

Variant FCC Test Report

Product Name : TracKing V5
Brand Name : Thermo King
Model No. : TKV5
FCC ID : Q37TKV5

Applicant : Thermo King Corporation
Address : 314 West 90th Street, Minneapolis, MN USA 55420

Date of Receipt : Nov. 26, 2021
Issued Date : Feb. 15, 2022
Report No. : 21B0999R-RFNAOTHV02-A
Report Version : V1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

This report must not be used to claim product endorsement by TAF or any agency of the government.

Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

The test report shall not be reproduced except in full without the written approval of DEKRA Testing and Certification Co., Ltd.

Variant Test Report Certification



Product Name : TrackKing V5
Applicant : Thermo King Corporation
Address : 314 West 90th Street, Minneapolis, MN USA 55420
Manufacturer : Thermo King Corporation
Address : 314 West 90th Street, Minneapolis, MN USA 55420
Brand Name : Thermo King
Model No. : TKV5
FCC ID : Q37TKV5
EUT Voltage : DC 14.2V
Testing Voltage : DC 14.2V
Applicable Standard : FCC CFR Title 47 Part 15 Subpart C Section 15.247
ANSI C63.10: 2013
Laboratory Name : Hsin Chu Laboratory
Address : No.372-2, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu
County 310, Taiwan, R.O.C.
TEL: +886-3-582-8001 / FAX: +886-3-582-8958
Test Result : Complied

Documented By :



(Hailey Peng / Senior Engineer)

Approved By :



(Louis Hsu / Deputy Manager)

The test results relate only to the samples tested.

The test report shall not be reproduced except in full without the written approval of DEKRA
Testing and Certification Co., Ltd.

Revision History

Version	Description	Issued Date
V1.0	Initial issue of report	Feb. 15, 2022

Class II Permissive Change (C2PC)

Report No.	Version	Description	Issued Date
2181021R-E3032110108	V1.0	Original application.	Nov. 12, 2021
21B0999R-RFNAOTHV02-A	V1.0	- Changing of crystal that generates the RF frequencies for the BT module, U13 (EFR32BG21A010F512IM32-B). - Original: 38.4MHz Crystal 1.2 × 1.0 mm size (Manufacturer part number: Murata XRCED38M400FXQ50R0). - Current: same frequency (38.4 MHz), bigger 2.0 × 1.6mm size (TaiSaw, Geyer, Murata). - The PCB pads will be modified to accommodate the bigger 2.0 x 1.6 mm crystals. - A metal shield can will be added to the top layer and to the bottom layer of the PCB. - RS485 transceiver (U26) is depopulated. - Package of power controller IC (U34) will be changed from 10-pin DFN to 10-pin MSOP. After evaluating, the worst result of original report is selected to verify radiated emission, radiated emission band edge tests and record in the report.	Feb. 15, 2022

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1. General Information

1.1 EUT Description

Product Name	TracKing V5
Brand Name	Thermo King
Model No.	TKV5
Frequency Range	1 Mbps: 2402 ~ 2480 MHz 2 Mbps: 2402 ~ 2480 MHz
Channel Number	1 Mbps: 40 Channels 2 Mbps: 40 Channels
Type of Modulation	GFSK

Antenna Information				
Ant.	Trade Name	Model No.	Type	Gain (dBi)
0	N/A	N/A	PCB	2.80

GFSK (1 Mbps/2 Mbps)

Working Frequency of Each Channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	10	2422 MHz	20	2442 MHz	30	2462 MHz
01	2404 MHz	11	2424 MHz	21	2444 MHz	31	2464 MHz
02	2406 MHz	12	2426 MHz	22	2446 MHz	32	2466 MHz
03	2408 MHz	13	2428 MHz	23	2448 MHz	33	2468 MHz
04	2410 MHz	14	2430 MHz	24	2450 MHz	34	2470 MHz
05	2412 MHz	15	2432 MHz	25	2452 MHz	35	2472 MHz
06	2414 MHz	16	2434 MHz	26	2454 MHz	36	2474 MHz
07	2416MHz	17	2436 MHz	27	2456 MHz	37	2476 MHz
08	2418 MHz	18	2438 MHz	28	2458 MHz	38	2478 MHz
09	2420 MHz	19	2440 MHz	29	2460 MHz	39	2480 MHz

Note:

1. Regards to the frequency band operation; the lowest , middle and highest frequency of channel were selected to perform the test, and then shown on this report.
2. The above EUT information is declared by the manufacturer.

1.2 Test Mode

DEKRA has verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Test Mode	Mode 1: Transmit
-----------	------------------

Test Items	Test Mode	Modulation	Channel	Result
Radiated Emission	Mode 1	GFSK (2 Mbps)	39	Pass
Radiated Emission Band Edge	Mode 1	GFSK (2 Mbps)	39	Pass

Note:

1. Determining compliance shall be based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
2. The EUT was performed at X axis and Z axis position for radiated emission and band edge tests.
The worst case was found at Z axis for original report, so the measurement will follow this same test configuration.

1.3 Comments and Remarks

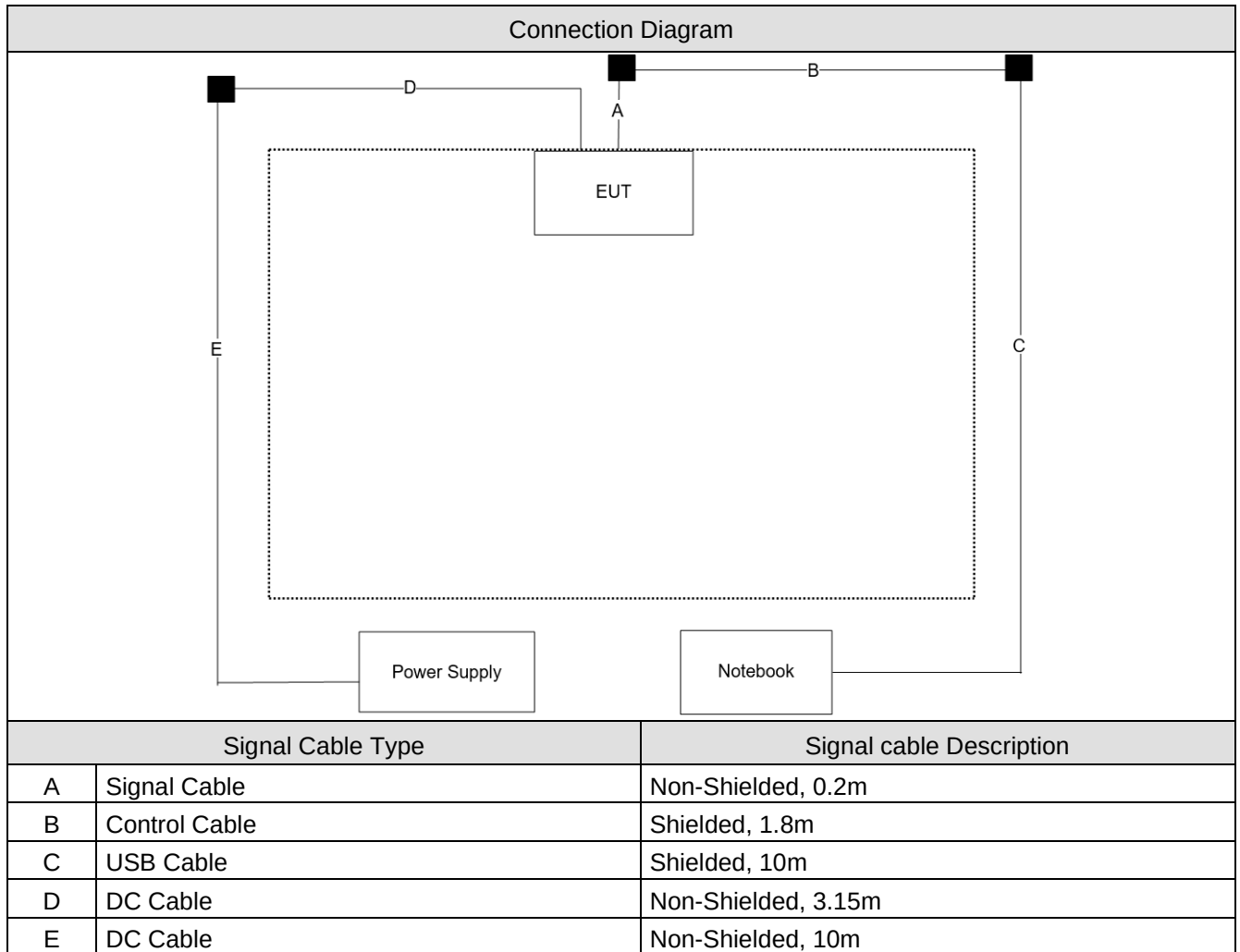
The product specification and testing instructions for the EUT declared in the report are provided by the manufacturer who will take all responsibilities for the accuracy.

1.4 Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system.

Product	Manufacturer	Model No.	Serial No.	FCC ID	Power Cord
1 Notebook	DELL	Latitude E6320	8611271467	N/A	AC in: Non-Shielded, 1.8m DC out: Shielded, 1.9m and with a core
2 Power Supply	Topward	6303D	8095908	N/A	Non-Shielded, 1.8m

1.5 Configuration of tested System



1.6 EUT Operation of during Test

1	Set the EUT as shown.
2	Execute control command by software "bgtool".
3	Configure test mode, test channel and data rate.
4	Let the EUT start transmitting signal continuously.
5	Verify that device is working properly.

1.7 Test Facility

Ambient conditions in the laboratory:

Items	Test Item	Actually	Tested by	Test Date	Test Site
Temperature (°C)	Radiated Emission	20.9 ~ 22	Ling Chen	2021/12/3 ~ 2021/12/9	CB2-H
Humidity (%RH)		52 ~ 60			
Temperature (°C)	Radiated Emission Band Edge	20.9 ~ 22	Ling Chen	2021/12/3 ~ 2021/12/9	CB2-H
Humidity (%RH)		52 ~ 60			

Note: Test site information refers to Laboratory Information.

Laboratory Information

USA : FCC Registration Number: TW3024
Canada : CAB identifier : TW3024

The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site: <http://www.dekra.com.tw>

If you have any comments, please don't hesitate to contact us. Our test sites as below:

Test Laboratory	DEKRA Testing and Certification Co., Ltd.
Address	1. No.372-2, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C. 2. No.372, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C.
Phone number	1. +886-3-582-8001 2. +886-3-582-8001
Fax number	1. +886-3-582-8958 2. +886-3-582-8958
Email address	info.tw@dekra.com
Website	http://www.dekra.com.tw
Note: Test site number for address 1 includes SR2-H. Test site number for address 2 includes CB2-H, CB3-H, CB4-H, SR10-H and SR12-H.	

1.8 List of Test Equipment

CB2-H

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Signal Analyzer	R&S	FSVA40	101455	2021/10/22	2022/10/21
Signal & Spectrum Analyzer	R&S	FSV40	101049	2021/03/31	2022/03/30
Signal Analyzer	R&S	FSVA40	101435	2021/06/04	2022/06/03
EXA Signal Analyzer	Keysight	N9010A	MY51440132	2021/01/25	2022/01/24
Trilog Broadband Antenna	Schwarzbeck	VULB 9168	1272	2021/08/20	2022/08/19
Bilog Antenna	Teseq	CBL6112D	23191	2021/02/26	2022/02/25
Horn Antenna	Schwarzbeck	BBHA 9120D	639	2021/05/17	2022/05/16
Horn Antenna	Schwarzbeck	BBHA 9170	202	2021/12/01	2022/11/30
Pre-Amplifier	EMCI	EMC01820I	980365	2021/05/28	2022/05/27
Pre-Amplifier	EMEC	EM01G18GA	060741	2021/07/02	2022/07/01
Pre-Amplifier	DEKRA	AP-400C	201801231	2021/11/12	2022/11/11
Coaxial Cable(13m)	Huber+Suhner	SF104	CB2-H	2021/08/17	2022/08/16
Coaxial Cable(3m)	Suhnerr,Rosnol	SF102_Rosnol	CB2-H	2021/08/17	2022/08/18
EMI Test Receiver	R&S	ESR7	102260	2020/12/28	2021/12/27
Magnetic Loop Antenna	Teseq	HLA 6121	44287	2021/09/06	2022/09/05
Coaxial Cable(10m)	Suhner	SF102_SF104	CB4-H	2021/08/09	2022/08/08
Radiated Software	AUDIX	e3 V9	CB2-H	N/A	N/A

Note: All equipment upon which need to calibrated are with calibration period of 1 year.

1.9 Measurement Uncertainty

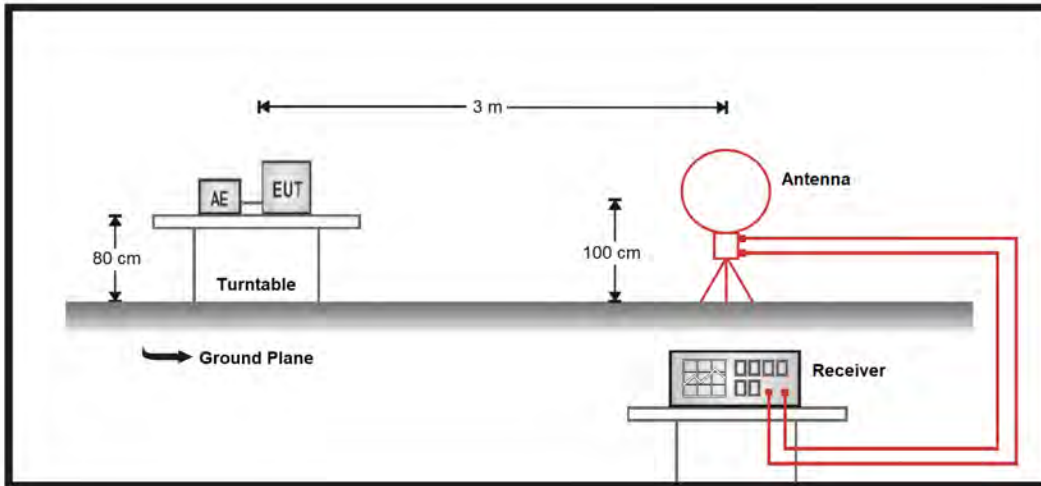
Uncertainties have been calculated according to the DEKRA internal document with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)).

Test item	Uncertainty
Radiated Emission	± 3.25 dB below 1 GHz ± 3.32 dB above 1 GHz
Radiated Emission Band Edge	± 3.32 dB

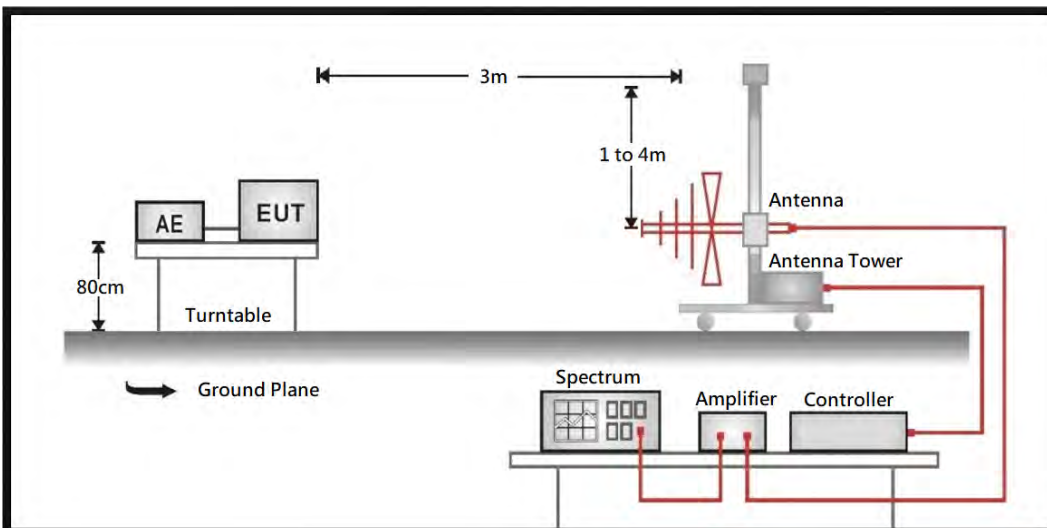
2. Radiated Emission

2.1 Test Setup

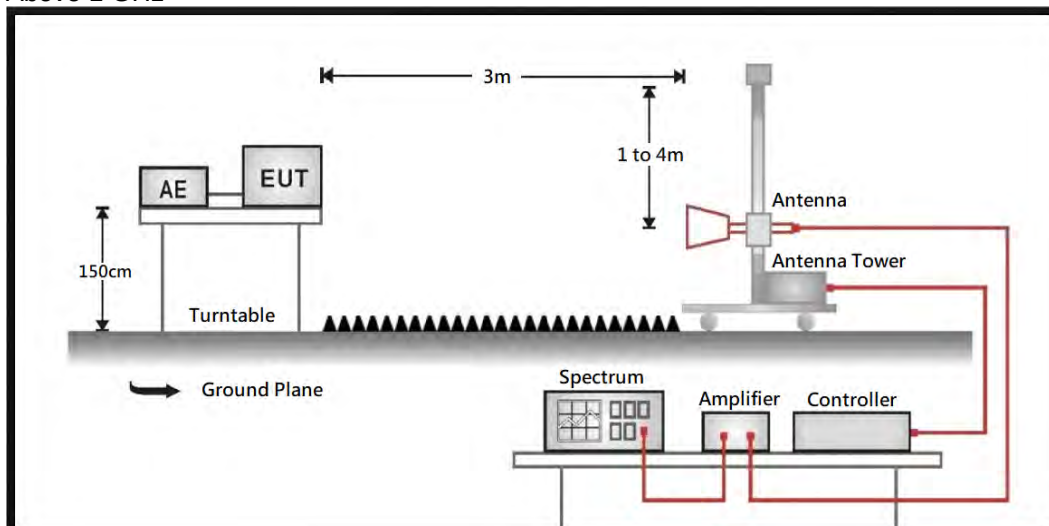
9 kHz ~ 30 MHz



30 MHz ~ 1 GHz



Above 1 GHz



2.2 Test Limit

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general radiated emission limit in paragraph 15.209, whichever is the lesser attenuation.

Frequency (MHz)	Field strength (uV/m)	Field strength (dBuV/m)	Measurement distance (m)
0.009 – 0.490	$2400/F(\text{kHz})$	$20 \log (2400/F(\text{kHz}))$	300
0.490 – 1.705	$24000/F(\text{kHz})$	$20 \log (24000/F(\text{kHz}))$	30
1.705 - 30	30	29.5	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

Remarks:

1. Field strength (dBuV/m) = $20 \log$ Field strength (uV/m)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

2.3 Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to DTS test procedure of KDB 558074 D01V05r02 for compliance to FCC 47CFR 15.247 requirements.

The EUT and its simulators are placed on a turn table which is 0.8 or 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

On any frequency or frequencies from 9 kHz (include The the lowest oscillator frequency generated within the device up to the 10th harmonic) to 1000 MHz, the limit shown are based on measuring equipment employing a quasi-peak detector function and on any frequency or frequencies above 1000 MHz the radiated limit shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurement are included emission measurement below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.

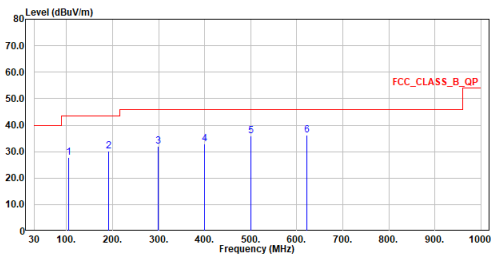
The bandwidth below 1 GHz setting on the field strength meter is 120 kHz and above 1 GHz is 1MHz.

2.4 Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

2.5 Test Result of Radiated Emissions (30 MHz ~ 1 GHz)

Site :CB2-H
Condition :3m Horizontal
Mode :BLE_2M_TX_2480MHz
Test by :Ling

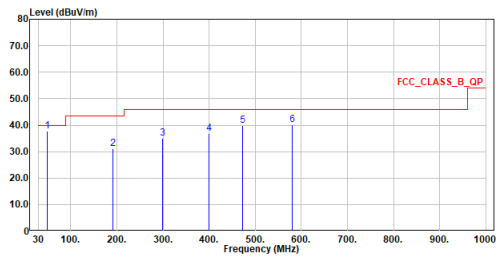


No.	Frequency MHz	Level dBuV/m	Limit Line dBuV/m	Over Limit dB	Read Level dBuV	Factor dB	Remark
1	104.690	27.75	43.50	-15.75	34.19	-6.44	QP
2	191.990	30.13	43.50	-13.37	35.57	-5.44	QP
3	299.660	31.86	46.00	-14.14	33.69	-1.83	QP
4	399.570	32.95	46.00	-13.05	32.14	0.81	QP
5	500.450	35.78	46.00	-10.22	32.54	3.24	QP
6	621.700	36.23	46.00	-9.77	30.06	6.17	QP

Note:

1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission under 30MHz was not included since the emission levels are very low against the limit.
5. The other emission levels were very low against the limit.

Site :CB2-H
Condition :3m Vertical
Mode :BLE_2M_TX_2480MHz
Test by :Ling



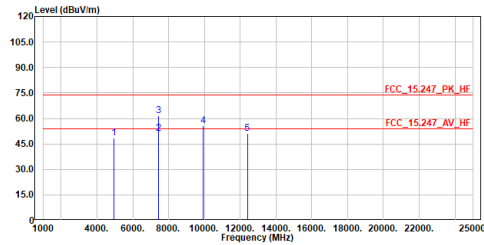
No.	Frequency MHz	Level dBuV/m	Limit Line dBuV/m	Over Limit dB	Read Level dBuV	Factor dB	Remark
1	49.400	37.71	40.00	-2.29	39.75	-2.04	QP
2	191.990	31.05	43.50	-12.45	36.49	-5.44	QP
3	299.660	34.98	46.00	-11.02	36.81	-1.83	QP
4	399.570	36.72	46.00	-9.28	35.91	0.81	QP
5	473.290	39.71	46.00	-6.29	36.83	2.88	QP
6	579.990	40.18	46.00	-5.82	35.17	5.01	QP

Note:

1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission under 30MHz was not included since the emission levels are very low against the limit.
5. The other emission levels were very low against the limit.

2.6 Test Result of Radiated Emissions (1 GHz ~ 10th Harmonic)

Site :CB2-H
Condition :3m Horizontal
Mode :BLE_2M_TX_2480MHz
Test by :Ling

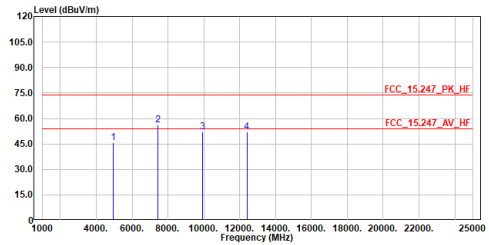


No.	Frequency	Level	Limit	Over	Read	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4960.000	48.35	74.00	-25.65	61.58	-13.23	Peak
2	7440.000	51.35	54.00	-2.65	55.79	-4.44	Average
3	7440.000	61.62	74.00	-12.38	66.06	-4.44	Peak
4	9920.000	55.79	74.00	-18.21	57.43	-1.64	Peak
5	12400.000	51.02	74.00	-22.98	50.44	0.58	Peak

Note:

1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

Site :CB2-H
Condition :3m Vertical
Mode :BLE_2M_TX_2480MHz
Test by :Ling



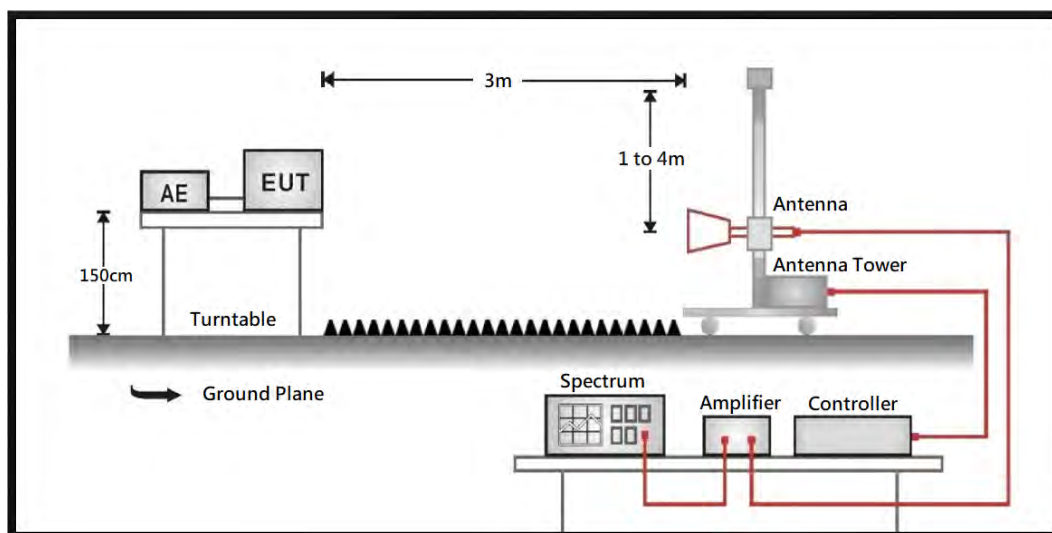
No.	Frequency	Level	Limit	Over	Read	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4960.000	45.07	74.00	-28.13	59.10	-13.23	Peak
2	7440.000	56.24	74.00	-17.76	60.68	-4.44	Peak
3	9920.000	52.00	74.00	-22.00	53.64	-1.64	Peak
4	12400.000	52.00	74.00	-22.00	51.42	0.58	Peak

Note:

1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

3. Radiated Emission Band Edge

3.1 Test Setup



3.2 Test Limit

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general radiated emission limit in paragraph 15.209, whichever is the lesser attenuation.

Frequency (MHz)	Field strength (uV/m)	Field strength (dBuV/m)	Measurement distance (m)
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

Remarks:

1. Field strength (dBuV/m) = 20 log Field strength (uV/m)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

3.3 Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to FHSS test procedure of FCC KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247 requirements.

The EUT and its simulators are placed on a turn table which is 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

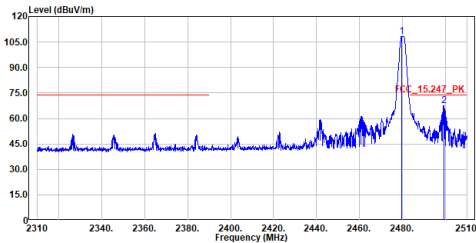
Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

3.4 Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

3.5 Test Result of Radiated Emission Band Edge

Site :CB2-H
Condition :3m Horizontal
Mode :BLE_2M_TX_2480MHz
Test by :Ling

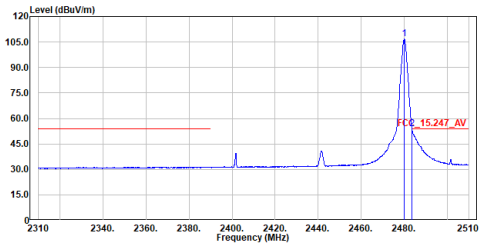


No.	Frequency	Level	Limit	Over	Read	Factor	Remark
	MHz	dBuV/m	Line	Limit	Level	dB	
1	2479.600	100.40	-----	-----	94.36	14.04	Peak
2	2499.200	67.58	74.00	-6.42	53.41	14.17	Peak

Note:

1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

Site :CB2-H
Condition :3m Horizontal
Mode :BLE_2M_TX_2480MHz
Test by :Ling

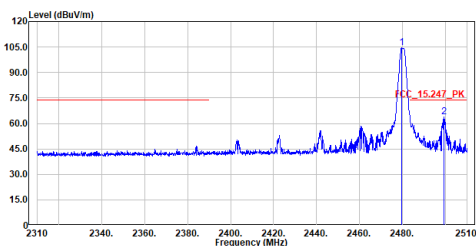


No.	Frequency	Level	Limit	Over	Read	Factor	Remark
	MHz	dBuV/m	Line	Limit	Level	dB	
1	2480.000	106.76	-----	-----	92.72	14.04	Average
2	2483.600	53.91	54.00	-0.09	39.84	14.07	Average

Note:

1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

Site :CB2-H
Condition :3m Vertical
Mode :BLE_2M_TX_2480MHz
Test by :Ling

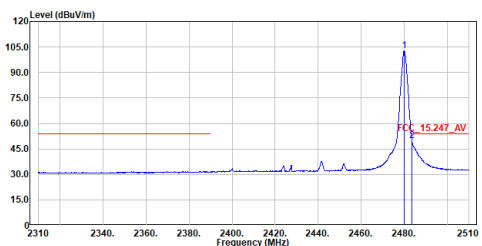


No.	Frequency	Level	Limit	Over	Read	Factor	Remark
	MHz	dBuV/m	Line	Limit	Level	dB	
1	2479.600	104.38	-----	-----	90.34	14.04	Peak
2	2499.300	63.80	74.00	-10.20	49.63	14.17	Peak

Note:

1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

Site :CB2-H
Condition :3m Vertical
Mode :BLE_2M_TX_2480MHz
Test by :Ling



No.	Frequency	Level	Limit	Over	Read	Factor	Remark
	MHz	dBuV/m	Line	Limit	Level	dB	
1	2480.000	102.69	-----	-----	88.65	14.04	Average
2	2483.600	49.87	54.00	-4.13	35.80	14.07	Average

Note:

1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.