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# TEST REPORT

**Application No.:** HKEM2109000950BA

Applicant: **Current Trend Products Limited** 

Address of Applicant: Rm 709B, 7/F, Opulent Building, 402-406 Hennessy Road, Wanchai, Hong

Kong

**Equipment Under Test (EUT):** 

**EUT Name:** KORE 2.0

Model No.: 30538, 30755, 30538-AMZ, 30755-AMZ

**Additional Model:** Please refer to section 2 of this report which indicates which model was

actually tested and which were electrically identical.

**Trade Mark: KORE** 

FCC ID: 2AX4F-30538

CFR 47 FCC Part 15, Subpart C, 2020 Standard(s):

2021-09-06 Date of Receipt:

2021-09-06 to 2021-09-07 **Date of Test:** 

2021-09-08 Date of Issue:

**Test Result:** Pass\*



#### Law Man Kit **EMC Manager**

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<sup>\*</sup> In the configuration tested, the EUT complied with the standards specified above.



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	Revision Record					
Version	Chapter	Date	Modifier	Remark		
01		2021-09-08		Original		

Authorized for issue by:		
	Zen Xn.	
	Leo Xu /Project Engineer	Date: 2021-09-08
	Law	
	Law Man Kit	
	/Reviewer	Date: 2021-09-08



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# 2 Test Summary

Radio Spectrum Technical Requirement					
Item	Standard	Method	Requirement	Result	
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass	

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Disturbance at AC Power Line(150kHz- 30MHz)	47 CFR Part 15, Subpart C 15.207	ANSI C63.10: 2013 Section 6.2	47 CFR FCC Part 15, Subpart C 15.207	Pass
Minimum 6dB	47 CFR Part 15,	ANSI C63.10 (2013)	47 CFR Part 15, Subpart	Pass
Bandwidth	Subpart C 15.247	Section 11.8.1	C 15.247a(2)	
Conducted Peak	47 CFR Part 15,	ANSI C63.10 (2013)	47 CFR Part 15, Subpart	Pass
Output Power	Subpart C 15.247	Section 11.9.1	C 15.247(b)(3)	
Power Spectrum	47 CFR Part 15,	ANSI C63.10 (2013)	47 CFR Part 15, Subpart	Pass
Density	Subpart C 15.247	Section 11.10.2	C 15.247(e)	
Conducted Band	47 CFR Part 15,	ANSI C63.10 (2013)	47 CFR Part 15, Subpart	Pass
Edges Measurement	Subpart C 15.247	Section 11.13.3.2	C 15.247(d)	
Conducted Spurious	47 CFR Part 15,	ANSI C63.10 (2013)	47 CFR Part 15, Subpart	Pass
Emissions	Subpart C 15.247	Section 11.11	C 15.247(d)	
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious	47 CFR Part 15,	ANSI C63.10 (2013)	47 CFR Part 15, Subpart	Pass
Emissions	Subpart C 15.247	Section 6.4,6.5,6.6	C 15.205 & 15.209	

### **Declaration of EUT Family Grouping:**

Item no.: 30538, 30755, 30538-AMZ, 30755-AMZ

According to the confirmation from the applicant, the above models are identical in all electrical aspects in relating to the circuit design, PCB layout, electrical components used, internal wiring and functions. The differences are only the model/item No and language setting.

Therefore only the model 30538 was tested in this report

### Abbreviation:

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

RF: In this whole report RF means Radiated Frequency.

CH: In this whole report CH means channel.Volt: In this whole report Volt means Voltage.

Temp: In this whole report Temp means Temperature.

Humid: In this whole report Humid means humidity.

Press: In this whole report Press means Pressure.

N/A: In this whole report not application.



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# **General Information**

# 4.1 Details of E.U.T.

Power supply:	3.7VDC, 130mAh
Test voltage:	3.7VDC
Cable:	66cm USB charging cable
Antenna Gain:	0 dBi
Antenna Type:	Chip antenna
Bluetooth Version:	5.0
Channel Spacing:	2MHz
Modulation Type:	GFSK
Number of Channels:	40
Operation Frequency:	2402MHz to 2480MHz
Series number:	A1
Hardware Version:	2126_V1.2
Software Version:	V004
	Remark: Power level setting was not adjustable and fixed default through SW Version.

# Frequency List

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

Remark: 1. Testing Channels are highlighted in **bold**.



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# 4.2 Description of Support Units

The EUT has been tested with corresponding accessories as below: Supplied by client

Description	Manufacturer	Model No.	SN/Certificate NO	
nRFgo Studio	Nordic Semiconductor ASA	Version 1.21.2.10	N/A	

### Supplied by SGS:

Description	Manufacturer	Model No.	SN/Certificate NO
NoteBook (EMC4)	Dell	P75F	N/A

### 4.3 Modulation configure

RF software:	SYDTEK_Studio	o.exe		
Modulation	Packet	Packet Type	Packet Size	Power
GFSK	Default	Default	Default	Default

### Remark:

1. default value was set in test software as maximum output power setting.



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### 4.4 Measurement Uncertainty

RF

No.	Item	Measurement Uncertainty
1	Radio Frequency	± 7.25 x 10 <sup>-8</sup>
2	Duty cycle	± 0.37%
3	Occupied Bandwidth	± 3%
4	RF conducted power (30MHz-40GHz)	1.5dB
5	RF power density	1.5dB
6	Conducted Spurious emissions	1.5dB
		4.9dB (30MHz-1GHz)
7	RF Radiated power &	4.6dB (1GHz-6GHz)
/	Radiated Spurious emission test	4.7dB (6GHz-18GHz)
		5.6dB (18GHz-40GHz)
8	Temperature test	± 1 ℃
9	Humidity test	± 3%
10	Supply voltages	± 1.5%
11	Time	± 3%

#### Remark:

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors in calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the test lab quality system according to ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.



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#### 4.5 Test Location

All tests were performed at:

SGS Hong Kong Limited

Unit 2 and 3, G/F, Block A, Po Lung Centre,

11 Wang Chiu Road, Kowloon Bay, Kowloon, Hong Kong

Tel: +852 2305 2570 Fax: +852 2756 4480

No tests were sub-contracted.

### 4.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

#### · HOKLAS (Lab Code: 009)

SGS Hong Kong Limited has been accepted by HKAS Executive, on the recommendation of the Accreditation Advisory Board, as a HOKLAS Accredited Laboratory, this laboratory meets the requirements of ISO/IEC 17025:2017 an it has been accredited for performing specific test as listed in the scope of accreditation within the test category of Electrical and Electronic Products.

#### • IAS Accreditation (Lab Code: TL-817)

SGS Hong Kong Limited has met the requirements of AC89, IAS Accreditation Criteria for Testing Laboratories, and has demonstrated compliance with ISO/IEC Standard 17025:2017, General requirements for the competence of testing and calibration laboratories. This organization is accredited to provide the services specified in the scope of accreditation maintained on the IAS website (www.iasonline.org).

The report must not be used by the client to claim product certification, approval, or endorsement by IAS, NIST, or any agency of the Federal Government.

#### • FCC Recognized Accredited Test Firm(CAB Registration No.: 514599)

SGS Hong Kong Limited has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: HK0015, Test Firm Registration Number: 514599.

### • Industry Canada (Site Registration No.: 26103; CAB Identifier No.: HK0015)

SGS Hong Kong Limited has been recognized by Department of Innovation, Science and Economic Development (ISED) Canada as a wireless testing laboratory. The acceptance letter from the ISED is maintained in our files. CAB Identifier No: HK0015, Site Registration Number: 26103.

#### 4.7 Deviation from Standards

None

#### 4.8 Abnormalities from Standard Conditions

None



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# **Equipment List**

Conducted Emissions at Mains Terminals (150kHz-30MHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver 9kHz to 3.6GHz	Rohde & Schwarz	ESR3 / 102326	E231	2021/08/17	2022/08/16
Artificial Mains Network (LISN)	Schwarzbeck	NSLK 8127 / 8127312	TE10	2021/04/13	2022/04/12
Impulse Limiter	Rohde & Schwarz	ESH-3-Z2 / 357881052	E028	2020/10/23	2021/10/22
EMC32 Test Software	R&S	Version 10	N/A		

Radiated Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	ChamPro	N/A	E229	2021/08/09	2022/08/08
Coaxial Cable	SGS	N/A	E167	2021/07/15	2022/07/14
EMI Test Receiver 9kHz to 7GHz	Rohde & Schwarz	ESR7 / 102298	E314	2021/04/26	2022/04/25
TRILOG Super Broadb. Test Antenna, (25) 30- 1000 (2	Schwarzbeck	9168-1110	E311	2020/02/13	2022/02/12
EMC32 Test software	Rohde & Schwarz	Version 10	N/A	N/A	N/A
Signal and Spectrum Analyzer 2Hz - 26.5GHz	Rohde & Schwarz	FSW26	E296	2021/08/16	2022/08/15
Horn Antenna 1 - 18GHz	Schwarzbeck	BBHA9120D	E211	2020/03/11	2022/03/10
Horn Antenna 15 - 40GHz	Schwarzbeck	BBHA9170	E212	2020/01/29	2022/01/28
Preamplifier 33dB, 1 - 18GHz	Schwarzbeck	BBV9718	E214	2021/04/09	2022/04/08
Broadband Coaxial Preamplifier typ. 30 dB, 18-40 G	Schwarzbeck	BBV 9721	E266	2020/09/21	2021/09/20
RF cable SMA to SMA 10000mm	HUBER+SUHNER	SF104- 26.5/2*11SMA 45	E207	2020/09/21	2021/09/20
Boresight Mast Controller	ChamPro	AM-BS-4500-E	E237	N/A	N/A
Turntable with Controller	ChamPro	EM1000	E238	N/A	N/A
Highpass Filter 7.1 - 26.5GHz	SHW	HP7.1-26.5	E326	2020/09/28	2021/09/27
Highpass Filter 3 - 18GHz	Mircowave Circuits	H3G018G1	E325	2020/09/28	2021/09/27
5GHz Band Reject Filter	MICRO-TRONICS	BRC20534	E323	2020/09/28	2021/09/27
Band Reject Filter 2.4 - 2.5GHz	MICRO-TRONICS	BRM50702	E324	2020/09/28	2021/09/27
Loop Antenna	Schwarzbeck	FMZB 1513	E327	2020/11/23	2022/11/22



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Radiated Spurious Emis	sions (above 1GHz)				
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	ChamPro	N/A	E229	2021/08/09	2022/08/08
Coaxial Cable	SGS	N/A	E167	2021/07/15	2022/07/14
EMI Test Receiver 9kHz to 7GHz	Rohde & Schwarz	ESR7 / 102298	E314	2021/05/18	2022/05/17
TRILOG Super Broadb. Test Antenna, (25) 30-1000 MHz	Schwarzbeck	9168-1110	E311	2020/02/13	2022/02/12
Signal and Spectrum Analyzer 2Hz - 26.5GHz	Rohde & Schwarz	FSW26	E296	2021/08/16	2022/08/15
Spectrum Analyzer 9kHz - 30GHz	Rohde & Schwarz	FSP30	E204	2020/03/11	2022/03/10
Horn Antenna 1 - 18GHz	Schwarzbeck	BBHA9120D	E211	2020/01/29	2022/01/28
Horn Antenna 15 - 40GHz	Schwarzbeck	BBHA9170	E212	2020/01/29	2022/01/28
Preamplifier 33dB, 1 - 18GHz	Schwarzbeck	BBV9718	E214	2019/04/24	2022/04/23
Preamplifier 33dB, 18 - 26.5GHz	Schwarzbeck	BBV9719	E215	2020/09/21	2022/09/20
Broadband Coaxial Preamplifier typ. 30 dB, 18-40 GHz	Schwarzbeck	BBV 9721	E266	2020/08/31	2022/08/30
Highpass Filter 3.5-26.5GHz	Wainwright	WHNX3.5/26.5 G-6SS	E205	2019/04/24	2022/04/23
Band Reject Filter 2.4-2.5GHz	Wainwright	WRCJV 2400/2500- 2100	E206	2019/04/24	2022/04/23
RF cable SMA to SMA 10000mm	HUBER+SUHNER	SF104- 26.5/2*11SMA 45	E207-1	2020/09/21	2021/09/20
Boresight Mast Controller	ChamPro	AM-BS-4500-E	E237	N/A	N/A
Turntable with Controller	ChamPro	EM1000	E238	N/A	N/A



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6dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
SMBV100A VECTOR SIGNAL GENERATOR	Rohde & Schwarz	SMBV100A	E234	2021/08/16	2022/08/15
FSV40 SIGNAL ANALYZER 40GHz	Rohde & Schwarz	FSV40	E235	2021/08/16	2022/08/15
Wireless Conn. Tester (CMW)	Rohde & Schwarz	CMW270	E240	2021/08/16	2022/08/15
OSP	Rohde & Schwarz	OSP-B157W8	E242	2021/08/16	2022/08/15
Cable	Rohde & Schwarz	J12J103539- 00-2	E239	2021/07/15	2022/07/14
WMS32 Test Software	R&S	Version 10	N/A		

Conducted Peak Output	Conducted Peak Output Power				
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
SMBV100A VECTOR SIGNAL GENERATOR	Rohde & Schwarz	SMBV100A	E234	2021/08/16	2022/08/15
FSV40 SIGNAL ANALYZER 40GHz	Rohde & Schwarz	FSV40	E235	2021/08/16	2022/08/15
Wireless Conn. Tester (CMW)	Rohde & Schwarz	CMW270	E240	2021/08/16	2022/08/15
OSP	Rohde & Schwarz	OSP-B157W8	E242	2021/08/16	2022/08/15
Cable	Rohde & Schwarz	J12J103539- 00-2	E239	2021/07/15	2022/07/14
WMS32 Test Software	R&S	Version 10	N/A		

Power Spectrum Densit	у				
Equipment	Manufacturer	Model No	<b>Inventory No</b>	Cal Date	Cal Due Date
SMBV100A VECTOR SIGNAL GENERATOR	Rohde & Schwarz	SMBV100A	E234	2021/08/16	2022/08/15
FSV40 SIGNAL ANALYZER 40GHz	Rohde & Schwarz	FSV40	E235	2021/08/16	2022/08/15
Wireless Conn. Tester (CMW)	Rohde & Schwarz	CMW270	E240	2021/08/16	2022/08/15
OSP	Rohde & Schwarz	OSP-B157W8	E242	2021/08/16	2022/08/15
Cable	Rohde & Schwarz	J12J103539- 00-2	E239	2021/07/15	2022/07/14
WMS32 Test Software	R&S	Version 10	N/A	-	



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<b>Conducted Band Edges</b>	Conducted Band Edges Measurement				
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
SMBV100A VECTOR SIGNAL GENERATOR	Rohde & Schwarz	SMBV100A	E234	2021/08/16	2022/08/15
FSV40 SIGNAL ANALYZER 40GHz	Rohde & Schwarz	FSV40	E235	2021/08/16	2022/08/15
Wireless Conn. Tester (CMW)	Rohde & Schwarz	CMW270	E240	2021/08/16	2022/08/15
OSP	Rohde & Schwarz	OSP-B157W8	E242	2021/08/16	2022/08/15
Cable	Rohde & Schwarz	J12J103539- 00-2	E239	2021/07/15	2022/07/14
WMS32 Test Software	R&S	Version 10	N/A		

General used equipmen	t				
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Digital temperature & humidity data logger	SATO	SK-L200TH II	E232	2020/09/12	2021/09/11
Electronic Digital Thermometer with Hygrometer	nil	2074/2075	E159	2020/09/12	2021/09/11
Barometer with digital thermometer	SATO	7612-00	E218	2021/03/29	2022/03/28
Conditional Chamber	Zhong Zhi Testing Instruments	CZ-E-608D	E216	2021/08/17	2022/08/16



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# 6 Radio Spectrum Technical Requirement

### 6.1 Antenna Requirement

#### 6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

#### 6.1.2 Conclusion

#### Standard Requirement:

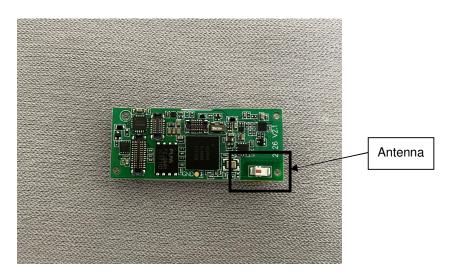
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

### 15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.



Antenna location: Refer to internal photo.



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# 7 Radio Spectrum Matter Test Results

**7.1** Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207, RSS-Gen Section 8.8

Test Method: ANSI C63.10 (2013) Section 6.2

Limit:

Erequency of emission/MU=)	Conducted limit(dBµV)				
Frequency of emission(MHz)	Quasi-peak	Average			
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.				

#### 7.1.1 E.U.T. Operation

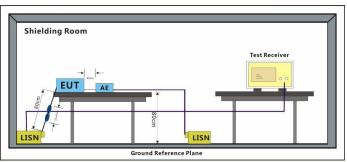
Operating Environment:

Temperature: 22.5 °C Humidity: 51.2 % RH

Test mode a :TX mode\_Keep the EUT in continuously transmitting mode with all modulation

types. Only the data of worst case is recorded in the report.

#### 7.1.2 Test Setup Diagram



#### 7.1.3 Measurement Procedure and Data

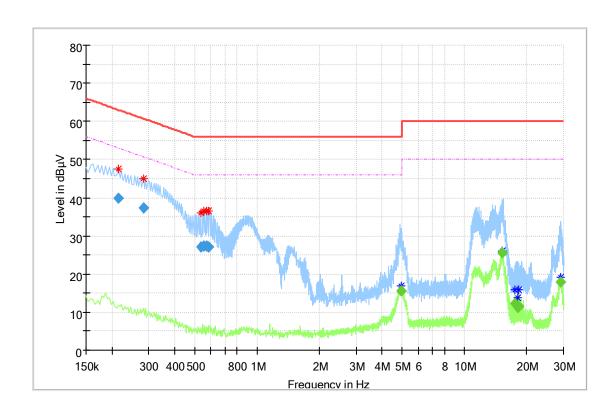
- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a  $50 \text{ohm}/50 \mu\text{H} + 5 \text{ohm}$  linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: LISN=Read Level+ Cable Loss+ LISN Factor



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Mode:a; Line: Live Line



Frequency	QuasiPeak	Average	Limit	Margin	Corr.	
(MHz)	(dBµV)	(dBμV)	(dBµV)	(dB)	(dB)	Result
0.214000	39.84		63.05	23.21	10.1	Pass
0.282000	37.32		60.76	23.43	10.1	Pass
0.534000	27.13		56.00	28.87	10.1	Pass
0.554000	27.37		56.00	28.63	10.1	Pass
0.570000	27.30		56.00	28.70	10.1	Pass
0.586000	27.03		56.00	28.97	10.1	Pass
4.934000		15.61	46.00	30.39	10.3	Pass
15.222000		25.51	50.00	24.49	11.0	Pass
17.482000		12.19	50.00	37.81	10.9	Pass
18.062000		11.22	50.00	38.78	10.8	Pass
18.330000		11.52	50.00	38.48	10.8	Pass
28.974000		17.88	50.00	32.12	10.9	Pass

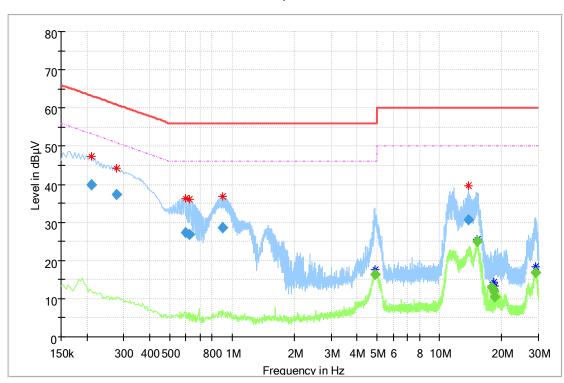


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Mode:a;

Line: Neutral Line

Full Spectrum



Frequency	QuasiPeak	Average	Limit	Margin	Corr.	Result
(MHz)	(dBµV)	(dBμV)	(dBµV)	(dB)	(dB)	nesuit
0.210000	39.97	-	63.21	23.24	10.1	Pass
0.278000	37.29		60.88	23.59	10.0	Pass
0.598000	27.37	I	56.00	28.63	10.1	Pass
0.622000	26.81		56.00	29.19	10.1	Pass
0.902000	28.55	I	56.00	27.45	10.2	Pass
4.874000	ł	16.40	46.00	29.60	10.6	Pass
13.802000	30.74	I	60.00	29.26	11.3	Pass
15.122000		24.92	50.00	25.08	11.4	Pass
17.778000		13.03	50.00	36.97	11.1	Pass
18.326000		12.12	50.00	37.88	11.0	Pass
18.458000	-	10.52	50.00	39.48	11.0	Pass
28.922000		16.79	50.00	33.21	11.1	Pass



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### 7.2 Minimum 6dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247a(2)
Test Method: ANSI C63.10 (2013) Section 11.8.1

Limit: ≥500 kHz

### 7.2.1 E.U.T. Operation

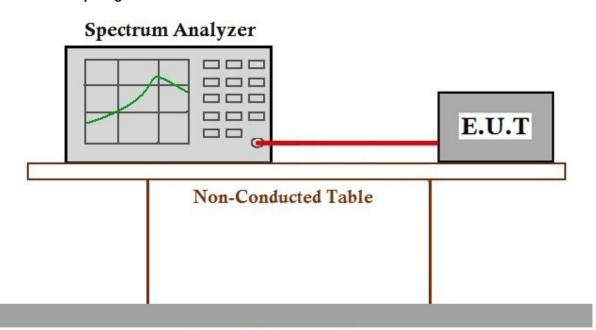
Operating Environment:

Temperature: 22.5 °C Humidity: 51.3 % RH

Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK

modulation

### 7.2.2 Test Setup Diagram



# **Ground Reference Plane**

### 7.2.3 Measurement Procedure and Data



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### 7.3 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)
Test Method: ANSI C63.10 (2013) Section 11.9.1

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
	1 for ≥50 hopping channels
902-928	0.25 for 25≤ hopping channels <50
	1 for digital modulation
	1 for ≥75 non-overlapping hopping channels
2400-2483.5	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

### 7.3.1 E.U.T. Operation

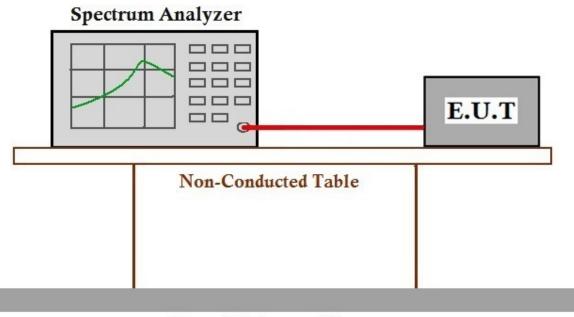
Operating Environment:

Temperature: 22.5 °C Humidity: 51.9 % RH :

Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK

modulation

### 7.3.2 Test Setup Diagram



# Ground Reference Plane

#### 7.3.3 Measurement Procedure and Data



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### 7.4 Power Spectrum Density

Test Requirement 47 CFR Part 15, Subpart C 15.247(e)
Test Method: ANSI C63.10 (2013) Section 11.10.2

Limit: ≤8dBm in any 3 kHz band during any time interval of continuous

transmission

### 7.4.1 E.U.T. Operation

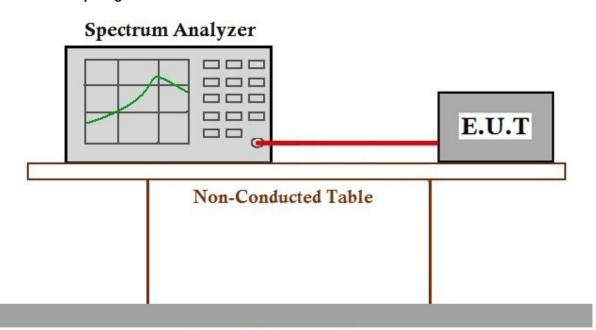
Operating Environment:

Temperature: 22.5 °C Humidity: 51.2 % RH

Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK

modulation

### 7.4.2 Test Setup Diagram



### Ground Reference Plane

### 7.4.3 Measurement Procedure and Data



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### 7.5 Conducted Band Edges Measurement

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)
Test Method: ANSI C63.10 (2013) Section 11.13.3.2

Limit: In any 100 kHz bandwidth outside the frequency band in which the spread

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

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

§15.209(a) (see §15.205(c)

### 7.5.1 E.U.T. Operation

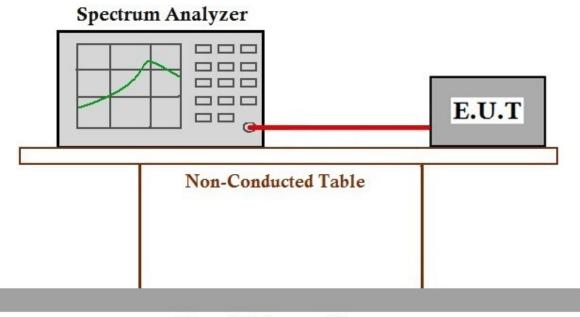
Operating Environment:

Temperature: 22.5 °C Humidity: 51.9 % RH

Test mode a:TX mode Keep the EUT in continuously transmitting mode with GFSK

modulation

#### 7.5.2 Test Setup Diagram



### Ground Reference Plane

#### 7.5.3 Measurement Procedure and Data



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### 7.6 Conducted Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)
Test Method: ANSI C63.10 (2013) Section 11.11

Limit: In any 100 kHz bandwidth outside the frequency band in which the spread

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

radiated emissions which fall in the restricted bands, as defined in

§15.205(a), must also comply with the radiated emission limits specified in

§15.209(a) (see §15.205(c)

### 7.6.1 E.U.T. Operation

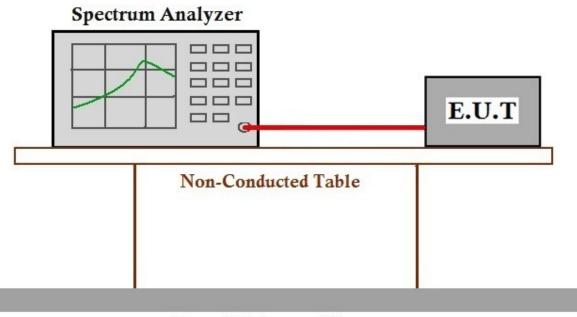
Operating Environment:

Temperature: 22.5 °C Humidity: 51.9 % RH

Test mode a:TX mode Keep the EUT in continuously transmitting mode with GFSK

modulation

#### 7.6.2 Test Setup Diagram



### Ground Reference Plane

#### 7.6.3 Measurement Procedure and Data



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### 7.7 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209, Section 3.3

Test Method: ANSI C63.10 (2013) Section 6.10.5

Measurement Distance: 3m

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.



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### 7.7.1 E.U.T. Operation

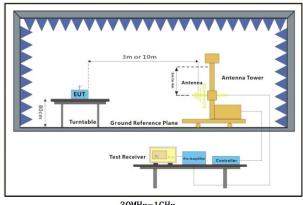
Operating Environment:

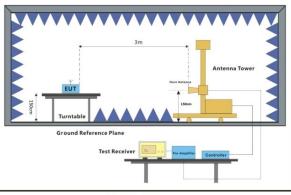
Temperature: 22.5 °C Humidity: 51.4 % RH

Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK

modulation

#### 7.7.2 Test Setup Diagram





30MHz-1GHz

Above 1GHz

#### 7.7.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.
- Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
- Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.



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### Worse test reulst as shown below:

Frequency	Antenna	Emission Lev	vel (dBµV/m)	Limit (d	IBμV/m)	Remark
(MHz)	Polarization	Peak	Average	Peak	Average	nemark
2390.000	Н	42.4	30.2	74.0	54.0	Pass
2483.500	Н	48.4	31.7	74.0	54.0	Pass
2390.000	V	41.9	28.4	74.0	54.0	Pass
2483.500	V	43.2	29.4	74.0	54.0	Pass



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## 7.8 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209
Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Measurement Distance: 3m

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.



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# 7.8.1 E.U.T. Operation

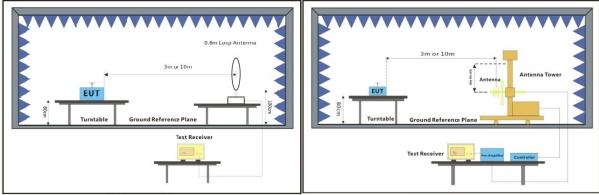
Operating Environment:

Temperature: 22.5 °C Humidity: 51.9 % RH

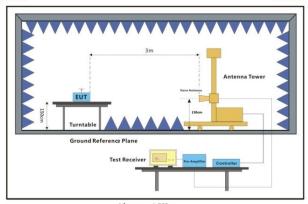
Test mode a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK

modulation

### 7.8.2 Test Setup Diagram



Below 30MHz 30MHz-1GHz



Above 1GHz



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#### 7.8.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

#### Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor

- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.



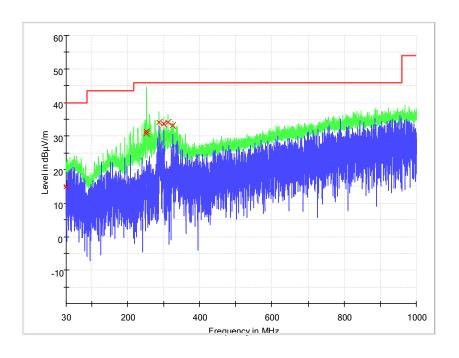
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### Radiated emission below 1GHz

Mode:a; Polarization:Horizontal; Modulation:GFSK;



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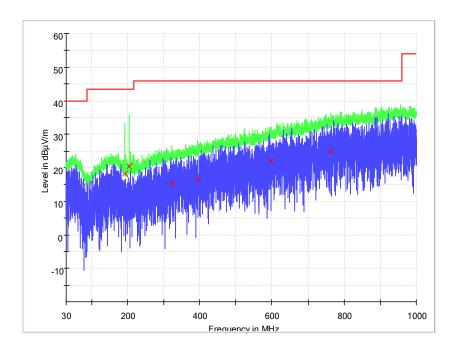
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Frequency	QuasiPeak	Del	Corr.	Margin	Limit	Decult
(MHz)	(dBµV/m)	Pol.	(dB/m)	(dB)	(dBµV/m)	Result
30.000000	14.9	Н	12.5	25.1	40.0	Pass
252.060714	31.5	Н	13.0	14.5	46.0	Pass
288.158571	34.1	Н	14.5	11.9	46.0	Pass
300.145000	33.6	Н	14.9	12.4	46.0	Pass
312.270000	34.1	Н	15.2	11.9	46.0	Pass
324.256429	33.2	Н	15.7	12.8	46.0	Pass



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Mode:a; Polarization:Vertical; Modulation:GFSK;



Frequency (MHz)	QuasiPeak (dBμV/m)	Pol.	Corr. (dB/m)	Margin (dB)	Limit (dBμV/m)	Result
192.197857	18.2	٧	11.1	25.3	43.5	Pass
204.253571	20.5	٧	10.8	23.0	43.5	Pass
322.316429	15.3	٧	15.6	30.7	46.0	Pass
394.235000	16.5	٧	17.3	29.5	46.0	Pass
596.687857	21.9	٧	21.9	24.1	46.0	Pass
762.488571	24.8	٧	24.7	21.2	46.0	Pass

Remark: Only the worst case is shown.



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Above 1GHz Channel:Low

Frequency	Antenna	Emission Level (dBμV/m)		Limit (d	Remark	
(MHz)	Polarization	Peak	Average	Peak	Average	
1931.875	Н	43.3	/	74.0	54.0	PASS
3143.500	Н	44.6	/	74.0	54.0	PASS
3029.125	Н	45.0	/	74.0	54.0	PASS
4379.000	V	48.1	/	74.0	54.0	PASS
7862.000	V	57.6	45.2	74.0	54.0	PASS
9909.500	V	57.4	44.8	74.0	54.0	PASS

### Channel:Middle

Frequency	Antenna	Emission Level (dBμV/m)		Limit (d	Remark	
(MHz)	Polarization	Peak	Average	Peak	Average	
1925.125	Н	41.8	/	74.0	54.0	PASS
3088.375	Н	44.6	/	74.0	54.0	PASS
4156.500	Н	46.3	/	74.0	54.0	PASS
4767.000	V	48.1	/	74.0	54.0	PASS
7859.000	Н	57.7	45.1	74.0	54.0	PASS
7862.000	V	57.4	44.8	74.0	54.0	PASS

Channel: High

Frequency	Antenna	Emission Level (dBμV/m)		Limit (d	Remark	
(MHz)	Polarization	Peak	Average	Peak	Average	
1932.625	Н	42.5	/	74.0	54.0	PASS
3133.000	Н	45.1	/	74.0	54.0	PASS
3674.125	V	47.9	/	74.0	54.0	PASS
5175.000	V	49.2	/	74.0	54.0	PASS
6982.000	V	54.2	41.9	74.0	54.0	PASS
8096.500	Н	58.5	45.8	74.0	54.0	PASS



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# 8 Photographs

# 8.1 EUT Constructional Details (EUT Photos)

Refer to the appendices setup, external and internal photos.



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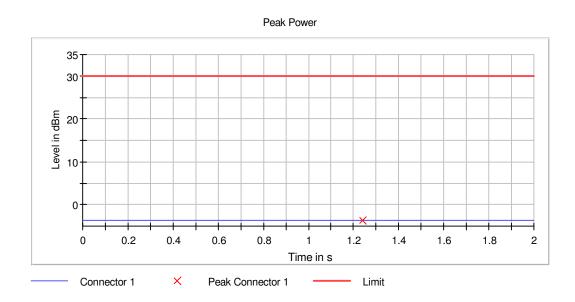
# 9 Appendix 15.247

# 9.1 Peak conducted output power

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	-3.1	30.0	PASS
2442.000000	-3.6	30.0	PASS
2480.000000	-2.2	30.0	PASS

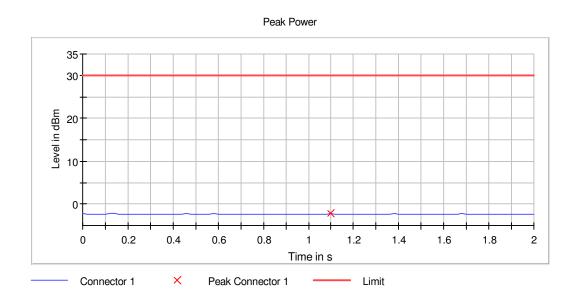
Remark: Antenna gain is 0 dBi

Peak Power 35 30 Level in dBm 0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 Time in s Connector 1 Peak Connector 1





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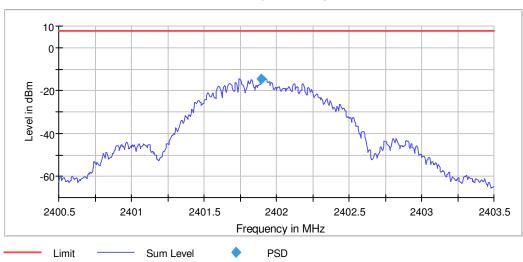


Remark: Cable loss 0.8dB was considered and set in system configuration.

# 9.2 Power Spectrum Density

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	2401.897500	-14.417	8.0	PASS

### Peak Power Spectral Density

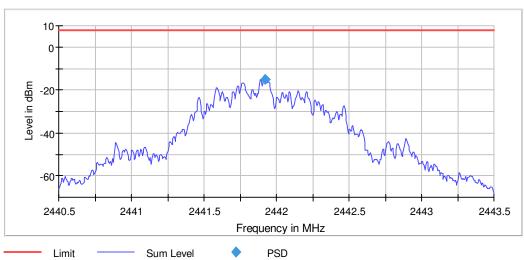




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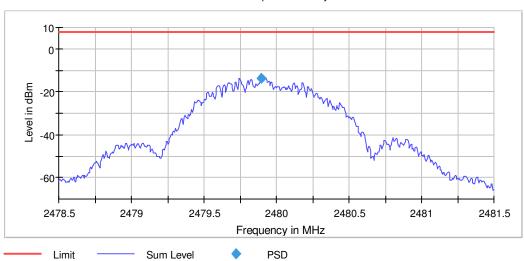
DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2442.000000	2441.922500	-15.002	8.0	PASS

Peak Power Spectral Density



DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2479.897500	-13.544	8.0	PASS

Peak Power Spectral Density





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# Measurement

Setting	Instrument Value	Target Value
Span	3.000 MHz	3.000 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	600	~ 600
Sweeptime	12.000 ms	12.000 ms
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	1	1
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	27 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.26 dB	0.50 dB

Remark: Cable loss 0.8dB was considered and set in system configuration.

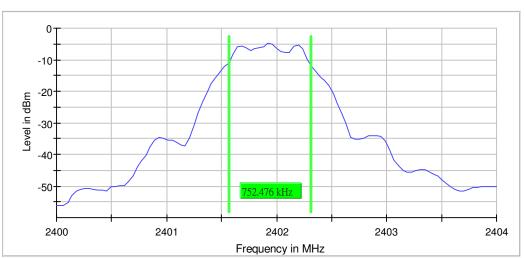


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### 9.3 Minimum 6dB Bandwidth

DUT Frequency	Bandwidth	Limit Min	Limit Max	Band Edge Left	Band Edge Right
(MHz)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
2402.000000	0.752476	0.500000		2401.564356	2402.316832
2442.000000	0.792080	0.500000		2441.524752	2442.316832
2480.000000	0.752476	0.500000		2479.564356	2480.316832

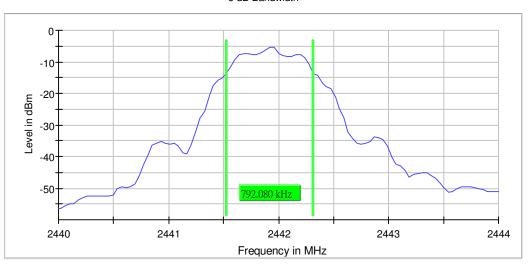
### 6 dB Bandwidth



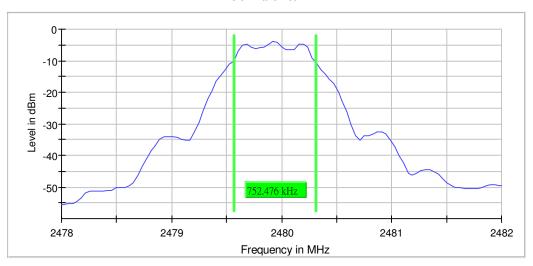


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### 6 dB Bandwidth



### 6 dB Bandwidth





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# Measurement

Setting	Instrument Value	Target Value
Span	4.000 MHz	4.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 80
Sweeptime	18.938 us	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	9 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.07 dB	0.50 dB

Remark: Cable loss 0.8dB was considered and set in system configuration.

# 9.4 Conducted Band Edge Measurement

# **Inband Peak**

Frequency (MHz)	Level (dBm)
2401.925000	-5.0
2479.975000	-4.1

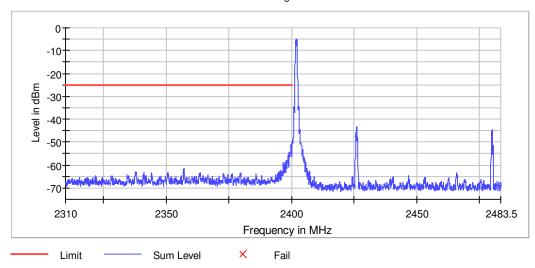
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.725000	-51.1	26.1	-25.0	PASS
2483.625000	-56.5	32.3	-24.1	PASS

Remark: Limit = Inband peak - 20dB

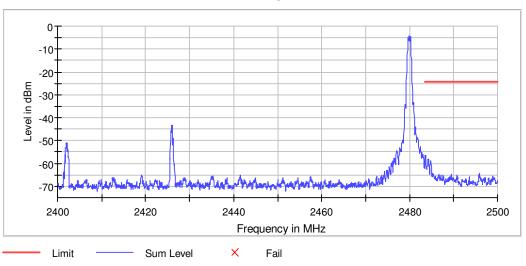


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### Band Edge



### Band Edge





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# **Measurement 1**

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	1.670 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.06 dB	0.50 dB

# **Measurement 2**

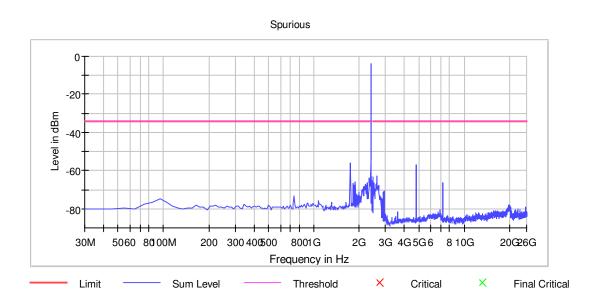
Setting	Instrument Value	Target Value
Start Frequency	2.48350 GHz	2.48350 GHz
Stop Frequency	2.50000 GHz	2.50000 GHz
Span	16.500 MHz	16.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	330	~ 330
Sweeptime	37.969 us	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	10 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.45 dB	0.50 dB

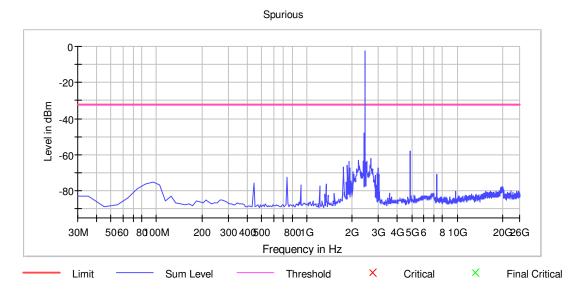
Remark: Cable loss 0.8dB was considered and set in system configuration.



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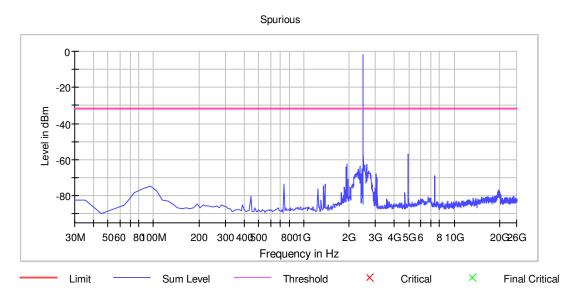
# 9.5 Conducted Spurious Emission







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### **Measurement 1**

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	238	~ 238
Sweeptime	23.700 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	24 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Remark: Cable loss 0.8dB was considered and set in system configuration.

- End of the Report -