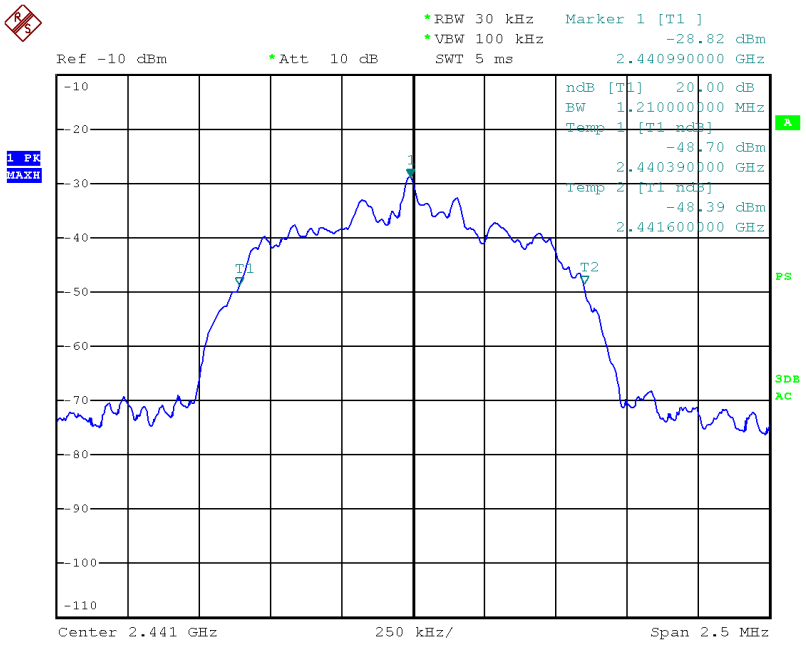
Date: 17.DEC.2014 12:42:22

Modulation	CH	Bandwidth (kHz)	Two-thirds of Bandwidth (kHz)
8DPSK	L	1210.00	806.67
	M	1210.00	806.67
	H	1210.00	806.67

Channel L



Channel M



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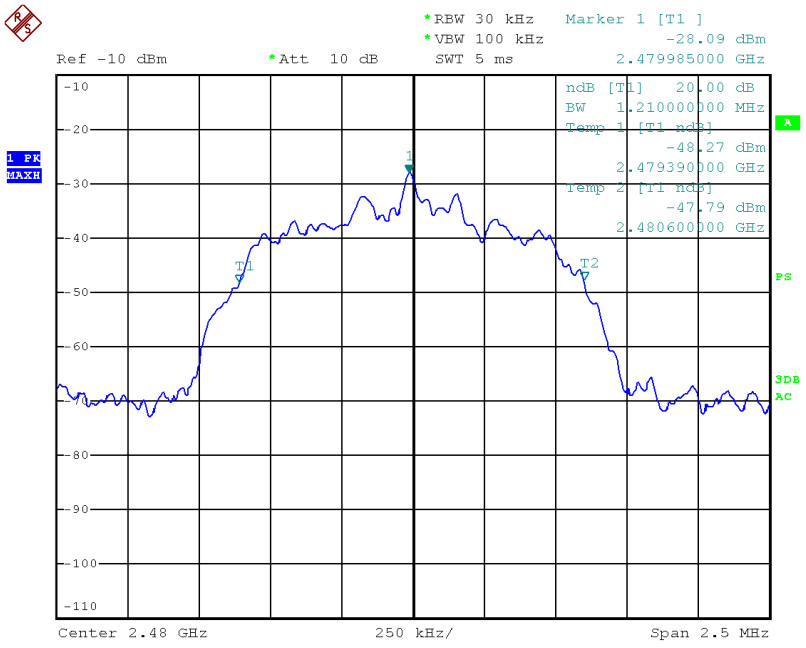
Channel H



Date: 5.NOV.2014 13:46:46

4. Carrier Frequency Separation

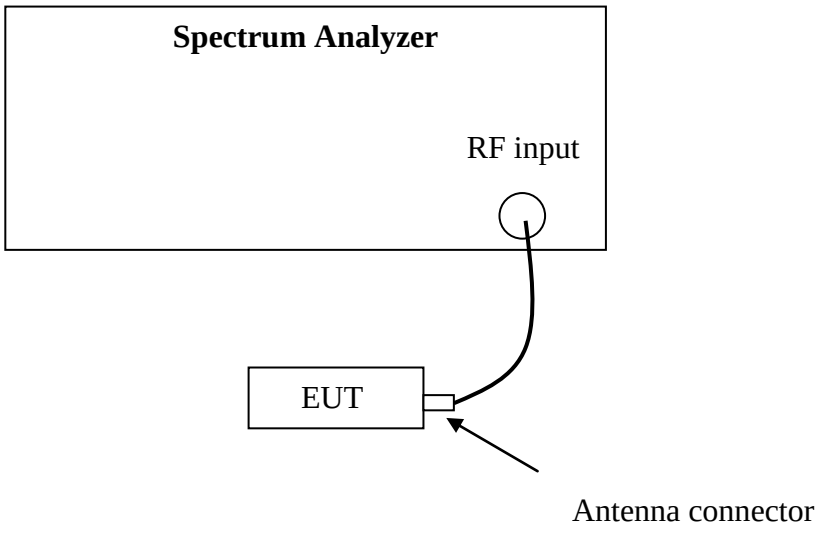
Test result: Pass

4.1 Limit

☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

4.2 Test Configuration



4.3 Test Procedure and test setup

The Carrier Frequency Separation per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span can capture two adjacent channels, RBW≥1% of the span, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

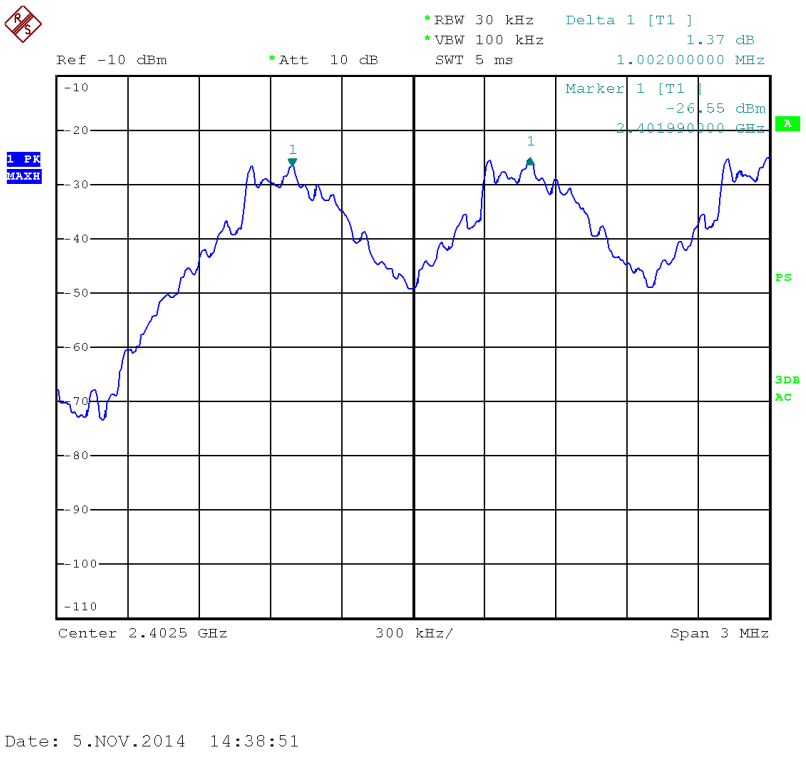
4.4 Test Protocol

Temperature : 22°C

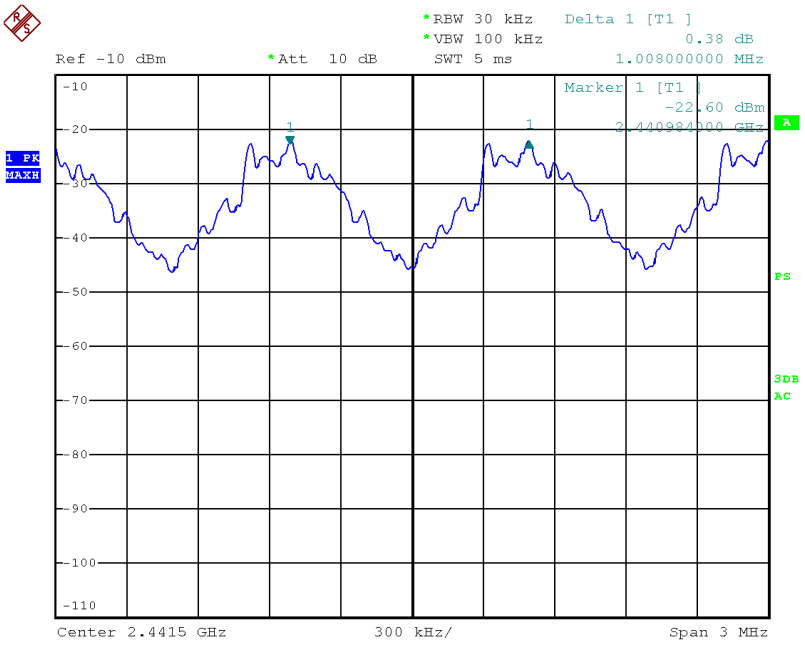
Relative Humidity : 52 %

Mode	CH	Frequency Separation (kHz)	Limit (kHz)
GFSK	L	1002.00	≥ 603.33
	M	1002.00	≥ 580.00
	H	1002.00	≥ 573.33

Channel L



Channel M



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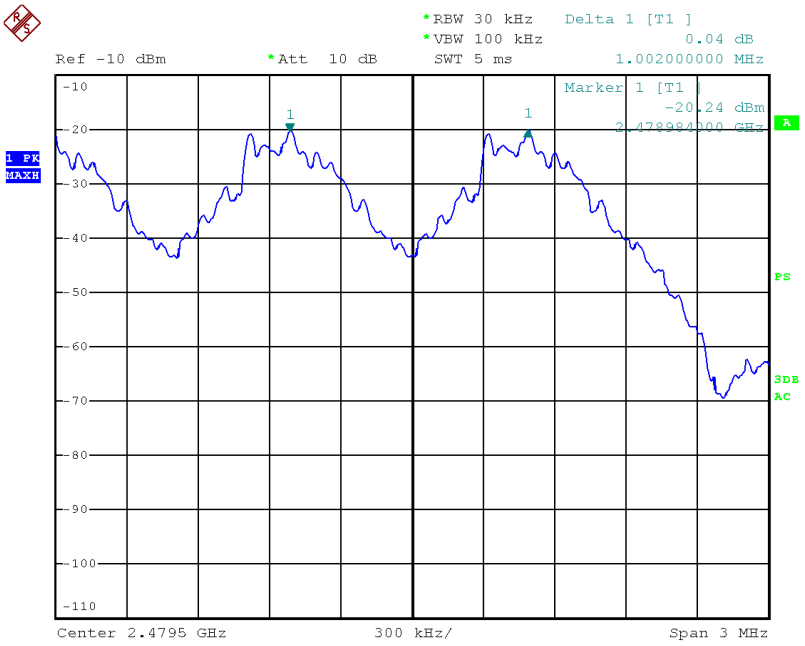
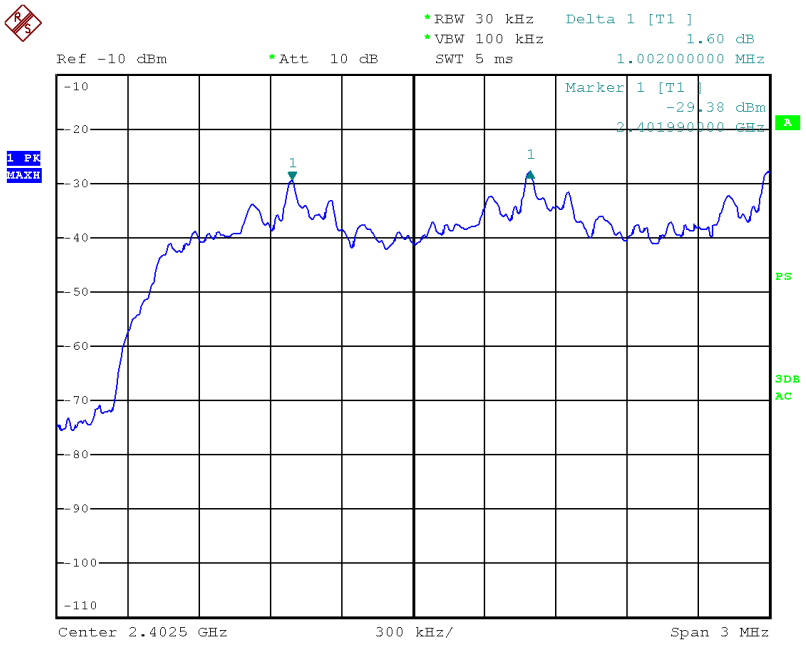
Channel H



Date: 5.NOV.2014 14:42:48

Mode	CH	Frequency Separation (kHz)	Limit (kHz)
8DPSK	L	1002.00	≥ 806.67
	M	1002.00	≥ 806.67
	H	1002.00	≥ 806.67

Channel L



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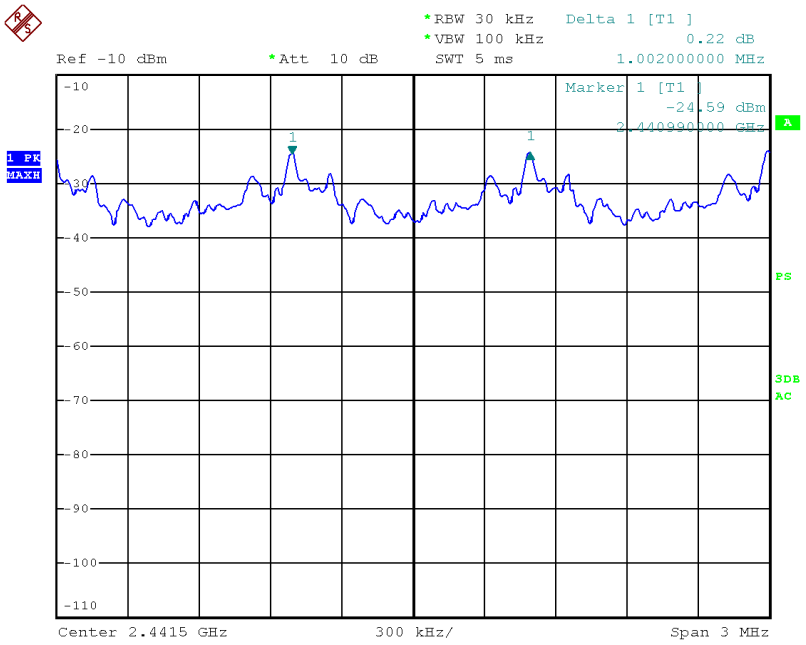
Channel M



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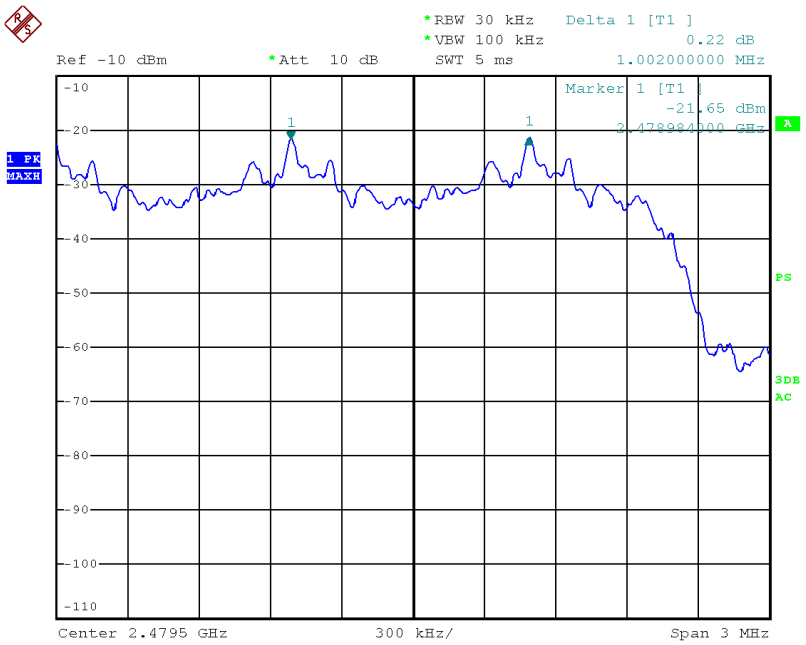
Channel H



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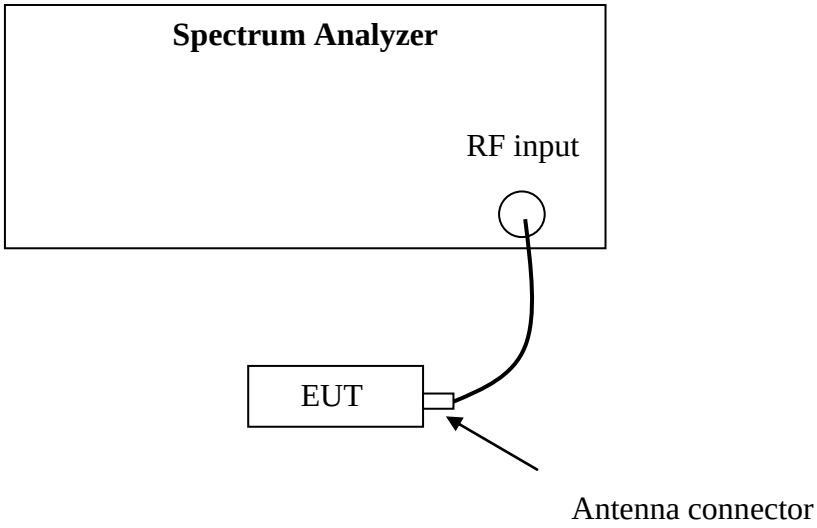
5. Maximum peak output power

Test result: Pass

5.1 Test limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

5.2 Test Configuration



5.3 Test procedure and test setup

The power output per FCC § 15.247(b) is measured using the Spectrum Analyzer with Span = 5 times the 20 dB bandwidth, RBW≥ the 20 dB bandwidth, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

5.4 Test protocol

Temperature : 22 °C

Relative Humidity : 52%

Mode	CH	Cable loss (dB)	Corrected reading (dBm)	Limit (dBm)
GFSK	L	1.50	1.90	≤21.00
	M	1.50	2.00	
	H	1.50	2.10	

Conclusion: The maximum EIRP = 2.10dBm+1dBi = 2.04mW which is lower than the limit of 4W listed in RSS-210.

Mode	CH	Cable loss (dB)	Corrected reading (dBm)	Limit (dBm)
8DPSK	L	1.50	-0.70	≤21.00
	M	1.50	0.56	
	H	1.50	1.03	

Conclusion: The maximum EIRP = 1.03dBm+1dBi = 1.60mW which is lower than the limit of 4W listed in RSS-210.

6. Radiated Spurious Emissions

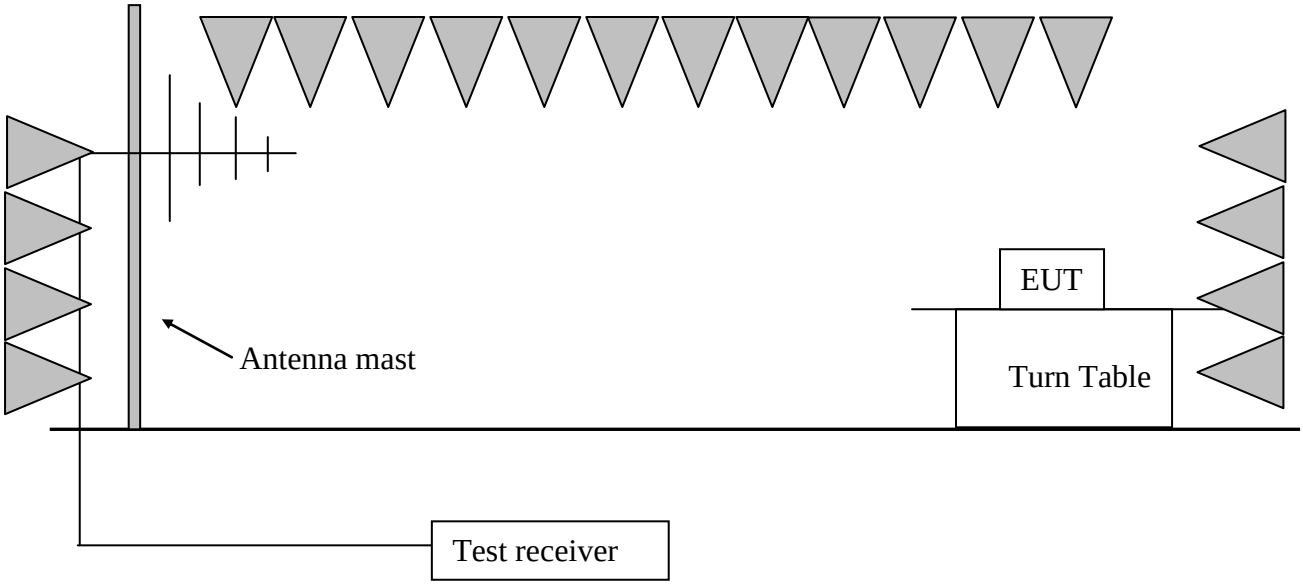
Test result: PASS

6.1 Test limit

The radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) showed as below:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

6.2 Test Configuration



6.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.
The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

The radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 100kHz, VBW = 300kHz (30MHz~1GHz)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);
RBW = 1MHz, VBW = 10Hz (>1GHz for AV);

If 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”.

6.4 Test protocol

GFSK Modulation:

CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2402.45	28.10	97.60	Fundamental	/	PK
	H	160.24	13.80	36.50	43.50	7.00	QP
	V	191.34	12.00	35.70	43.50	7.80	QP
	H	276.87	14.40	38.20	46.00	7.80	QP
	H	799.78	24.20	38.10	46.00	7.90	QP
	H	2380.52	34.20	52.50	74.00	21.50	PK
	H	4804.25	-3.60	55.60	74.00	18.40	PK
	H	4804.25	-3.60	42.20	54.00	11.80	AV
	H	7206.21	2.10	56.20	74.00	17.50	PK
	H	7206.21	2.10	42.20	54.00	11.80	AV
M	H	2441.29	34.60	97.50	Fundamental	/	PK
	H	160.24	13.80	36.50	43.50	7.00	QP
	V	191.34	12.00	35.70	43.50	7.80	QP
	H	276.87	14.40	38.20	46.00	7.80	QP
	H	799.78	24.20	38.10	46.00	7.90	QP
	H	4882.17	-3.50	54.40	74.00	18.60	PK
	H	4882.17	-3.50	41.50	54.00	12.50	AV
	H	7323.69	2.50	60.35	74.00	13.65	PK
	H	7323.69	2.50	46.30	54.00	7.70	AV
H	H	2480.54	34.70	98.10	Fundamental	/	PK
	H	160.24	13.80	36.50	43.50	7.00	QP
	V	191.34	12.00	35.70	43.50	7.80	QP
	H	276.87	14.40	38.20	46.00	7.80	QP
	H	799.78	24.20	38.10	46.00	7.90	QP
	H	2485.50	34.80	53.00	74.00	21.00	PK
	H	4960.26	-3.30	60.35	74.00	19.40	PK

	H	4960.26	-3.30	46.30	54.00	7.70	AV
	H	7440.08	2.70	44.40	74.00	25.60	PK

8DPSK Modulation:

CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2402.65	28.10	95.50	Fundamental	/	PK
	H	160.24	13.80	36.50	43.50	7.00	QP
	V	191.34	12.00	35.70	43.50	7.80	QP
	H	276.87	14.40	38.20	46.00	7.80	QP
	H	799.78	24.20	38.10	46.00	7.90	QP
	H	2375.65	34.10	52.50	74.00	21.50	PK
	H	4804.25	-3.60	55.60	74.00	18.40	PK
	H	4804.25	-3.60	42.20	54.00	11.80	AV
	H	7206.21	2.10	56.20	74.00	17.50	PK
	H	7206.21	2.10	42.20	54.00	11.80	AV
M	H	2441.67	30.70	92.50	Fundamental	/	PK
	H	160.24	13.80	36.50	43.50	7.00	QP
	V	191.34	12.00	35.70	43.50	7.80	QP
	H	276.87	14.40	38.20	46.00	7.80	QP
	H	799.78	24.20	38.10	46.00	7.90	QP
	H	4882.17	-3.50	54.40	74.00	18.60	PK
	H	4882.17	-3.50	41.50	54.00	12.50	AV
	H	7323.69	2.50	60.35	74.00	13.65	PK
	H	7323.69	2.50	46.30	54.00	7.70	AV
H	H	2480.73	30.70	93.95	Fundamental	/	PK
	H	160.24	13.80	36.50	43.50	7.00	QP
	V	191.34	12.00	35.70	43.50	7.80	QP
	H	276.87	14.40	38.20	46.00	7.80	QP

	H	799.78	24.20	38.10	46.00	7.90	QP
	H	2485.50	34.80	53.00	74.00	21.00	PK
	H	4960.26	-3.30	60.35	74.00	19.40	PK
	H	4960.26	-3.30	46.30	54.00	7.70	AV
	H	7440.08	2.70	44.40	74.00	25.60	PK

Remark: 1. For fundamental emission, no amplifier is employed.
2. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
3. Corrected Reading = Original Receiver Reading + Correct Factor
4. Margin = limit – Corrected Reading
5. If the PK reading is lower than AV limit, the AV test can be elided.
6. The emission was conducted from 30MHz to 25GHz.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m, Corrected Reading = 10.20dBuV/m, then Margin = 54 -10.20 = 43.80dBuV/m

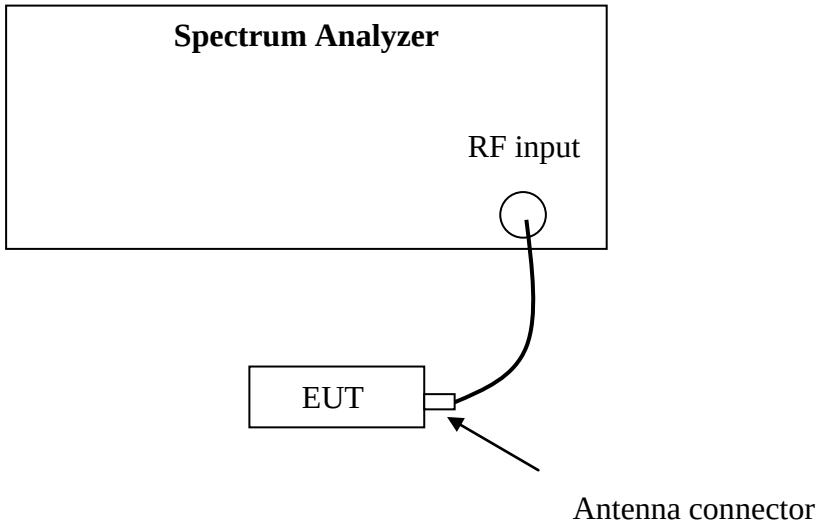
7. Conducted Spurious Emissions & Band Edge

Test result: **PASS**

7.1 Limit

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

7.2 Test Configuration



7.3 Test procedure and test setup

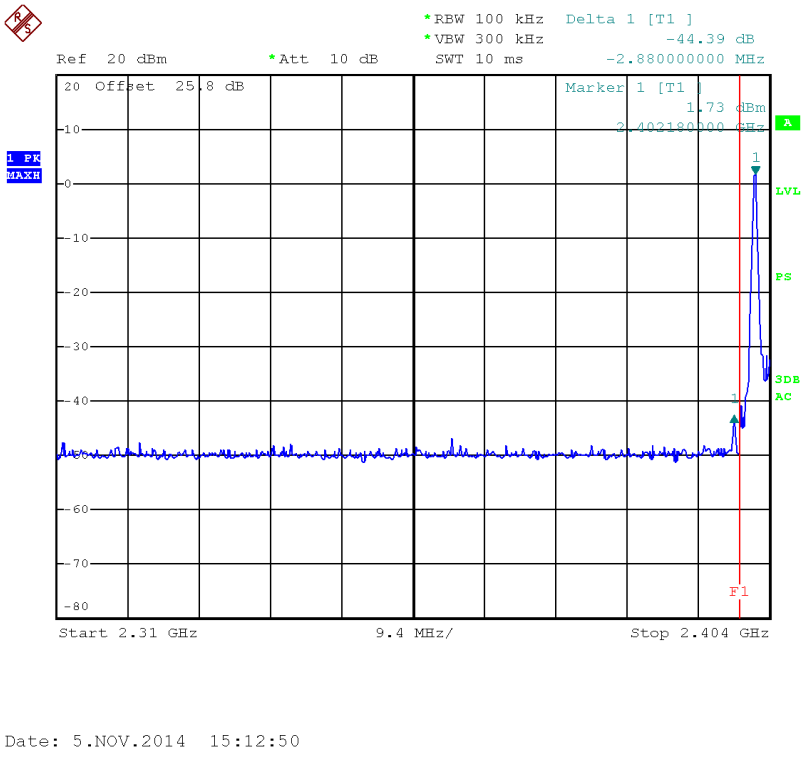
The Conducted Spurious Emissions per FCC § 15.247(d) is measured using the Spectrum Analyzer with Span wide enough capturing all spurious from the lowest emission frequency of the EUT up to 10th harmonics, RBW = 100kHz, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

7.4 Test protocol

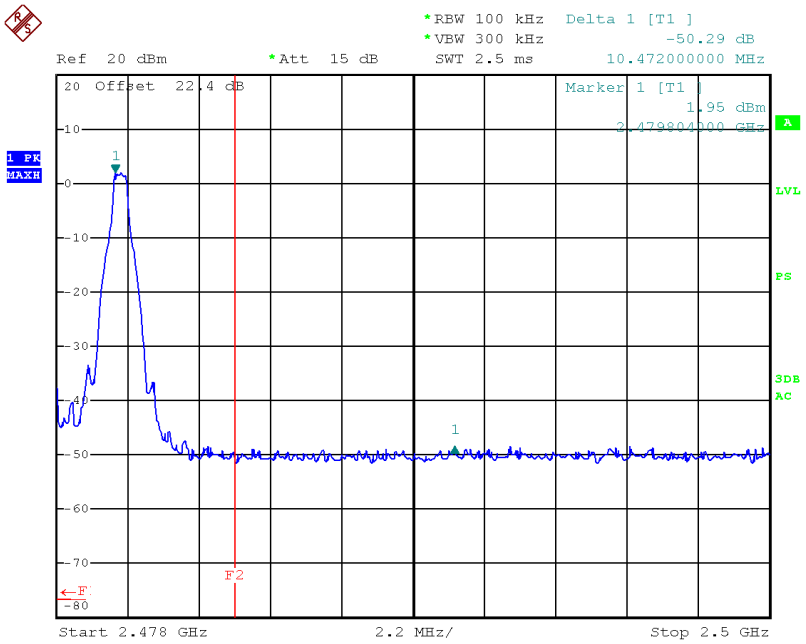
Model	CH	Max reading among band (dBm)	The most restrict Attenuation outside band (dB)	Limit (dB)
GFSK	L	1.73	44.39	≥20
	H	1.95	50.29	

Note: The test was performed from 9kHz to 26GHz and the worst data is listed here.

Channel L



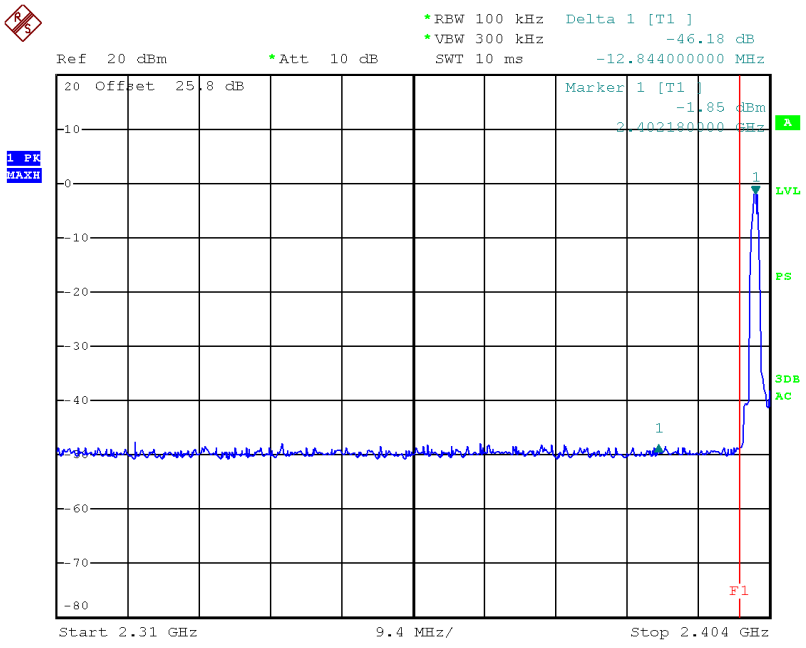
Channel H



Model	CH	Max reading among band (dBm)	The most restrict Attenuation outside band (dB)	Limit (dB)
8DPSK	L	-1.85	46.18	≥20
	H	1.96	49.87	

Note: The test was performed from 9kHz to 26GHz and the worst data is listed here.

Channel L



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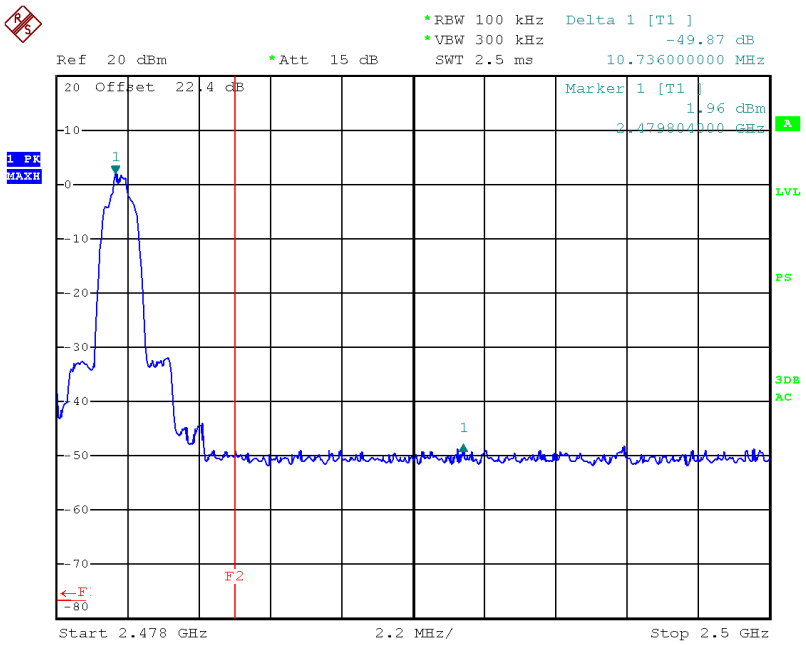
Channel H



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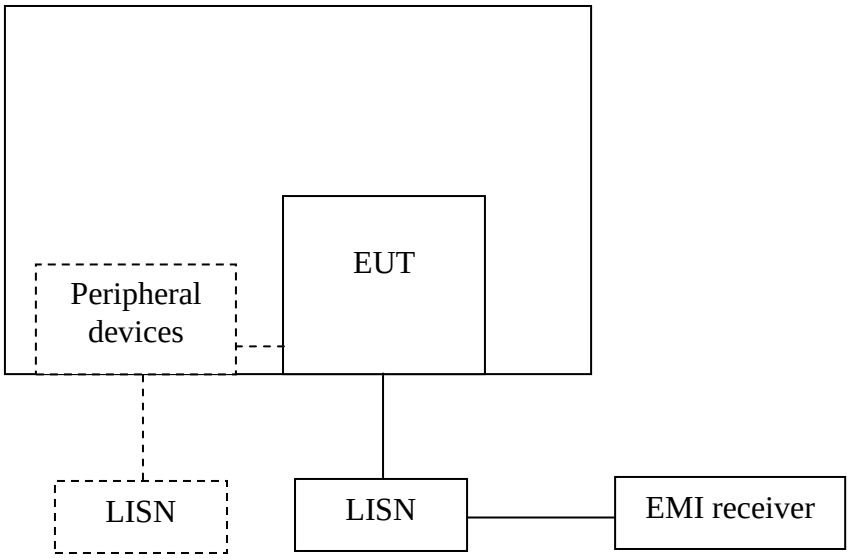
8. Power line conducted emission

Test result: **Pass**

8.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

8.2 Test configuration



☐ For table top equipment, wooden support is 0.8m height table

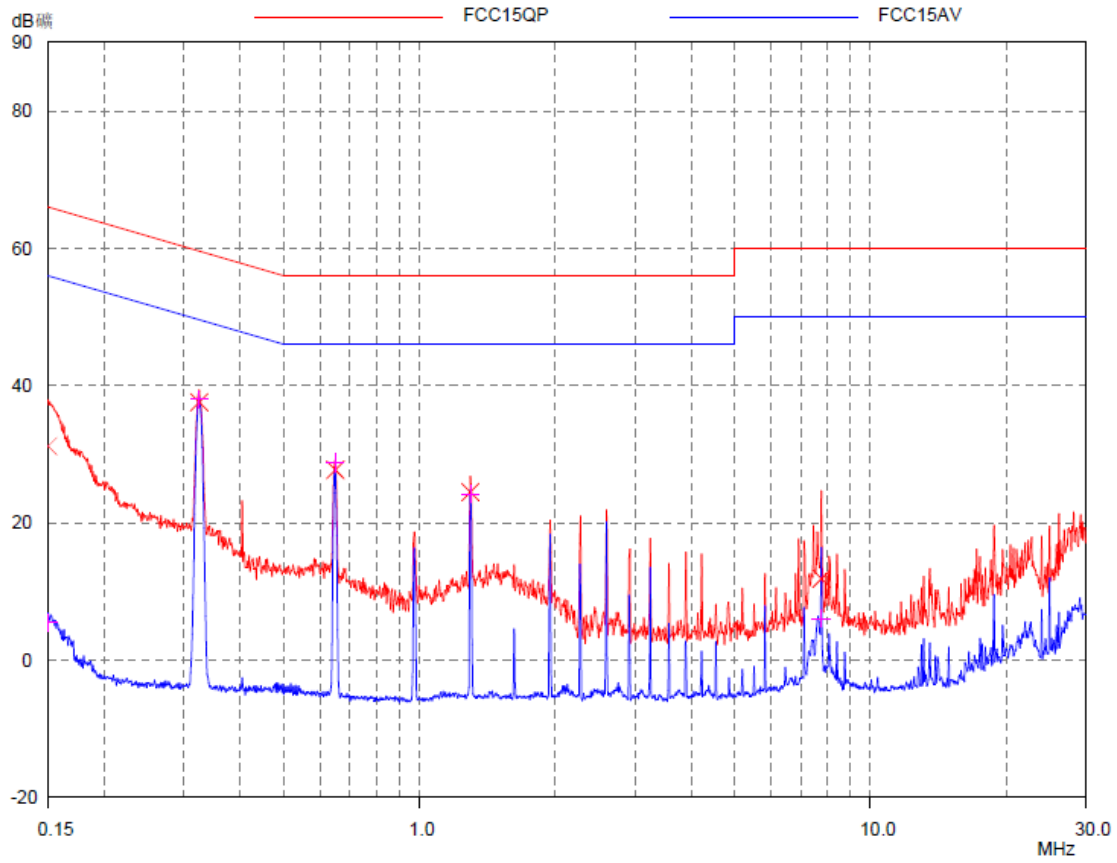
☒ For floor standing equipment, wooden support is 0.12m height rack.

8.3 Test procedure and test set up

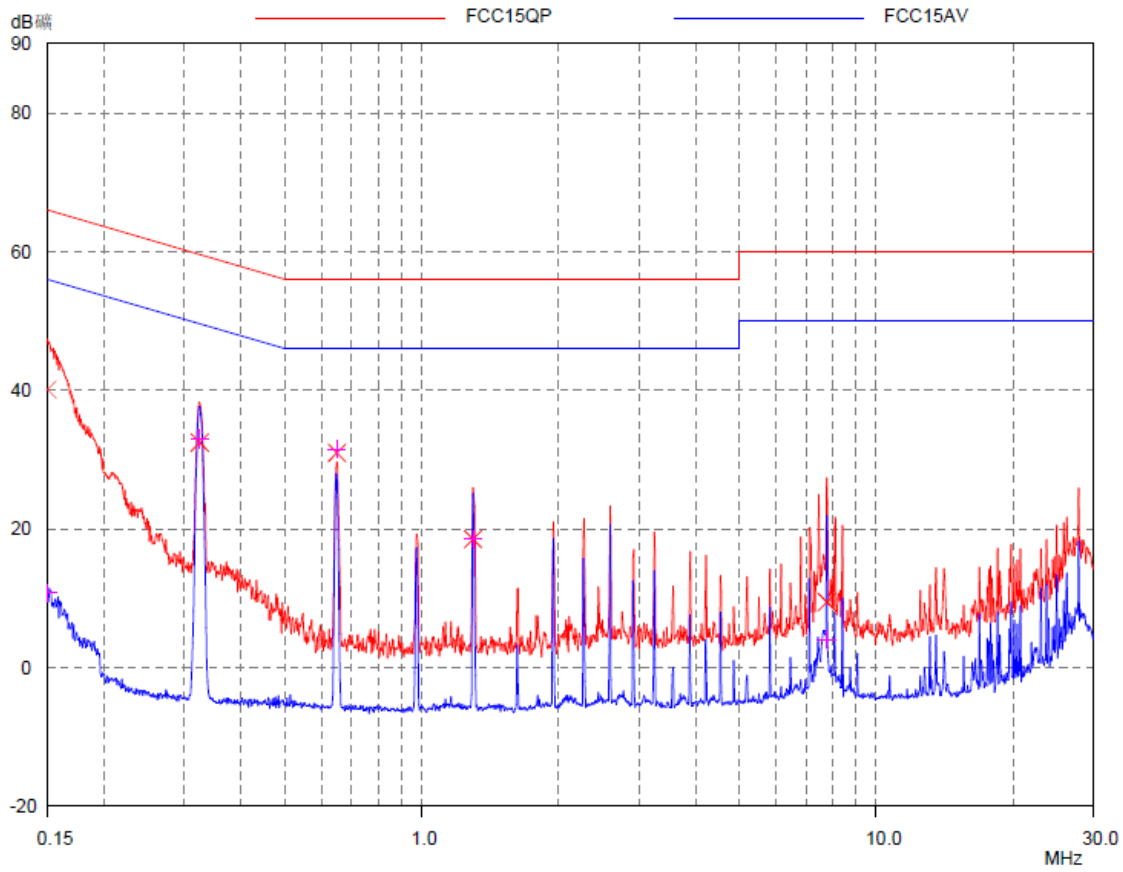
The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50Ω/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50Ω/50uH coupling impedance with 50Ω termination.
Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4 on conducted measurement.
The bandwidth of the test receiver is set at 9 kHz.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

8.4 Test protocol

L line:



N line:



Test Data:

Frequency (MHz)	Quasi-peak			Average			Phase
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)	
0.15	31.19	66.00	34.81	5.48	56.00	50.52	L
0.32	37.56	59.60	22.04	38.01	49.60	11.59	L
0.65	27.73	56.00	28.27	28.79	46.00	17.21	L
1.30	24.50	56.00	31.50	24.20	46.00	21.80	L
0.15	40.14	66.00	25.86	10.74	56.00	45.26	N
0.32	32.48	59.60	27.12	32.96	49.60	16.64	N
0.65	30.99	56.00	25.01	31.51	46.00	14.49	N
1.30	18.55	56.00	37.45	18.54	46.00	27.46	N

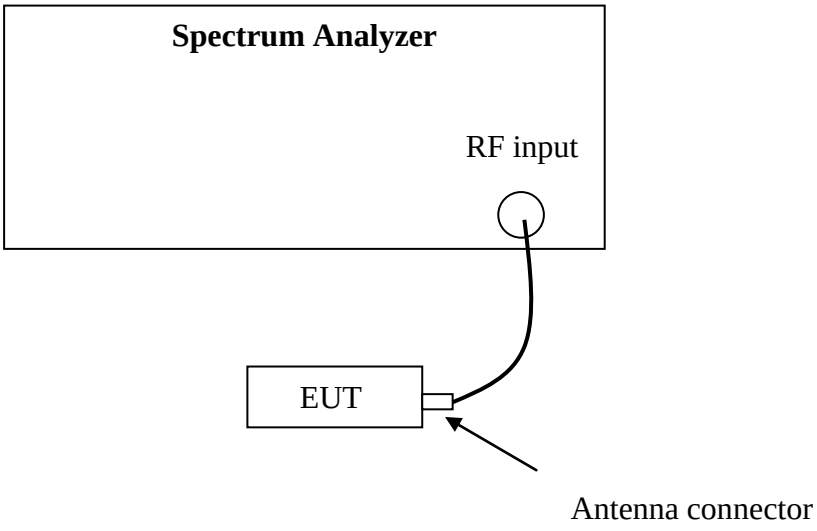
9. Number of Hopping Frequencies

Test result: **Pass**

9.1 Limit

Number of Hopping Frequencies in the 2400-2483.5 MHz band shall use at least 15 channels.

9.2 Test Configuration

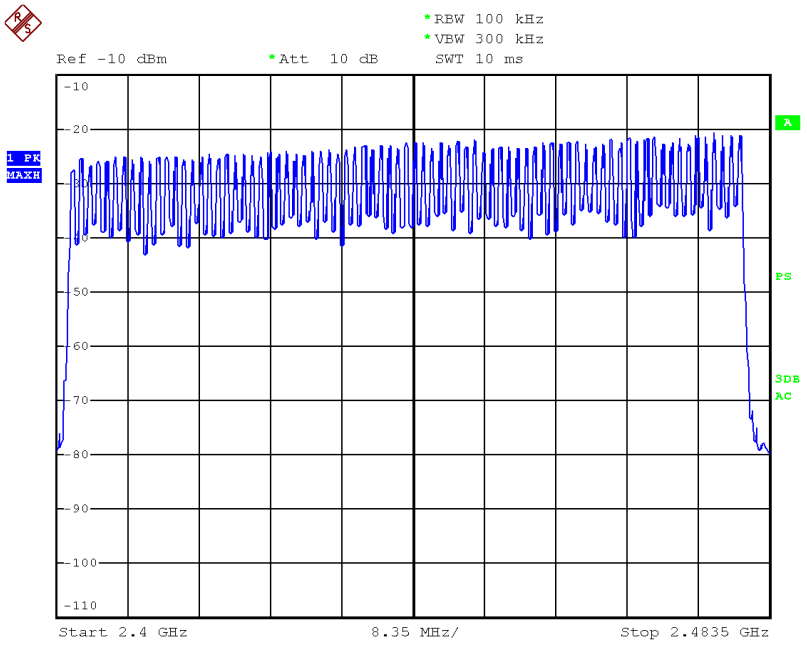


9.3 Test procedure and test setup

The channel number per FCC §15.247(a)(1)(iii) is measured using the Spectrum Analyzer with RBW=100kHz, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold. The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

9.4 Test protocol

Channel Number	Limit
79	≥15



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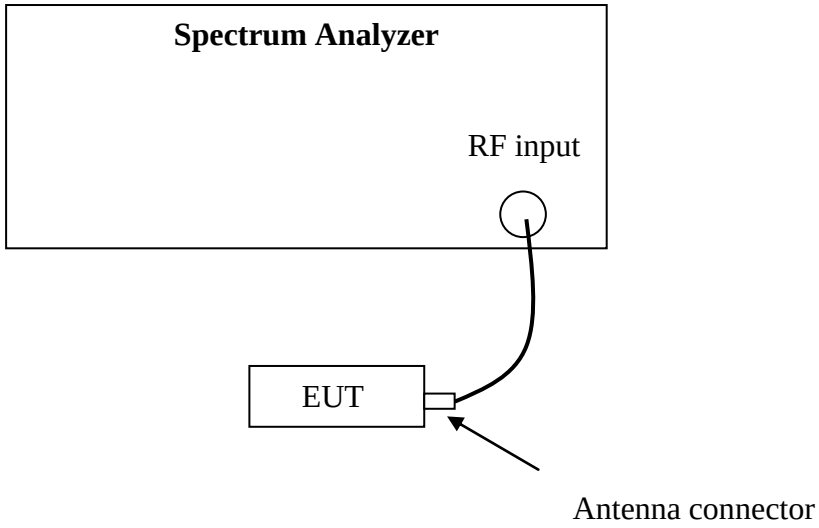
10. Dwell Time

Test result: **Pass**

10.1 Limit

The dwell time on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

10.2 Test Configuration



10.3 Test procedure and test setup

Dwell time per FCC § 15.247(a)(1)(iii) is measured using the Spectrum Analyzer with Span = 0, RBW=1MHz, VBW≥RBW, Sweep can capture the entire dwell time, Detector = peak, Trace = max hold.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

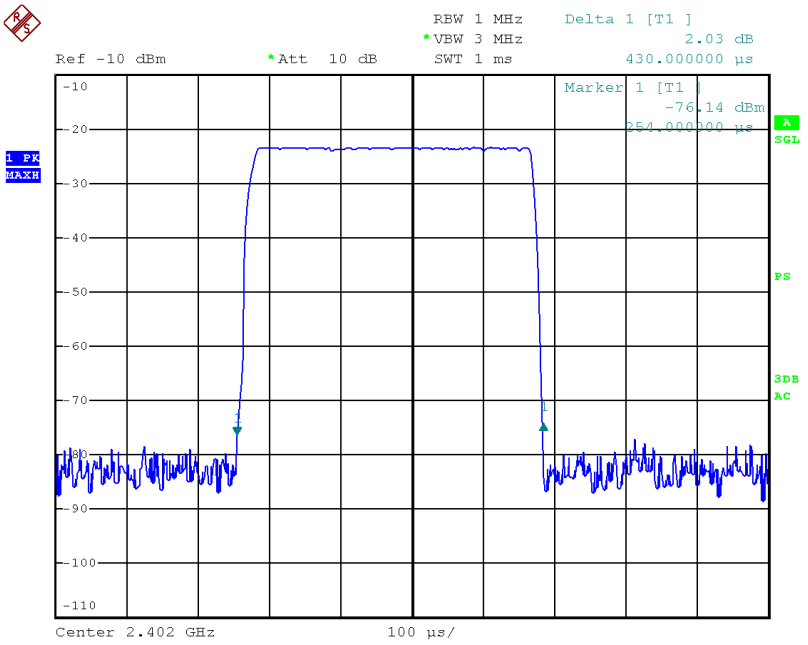
10.4 Test protocol

Packet	Occupancy time for single hop (ms) **O**	CH	Real observed period (s) **P**	Hops among Observed period **I**	Dwell time (ms) **T**	Limit (s)
DH1	0.430	L	3.16	32	137.6	≤0.4
		M	3.16	32	137.6	
		H	3.16	32	137.6	
DH3	1.690	L	3.16	16	270.04	
		M	3.16	16	270.04	
		H	3.16	16	270.04	
DH5	2.940	L	3.16	11	323.4	
		M	3.16	11	323.4	
		H	3.16	11	323.4	

Remark: 1. There are 79 channels in all. So the complete observed period P = 0.4 * 79 = 31.6 s.

2. Average time of occupancy **T = O *I * 31.6 / P**

DH1



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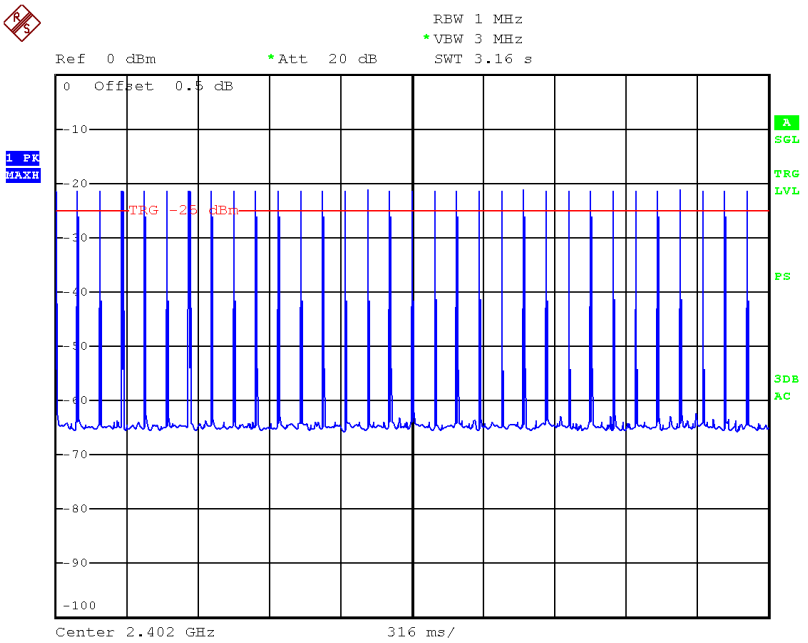
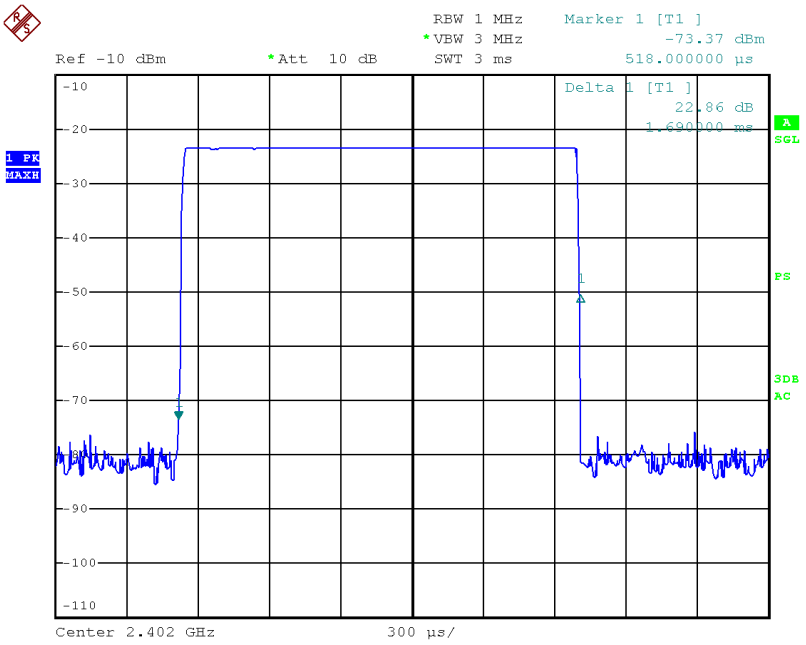


DH3



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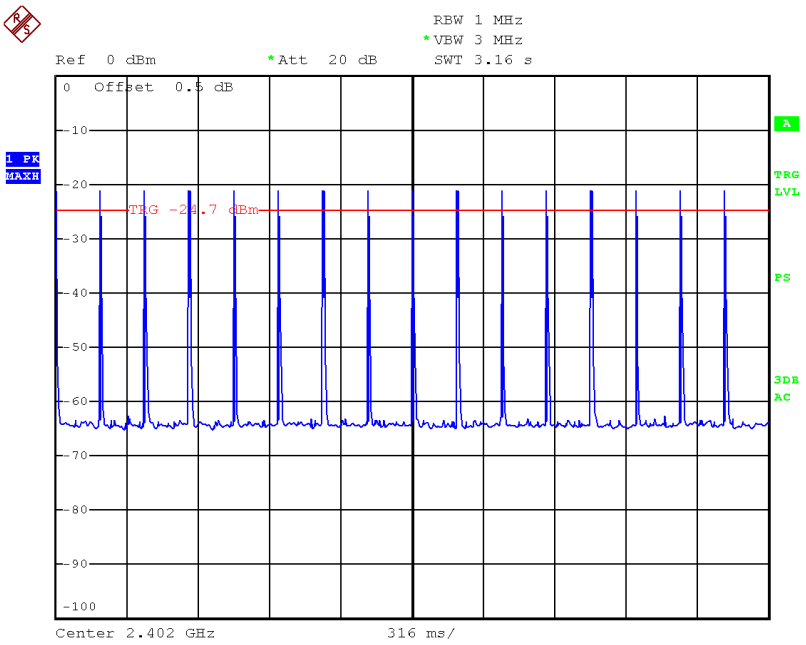
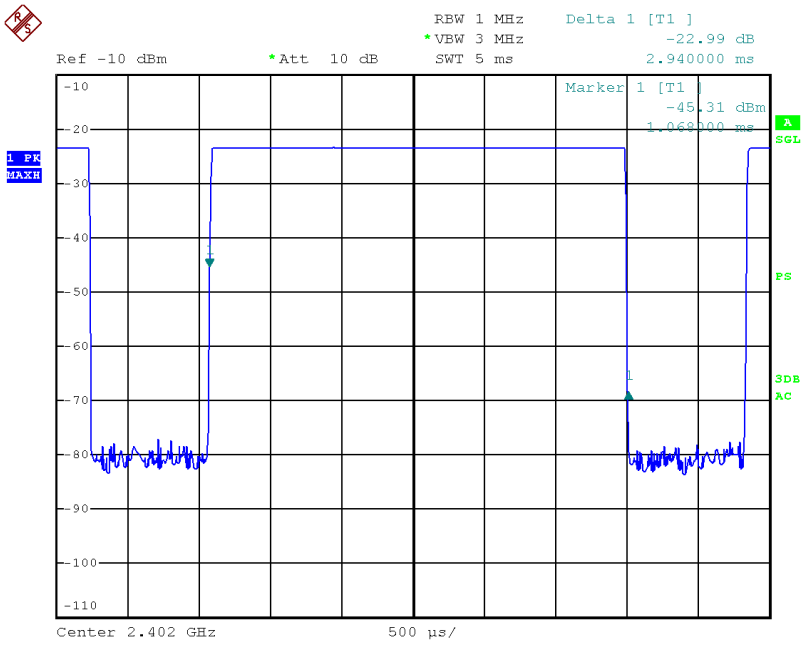


DH5



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