Prüfbericht-Nr.: *Test report no.:*	CN21OHKJ(P15C-BLE) 001	**Auftrags-Nr.:** *Order no.:*	238519484	
Kunden-Referenz-Nr.: *Client reference no.:*	N/A	**Auftragsdatum:** *Order date:*	2021-08-30	
Auftraggeber: *Client:*	Sandbox Smart Technology Co.,Ltd. 15F.-4, No. 2, Jian 8th Rd., Zhonghe Dist., New Taipei City 235, Taiwan			
Prüfgegenstand: *Test item:*	Sandbox Smart R2 Roaster			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	Sandbox Smart R2			
Auftrags-Inhalt: *Order content:*	FCC Part 15C Test report (BLE)			
Prüfgrundlage: *Test specification:*	FCC 47CFR Part 15: Subpart C Section 15.247			
Wareneingangsdatum: *Date of sample receipt:*	2021-08-31			
Prüfmuster-Nr.: *Test sample no:*	A003120395-003			
Prüfzeitraum: *Testing period:*	2021-09-07 - 2021-09-10			
Ort der Prüfung: *Place of testing:*	EMC/RF Taipei Testing Site			
Prüflaboratorium: *Testing laboratory:*	Taipei Testing Laboratories			
Prüfergebnis*: *Test result*:*	Pass			

überprüft von: *compiled by:*		**genehmigt von:** authorized by:	
Datum: *Date:* 2021-09-17		**Ausstellungsdatum:** *Issue date:* 2021-09-17	
Stellung / *Position:*	Ryan Chen Senior Project Manager	**Stellung** / *Position:*	Brenda Chen Senior Project Manager

Sonstiges / *Other:*

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.
V05

TEST SUMMARY

Report Section	FCC Clause	Test Item	Result
5.1.1	15.247(b) & 15.203	Antenna Requirement	Pass
5.1.2	15.247(b)(3)	Peak Output Power	Pass
5.1.3	15.247(a)(2)	6 dB Bandwidth	Pass
5.1.3	2.1049	99% Occupied Bandwidth	Pass
5.1.4	15.247(e)	Power Spectral Density	Pass
5.1.5	15.247(d)	Conducted Spurious Emissions and Band Edges	Pass
5.1.6	15.247(d) & 15.205 & 15.209	Radiated Spurious Emissions and Band Edges	Pass
5.2.1	15.207	Mains Conducted Emission	Pass

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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APPENDIX A - TEST RESULT OF CONDUCTED

APPENDIX B - TEST RESULT OF RADIATED EMISSIONS & MAINS CONDUCTED EMISSION

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APPENDIX EP - PHOTOGRAPHS OF EUT

HISTORY OF THIS TEST REPORT

Report No.	Description	Date Issued
CN21OHKJ(P15C-BLE) 001	Original Release	2021-09-17

1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:
Appendix A - Test Result of Conducted
Appendix B - Test Result of Radiated Emissions & Mains Conducted Emission
Appendix SP - Photographs of Test Setup
Appendix EP - Photographs of EUT

Applied Standard and Test Levels

Radio
FCC 47CFR Part 15: Subpart C Section 15.247 FCC 47CFR Part 2: Subpart J Section 2.1049 ANSI C63.10:2013 KDB 558074 D01 15.247 Meas Guidance v05r02

1.2 Decision Rule of Conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

2. Test Sites

2.1 Test Laboratory

Taipei Testing Laboratories

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

2.2 Test Facility

Taipei Testing Laboratories

No.458-18, Sec. 2, Fenliao Rd., Linkou Dist.,
New Taipei City 244
Taiwan (R.O.C.)
FCC Registration No.: 226631
ISED Registration No.: 25563

2.3 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular basics using in house standards or comparisons.

2.5 Measurement Uncertainty

All measurement uncertainty values are shown with a coverage factor of k=2 to indicate a 95% level of confidence.

Emission Measurement Uncertainty

Parameter	Uncertainty
Radiated Emission (9 kHz ~ 30 MHz)	± 1.15 dB
Radiated Emission (30 MHz ~ 200 MHz)	± 1.32 dB
Radiated Emission (200 MHz ~ 1 GHz)	± 1.31 dB
Radiated Emission (1 GHz ~ 18 GHz)	± 1.53 dB
Radiated Emission (18 GHz ~ 40 GHz)	± 2.50 dB
Mains Conducted Emission	± 1.65 dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Sandbox Smart R2 Roaster. It contains a Bluetooth compatible module enabling the user to communicate data through a Wireless interface.
For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Sandbox Smart R2 Roaster
Type Identification	Sandbox Smart R2
FCC ID	2AW85384R2A

Technical Specification of EUT

Item	EUT information
Operating Frequency	2402 MHz ~ 2480 MHz
Channel Spacing	2 MHz
Channel Number	40
Data Rate	1Mbps
Operation Voltage	120Vac (Tested at 5Vdc (USB))
Modulation	GFSK
Maximum Output Power (mW)	2.06
Antenna Information	Refer to 5.1.1
Accessory Device	Refer to 4.4

Note:
1. All models are listed as below.

Type Identification	Appearence Color	Difference
Sandbox Smart R2	White	All models are electrically identical, different colors are for the marketing purpose.
	Black	

3.3 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.4 Submitted Documents

- Circuit Diagram
- Instruction Manual
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The test modes were adapted accordingly in reference to the instructions for use.
During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output expected by the customer and is going to be fixed on the firmware of the final end product.

Table for Parameters of Test Software Setting

Frequency (MHz)	Power Setting
2402	Default
2440	Default
2480	Default

4.2 Carrier Frequency and Channel

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

4.3 Test Operation and Test Software

Setup for testing: Test samples are provided with a USB interface which makes it possible to control them through a test software installed on a notebook computer.
This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed as below.

Test Software	RTL8762C_RFTestTool_v1.0.0.8

The samples were used as follows:
A003120395-003 for radiate and conducted tests
Full test was applied on all test modes, but only worst case was shown.

EUT Configure Mode	Applicable To				Description
	Antenna Port Conducted Measurement	Radiated Spurious Emissions above 1 GHz	Radiated Spurious Emissions below 1 GHz	Mains Conducted Emission	
-	√	√	√	√	-

Note:
1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when position on Y-plane.
2. "-" means no effect.

Antenna Port Conducted Measurement

☒ Pre-Scan full test was applied on all test modes, but only worst case was shown.
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)	Date Rate (Mbps)
-	2402 to 2480	2402, 2440, 2480	1

Radiated Spurious Emissions (Above 1 GHz)

☒ Pre-Scan full test was applied on all test modes, but only worst case was shown.
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)	Date Rate (Mbps)
Tx			
-	2402 to 2480	2402, 2440, 2480	1

Radiated Spurious Emissions (Below 1 GHz)

☒ Pre-Scan full test was applied on all test modes, but only worst case was shown.
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)	Date Rate (Mbps)
-	2402 to 2480	2440	1

Mains Conducted Emission

☒ Pre-Scan full test was applied on all test modes, but only worst case was shown.
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)	Date Rate (Mbps)
-	2402 to 2480	2440	1

Test Condition

Test Item	Ambient Temperature	Relative Humidity	Tested by
Conducted Measurement	24.2 °C	62 %	Stanislas Charles
Radiated Spurious Emissions above 1 GHz	23.6-24.1 °C	61.3-62.5 %	Simon Tsai
Radiated Spurious Emissions below 1 GHz	23.6-24.1 °C	61.3-62.5 %	Simon Tsai
Mains Conducted Emission	21.9 °C	59 %	Simon Tsai

4.4 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

Accessory of EUT

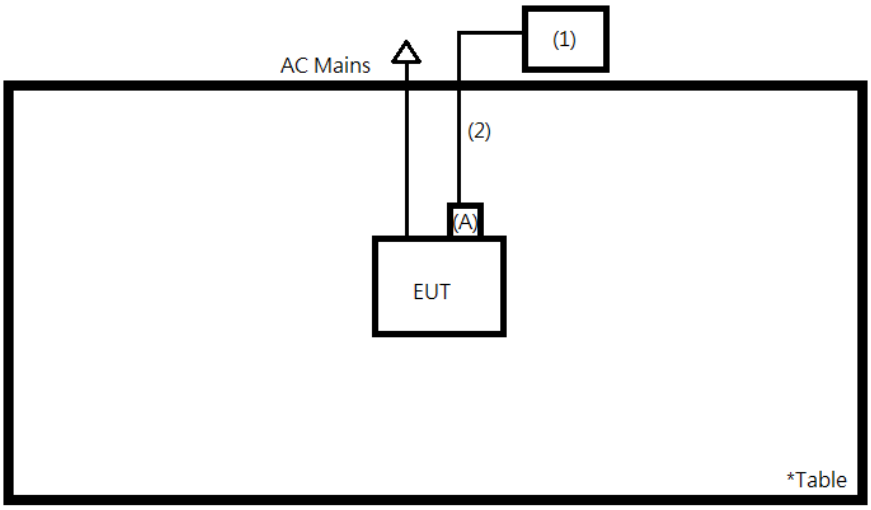
No.	Product	Brand	Model	Description
-	電源插頭 (AC Power Cable)	琪嘉電子 (GANGQI-GRP)	SY-12	-

Support Unit

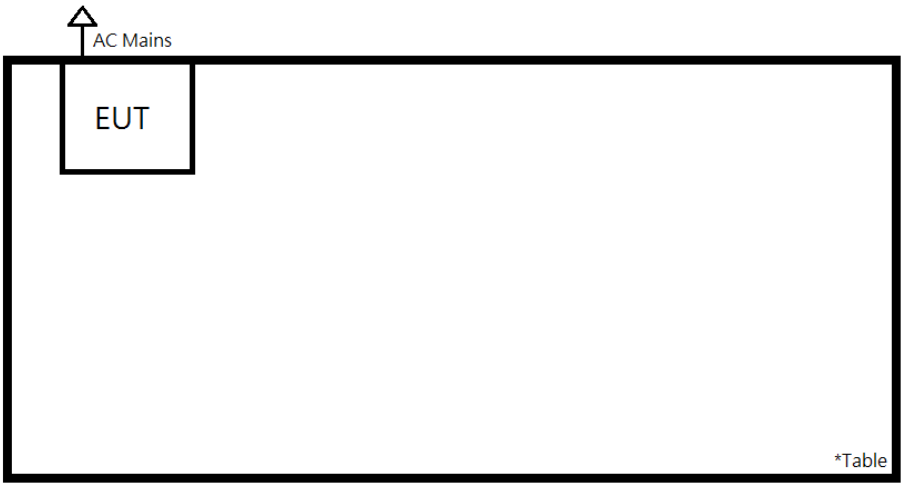
No.	Description	Brand	Model	S/N	Remark
Radiated Test					
A	UART	Sandbox	CP2102	-	-
1	Notebook	HP	15s-du0007TX	CND93662VF	-
2	USB Cable	Pro-Best	MK-USBMF-3M	-	300 m shielded cable with core
Conducted Test					
-	Notebook	HP	TPN-C139	CND93662WT	-
-	Power Supply	PeakTech	2250	188	-

4.5 Test Setup Diagram

<Radiated Spurious Emissions mode>



<Mains Conducted Emission mode>



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

Requirement Use of approved antennas only

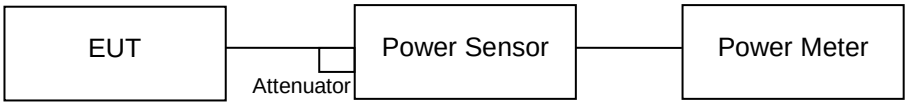
According to the manufacturer declaration, the EUT has an antenna with a directional gain of 0.64 dBi. The antenna is a PCB antenna with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.
Refer to EUT photo for details.

5.1.2 Peak Output Power

Limit 1 watt (30 dBm)

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Power Meter	Anritsu	ML2495A	1901008	2021/3/24	2022/3/23	2021/9/10	2021/9/10
Power Sensor	Anritsu	MA2411B	1725269	2021/3/24	2022/3/23	2021/9/10	2021/9/10

Test Procedures

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst.
Duty factor is not added to measured value.

Test Result

Peak Output Power

<1Mbps>

Channel	Channel Frequency	Peak Output Power		Limit (dBm)
	(MHz)	(dBm)	(mW)	
Low Channel	2402	2.26	1.68	30
Middle Channel	2440	2.64	1.84	30
High Channel	2480	3.13	2.06	30

Average Power

<1Mbps>

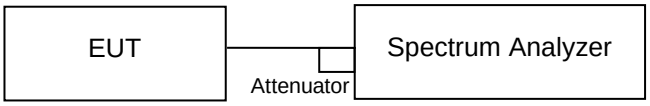
Channel	Channel Frequency	Average Power	
	(MHz)	(dBm)	(mW)
Low Channel	2402	2.12	1.63
Middle Channel	2440	2.53	1.79
High Channel	2480	3.05	2.02

5.1.3 6 dB Bandwidth and 99% Occupied Bandwidth

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

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV40	101512	2021/1/29	2022/1/28	2021/9/10	2021/9/10

Test Procedure

a. Set resolution bandwidth (RBW) = 100 kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.
f. For 99% occupied bandwidth measurement, the transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean power of a given emission.

Test Results

Please refer to Appendix A.

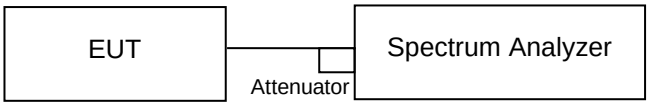
5.1.4 Power Spectral Density

Limit

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

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV40	101512	2021/1/29	2022/1/28	2021/9/10	2021/9/10

Test Procedure

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ 3 × RBW.
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.

Test Results

Please refer to Appendix A.

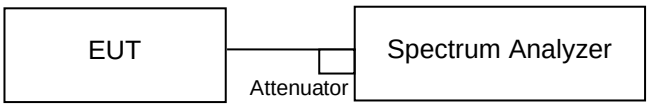
5.1.5 Conducted Spurious Emissions and Frequency Band Edges Measured in 100kHz Bandwidth

Limit

20 dB (below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.)

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV40	101512	2021/1/29	2022/1/28	2021/9/10	2021/9/10

Test Procedure

Measurement procedure REF
1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement procedure OOBE
1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

Test Results

Please refer to Appendix A.

5.1.6 Radiated Spurious Emissions and Band Edges

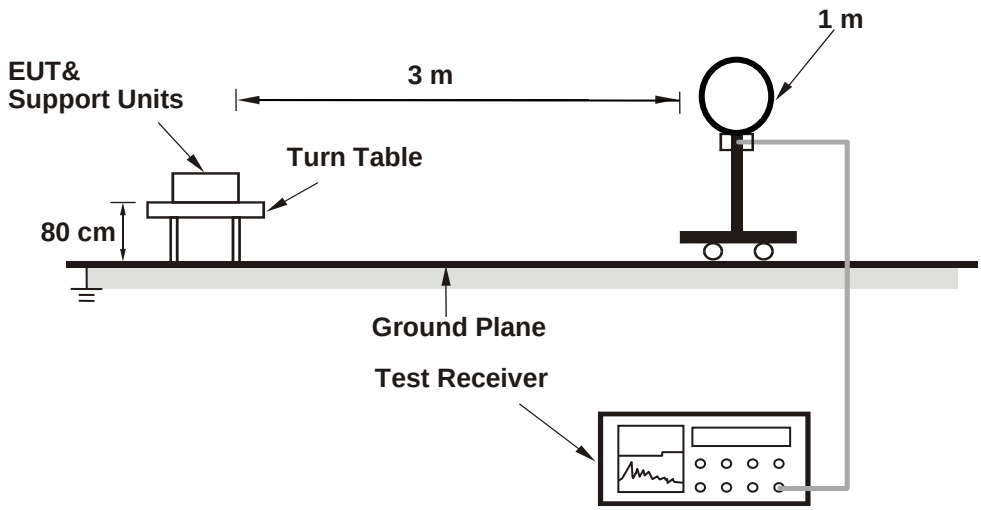
Limit

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).
Emissions radiated outside the restricted and authorized frequency bands must either comply with the radiated emission limits specified for the restricted bands or in §15.247(d).

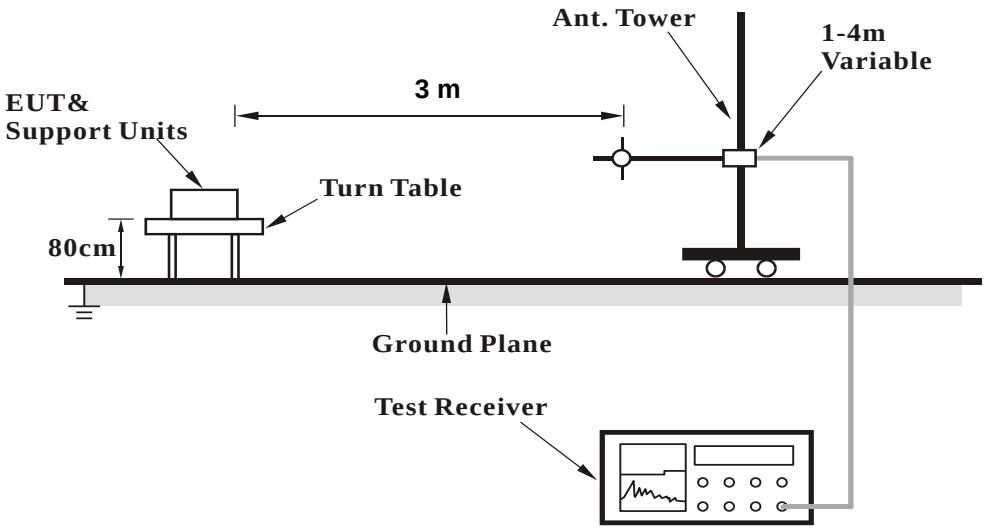
Kind of Test Site 3m Semi-Anechoic Chamber

Test Setup

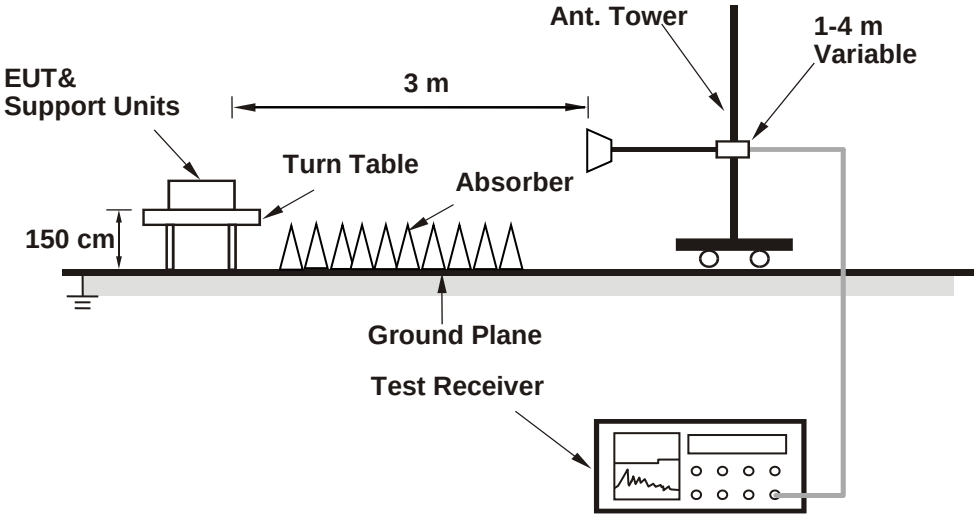
<Radiated Emissions below 30 MHz>



<Radiated Emissions 30 MHz to 1 GHz>



<Radiated Emissions above 1 GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date
Signal Analyzer	R&S	FSV40	101509	2021/3/24	2022/3/23
Receiver	R&S	ESR7	102108	2021/3/17	2022/3/16
Bilog Antenna	SCHWARZBECK	VULB-9168	00950	2021/1/25	2022/1/24
Horn Antenna	ETS-Lindgren	3117	00218929	2020/11/6	2021/11/5
LF-AMP	Agilent	8447D	2727A05146	2021/2/1	2022/1/31
HF-AMP + AC source	EMCI	EMC051845SE	980635	2021/2/1	2022/1/31
HF-AMP + AC source	EMCI	EMC184045SE	980656	2021/2/9	2022/2/8
Horn Antenna	SCHWARZBECK	BBHA 9170	00890	2021/4/14	2022/4/13
Microwave Cable	HUBER+SUHNER	SUCOFLEX 104EA	800057/4EA	2021/4/14	2022/4/13
Microwave Cable	HUBER+SUHNER	SUCOFLEX 104	802244/4	2021/4/14	2022/4/13
Microwave Cable	HUBER+SUHNER	SUCOFLEX 104	MY37203/4	2021/4/14	2022/4/13
Microwave Cable	HUBER+SUHNER	SUCOFLEX 102EA	800897/2EA	2021/3/11	2022/3/10
Microwave Cable	HUBER+SUHNER	SUCOFLEX 102EA	800902/2EA	2021/3/11	2022/3/10
Microwave Cable	HUBER+SUHNER	SUCOFLEX 102EA	801026/2EA	2021/3/11	2022/3/10
Loop Antenna	SCHWARZBECK	FMZB1519B	00215	2020/9/17	2021/9/15

Test Procedures

For Radiated Emissions below 30 MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. Parallel (OPEN), perpendicular (CLOSE), and ground-parallel (GROUND) orientations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30 MHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated Emissions above 30 MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna 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.
d. 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 and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98 %) or 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The Radiated Emissions testing was performed in the X(E1), Y(H) and Z(E2) axis orientation. The worst-case Axis orientation is recorded in this test report.

Test Results

Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
Level (dBuV/m) = Reading (dBuV) + Factor (dB/m)

Please refer to Appendix B.

5.2 Mains Emission

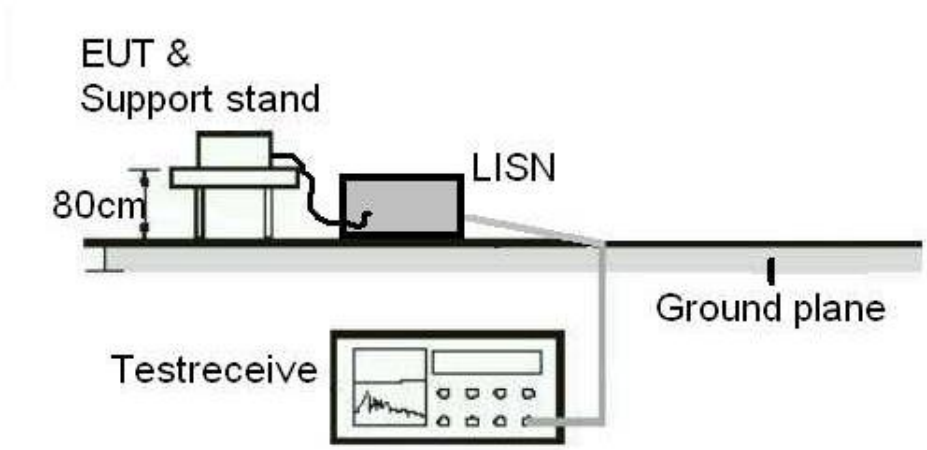
5.2.1 Mains Conducted Emission

Limit

Mains Conducted Emission as defined in §15.207 must comply with the mains conducted emission limits.

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date
TWO-LINE V-NETWORK	R&S	ENV216	1816064	2020/9/10	2021/9/9
EMI Test Receiver	R&S	ESCI	1816063	2020/11/17	2021/11/16
RF Cable	N/A	N/A	EMC-003	2020/11/15	2021/11/14

Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.

Test Results

Please refer to Appendix B.

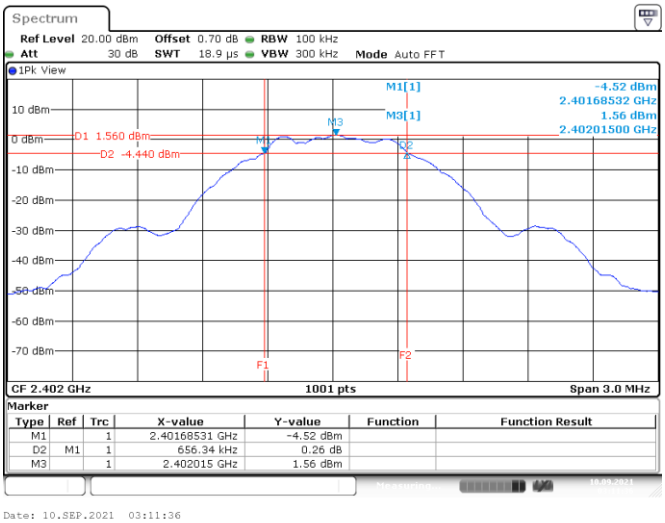
Appendix A: Test Results of Conducted Test

Test Result of 6 dB Bandwidth

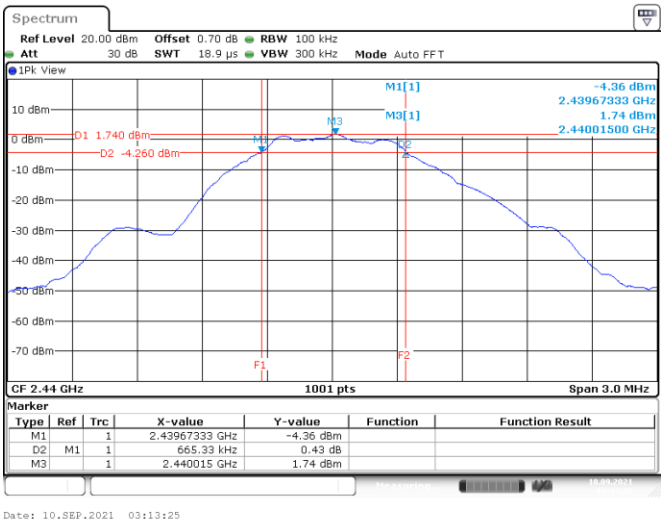
BLE_1M

Channel	Channel Frequency (MHz)	6 dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	656.34	> 500	Pass
Middle Channel	2440	665.33	> 500	Pass
High Channel	2480	731.27	> 500	Pass

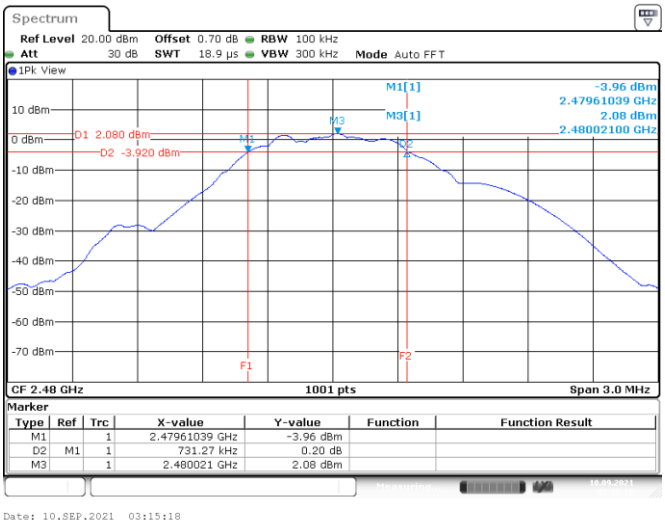
Low Channel



Middle Channel



High Channel

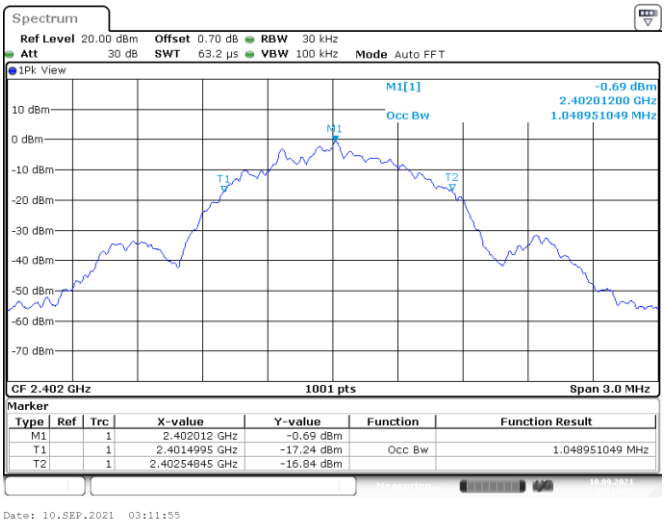


Test Result of 99% Occupied Bandwidth

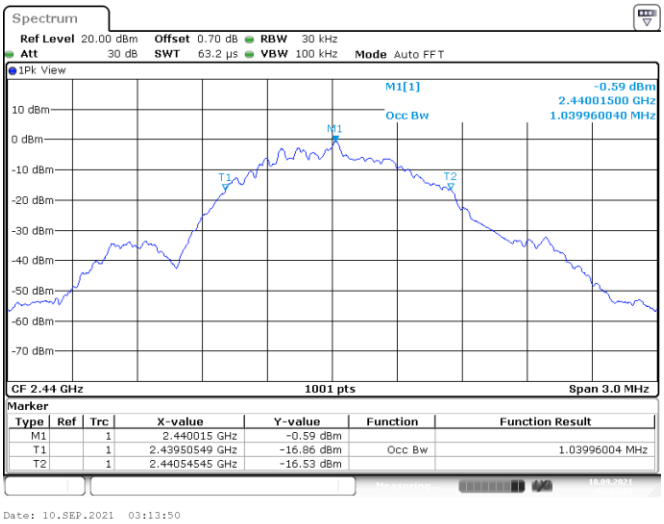
BLE_1M

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Low Channel	2402	1.05
Middle Channel	2440	1.04
High Channel	2480	1.08

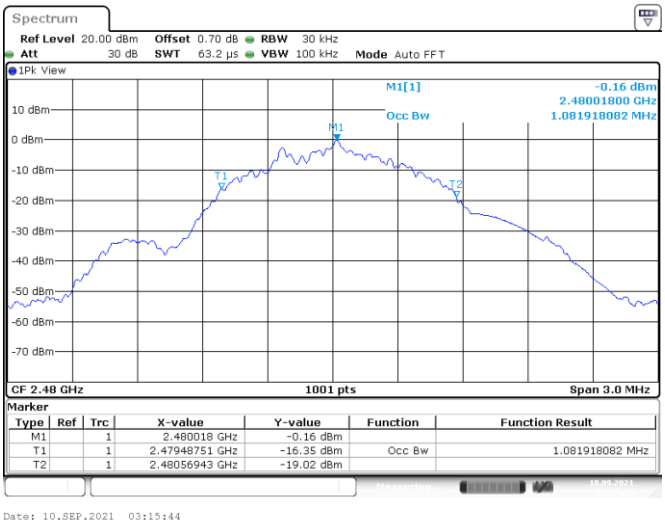
Low Channel



Middle Channel



High Channel

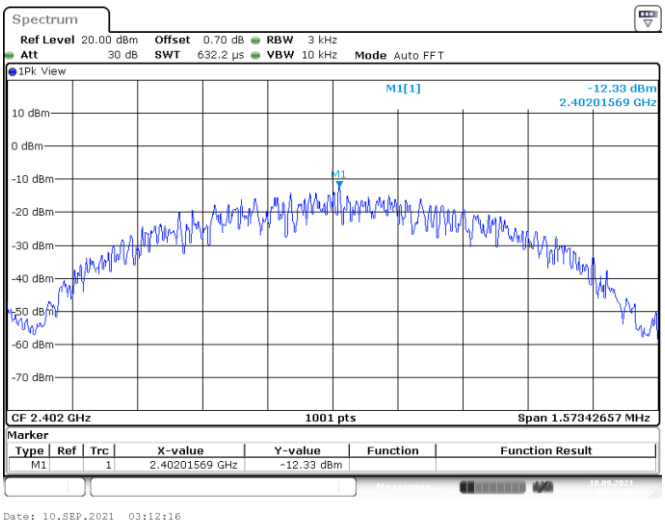


Test Result of Power Spectral Density

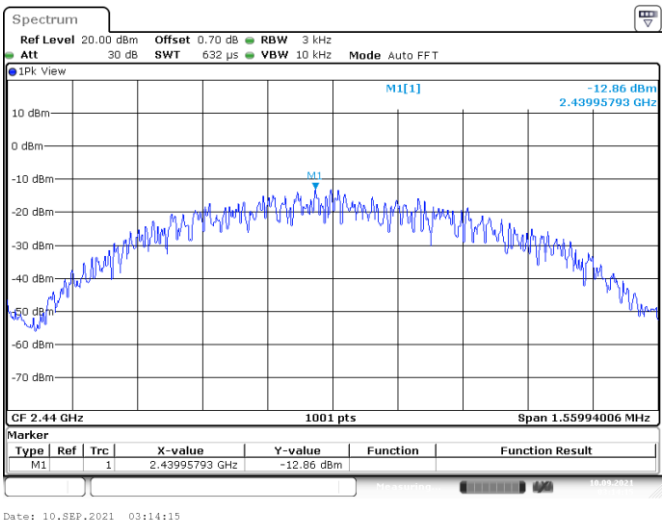
BLE_1M

Channel	Channel Frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
Low Channel	2402	-12.33	8	Pass
Middle Channel	2440	-12.86	8	Pass
High Channel	2480	-13.06	8	Pass

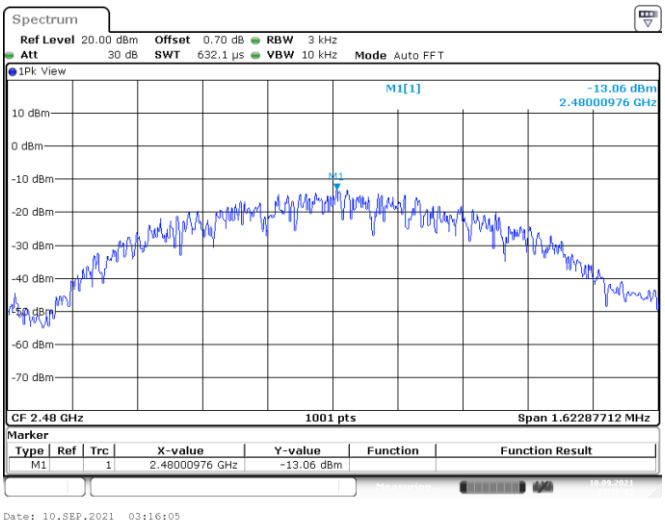
Low Channel



Middle Channel

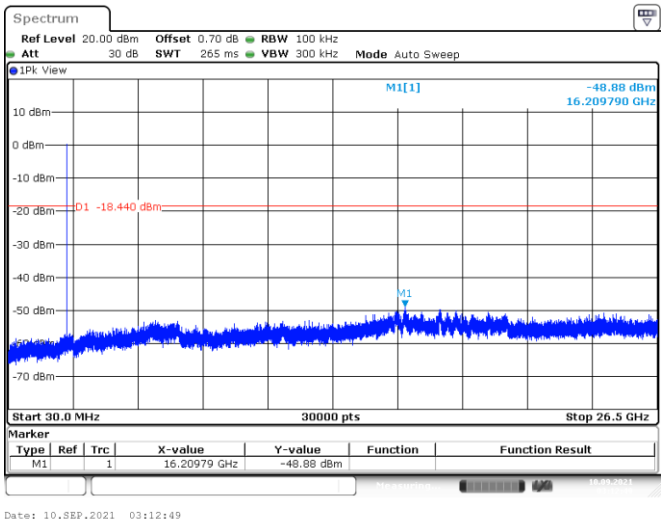
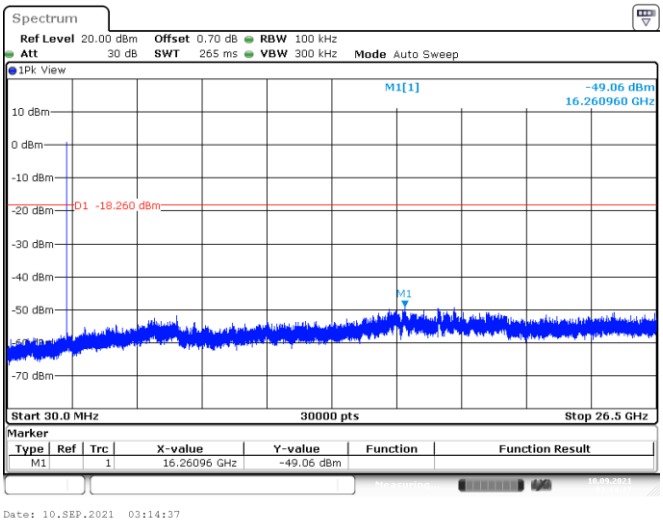
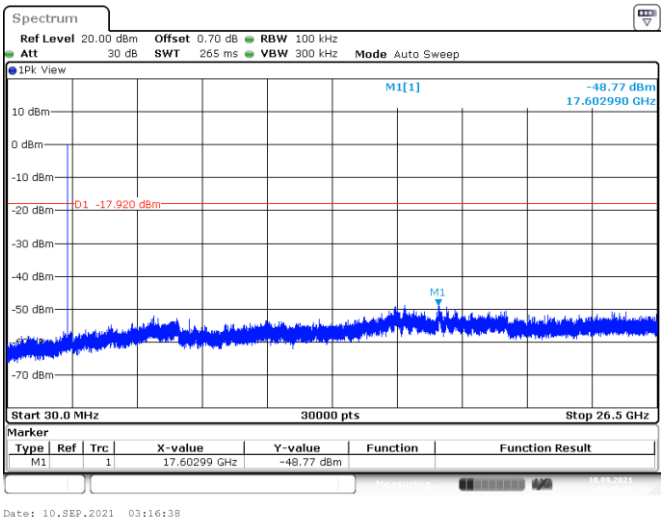


High Channel



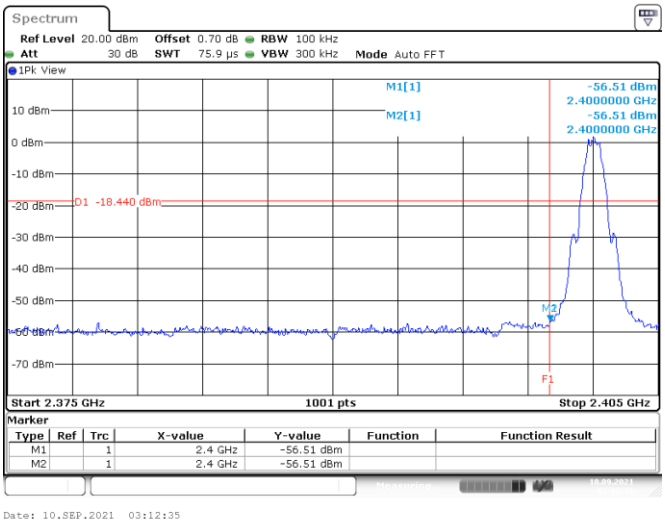
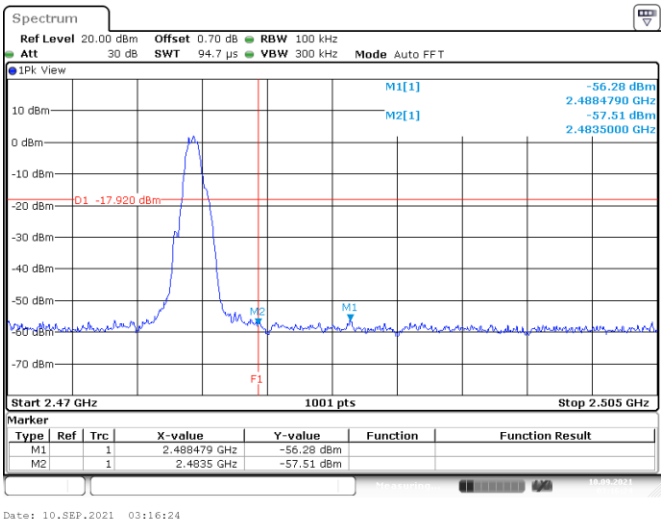
Test Result of Conducted Spurious Emissions, Tx Mode

BLE_1M

Low Channel	Middle Channel
	
High Channel	
	

Test Result of Conducted Band Edge, Tx Mode

BLE_1M

Low Channel	High Channel
	

Appendix B: Test Results of Radiated Spurious Emissions & Mains

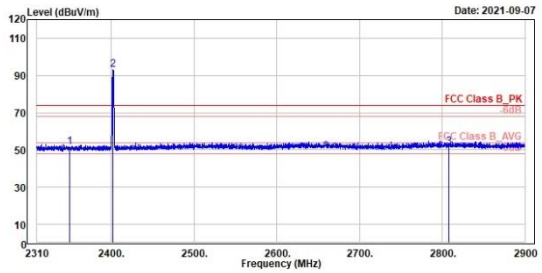
Conducted Emission Test

Band Edges, 2.31GHz ~ 2.9GHz

BLE_1M

Low Channel (Horizontal) Peak

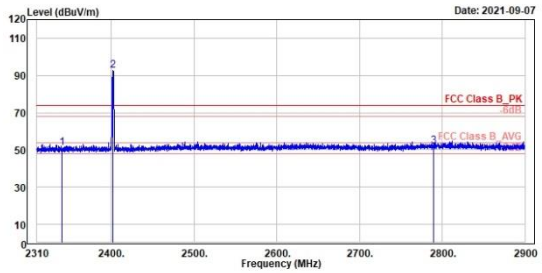
TÜV Rheinland Taiwan Ltd.
No. 458-18,Sec 2,Fenliao.,Linkou Dist.,New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2349.93	51.43	14.17	37.26	74.00	-22.57	135	300	Peak	Horizontal	
2 *	2402.00	93.03	55.71	37.32	74.00	19.03	135	300	Peak	Horizontal	
3	2808.36	51.73	13.54	38.19	74.00	-22.27	135	300	Peak	Horizontal	

Low Channel (Vertical) Peak

TÜV Rheinland Taiwan Ltd.
No. 458-18,Sec 2,Fenliao.,Linkou Dist.,New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2340.04	50.97	13.79	37.18	74.00	-23.03	100	54	Peak	Vertical	
2 *	2402.00	92.63	55.31	37.32	74.00	18.63	100	54	Peak	Vertical	
3	2789.99	52.01	13.86	38.15	74.00	-21.99	100	54	Peak	Vertical	

BLE_1M

Low Channel (Horizontal) Average

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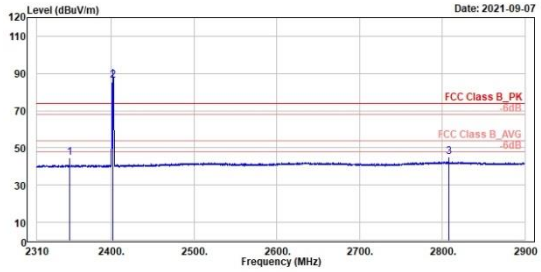
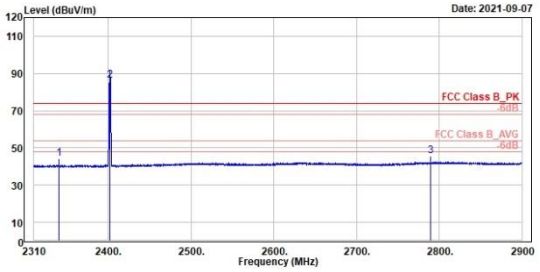
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2349.93	44.85	7.59	37.26	54.00	-9.15	135	300	Average	Horizontal	CF
2 *	2402.00	86.45	49.13	37.32	54.00	32.45	135	300	Average	Horizontal	CF
3	2808.36	45.15	6.96	38.19	54.00	-8.85	135	300	Average	Horizontal	CF

Low Channel (Vertical) Average

TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2340.04	44.38	7.20	37.18	54.00	-9.62	100	54	Average	Vertical	CF
2 *	2402.00	86.05	48.73	37.32	54.00	32.05	100	54	Average	Vertical	CF
3	2789.99	45.43	7.28	38.15	54.00	-8.57	100	54	Average	Vertical	CF

BLE_1M

High Channel (Horizontal) Peak

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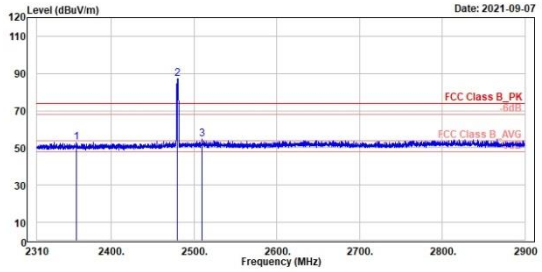
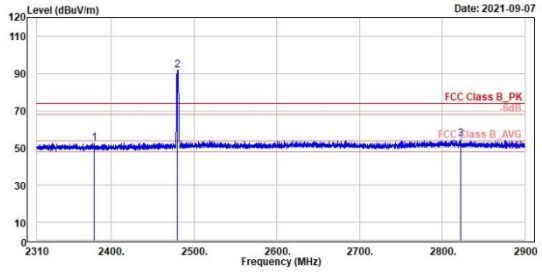
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2357.70	53.06	15.80	37.26	74.00	-20.94	232	302	Peak	Horizontal	
2 *	2480.00	87.15	49.46	37.69	74.00	13.15	232	302	Peak	Horizontal	
3	2509.53	54.71	16.87	37.84	74.00	-19.29	232	302	Peak	Horizontal	

High Channel (Vertical) Peak

TUV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2379.02	52.65	15.36	37.29	74.00	-21.35	142	59	Peak	Vertical	
2 *	2480.00	91.85	54.16	37.69	74.00	17.85	142	59	Peak	Vertical	
3	2822.61	54.72	16.52	38.20	74.00	-19.28	142	59	Peak	Vertical	

BLE_1M

High Channel (Horizontal) Average

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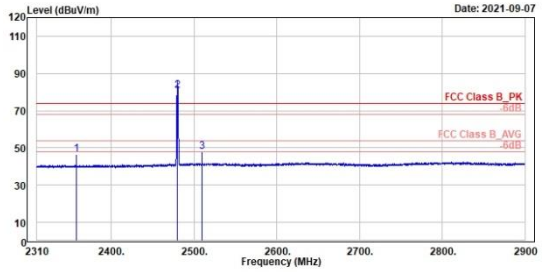
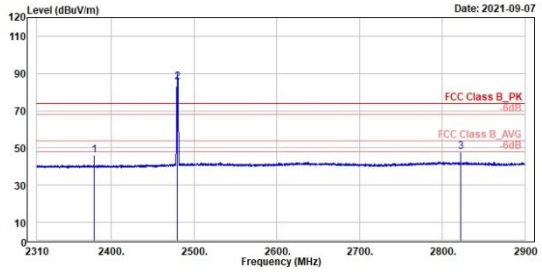
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2357.70	46.47	9.21	37.26	54.00	-7.53	232	302	Average	Horizontal	CF
2 *	2480.00	80.57	42.88	37.69	54.00	26.57	232	302	Average	Horizontal	CF
3 !	2509.53	48.12	10.28	37.84	54.00	-5.88	232	302	Average	Horizontal	CF

High Channel (Vertical) Average

TUV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2379.02	46.07	8.78	37.29	54.00	-7.93	142	59	Average	Vertical	CF
2 *	2480.00	85.27	47.58	37.69	54.00	31.27	142	59	Average	Vertical	CF
3 !	2822.61	48.13	9.93	38.20	54.00	-5.87	142	59	Average	Vertical	CF

Spurious Emissions, Tx Mode, 9kHz ~ 30MHz

BLE_1M

Middle Channel (Open) 9kHz~150kHz

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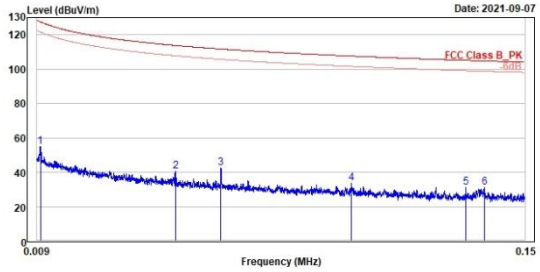
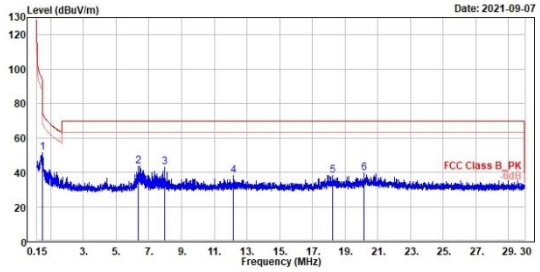
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	0.01	54.97	35.03	19.94	127.60	-72.63	100	45	QP	Open	
2	0.05	40.54	20.27	20.27	113.77	-73.23	100	206	QP	Open	
3	0.06	42.62	22.37	20.25	111.72	-69.10	100	64	QP	Open	
4	0.10	33.46	13.26	20.20	107.61	-74.15	100	142	QP	Open	
5	0.13	30.97	10.80	20.17	105.12	-74.15	100	184	QP	Open	
6	0.14	30.93	10.77	20.16	104.78	-73.85	100	202	QP	Open	

Middle Channel (Open) 150kHz~30MHz

TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322

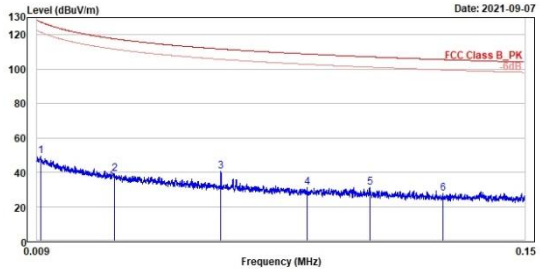


	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	0.48	51.57	31.49	20.08	93.95	-42.38	100	199	QP	Open	
2	6.36	43.72	23.44	20.28	69.50	-25.78	100	38	QP	Open	
3	7.95	43.00	22.66	20.34	69.50	-26.50	100	191	QP	Open	
4	12.16	38.16	17.65	20.51	69.50	-31.34	100	12	QP	Open	
5	18.26	38.24	17.62	20.62	69.50	-31.26	100	321	QP	Open	
6	20.15	39.33	18.69	20.64	69.50	-30.17	100	97	QP	Open	

BLE_1M

Middle Channel (Close) 9kHz~150kHz

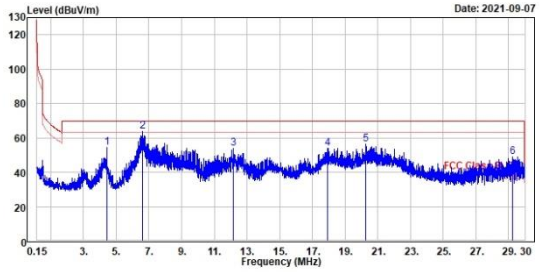
TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	0.01	49.29	29.35	19.94	127.54	-78.25	100	294	QP	Close	
2	0.03	38.93	18.64	20.29	117.65	-78.72	100	56	QP	Close	
3	0.06	40.50	20.25	20.25	111.72	-71.22	100	11	QP	Close	
4	0.09	30.92	10.71	20.21	108.79	-77.87	100	223	QP	Close	
5	0.11	31.03	10.84	20.19	107.16	-76.13	100	213	QP	Close	
6	0.13	27.54	7.37	20.17	105.57	-78.03	100	311	QP	Close	

Middle Channel (Close) 150kHz~30MHz

TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



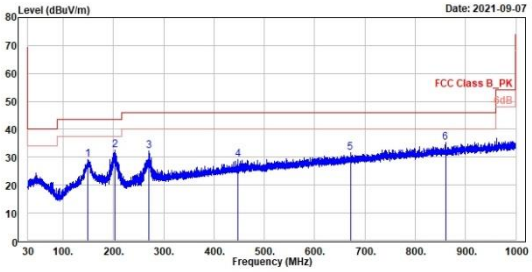
	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4.43	54.20	33.95	20.25	69.50	-15.30	100	51	QP	Close	
2 !	6.63	63.91	43.61	20.30	69.50	-5.59	100	43	QP	Close	
3	12.16	53.69	33.18	20.51	69.50	-15.81	100	306	QP	Close	
4	17.96	54.11	33.49	20.62	69.50	-15.39	100	316	QP	Close	
5	20.27	56.51	35.87	20.64	69.50	-12.99	100	83	QP	Close	
6	29.24	48.72	27.98	20.74	69.50	-20.78	100	143	QP	Close	

Spurious Emissions, Tx Mode, 30MHz ~ 1GHz

BLE_1M

Middle Channel (Horizontal)

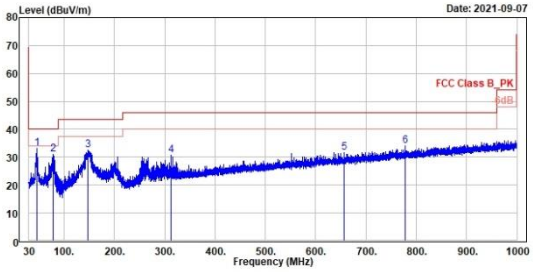
TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	148.92	29.10	34.96	-5.86	43.50	-14.40	200	153	QP	Horizontal	
2	202.56	32.43	40.56	-8.13	43.50	-11.07	200	202	QP	Horizontal	
3	269.69	32.11	37.83	-5.72	46.00	-13.89	200	176	QP	Horizontal	
4	447.78	29.14	31.13	-1.99	46.00	-16.86	200	83	QP	Horizontal	
5	671.07	31.73	30.50	1.23	46.00	-14.27	400	289	QP	Horizontal	
6	860.03	35.29	31.03	4.26	46.00	-10.71	300	258	QP	Horizontal	

Middle Channel (Vertical)

TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



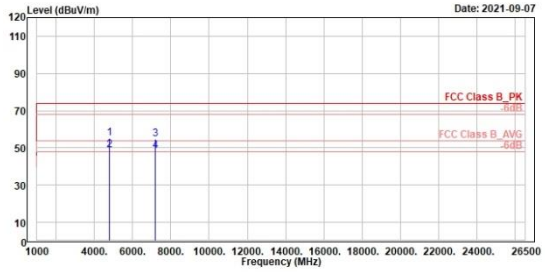
	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	46.68	33.07	38.78	-5.71	40.00	-6.93	100	166	QP	Vertical	
2	77.82	31.05	41.02	-9.97	40.00	-8.95	100	274	QP	Vertical	
3	147.47	32.60	38.43	-5.83	43.50	-10.90	100	336	QP	Vertical	
4	312.46	30.85	35.24	-4.39	46.00	-15.15	100	288	QP	Vertical	
5	656.43	31.58	30.57	1.01	46.00	-14.42	128	360	QP	Vertical	
6	778.16	34.16	31.03	3.13	46.00	-11.84	200	169	QP	Vertical	

Spurious Emissions, Tx Mode, 1GHz ~ 26.5GHz

BLE_1M

Low Channel (Horizontal)

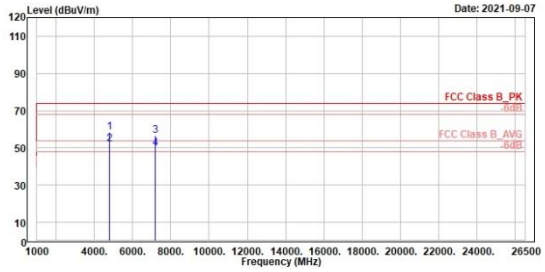
TUV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4804.00	55.42	64.83	-9.41	74.00	-18.58	100	160	Peak	Horizontal	
2 !	4804.00	48.84	58.25	-9.41	54.00	-5.16	100	160	Average	Horizontal	CF
3	7206.00	54.77	61.41	-6.64	73.03	-18.26	293	327	Peak	Horizontal	
4	7206.00	48.19	54.83	-6.64	66.45	-18.26	293	327	Average	Horizontal	CF

Low Channel (Vertical)

TUV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4804.00	58.48	67.89	-9.41	74.00	-15.52	100	191	Peak	Vertical	
2 !	4804.00	51.90	61.31	-9.41	54.00	-2.10	100	191	Average	Vertical	CF
3	7206.00	56.40	63.04	-6.64	72.63	-16.23	198	357	Peak	Vertical	
4	7206.00	49.82	56.46	-6.64	66.05	-16.23	198	357	Average	Vertical	CF

BLE_1M

Middle Channel (Horizontal)

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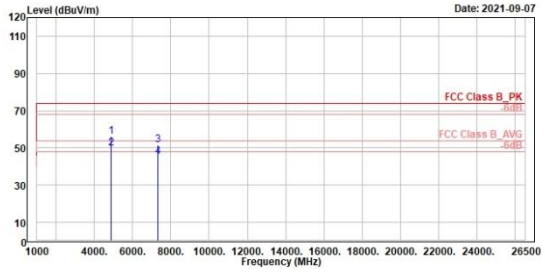
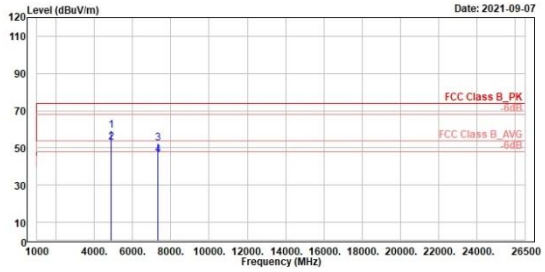
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4880.00	56.26	65.62	-9.36	74.00	-17.74	400	123	Peak	Horizontal	
2 !	4880.00	49.69	59.05	-9.36	54.00	-4.31	400	123	Average	Horizontal	CF
3	7320.00	51.72	58.35	-6.63	74.00	-22.28	320	337	Peak	Horizontal	
4	7320.00	45.11	51.74	-6.63	54.00	-8.89	320	337	Average	Horizontal	CF

Middle Channel (Vertical)

TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322

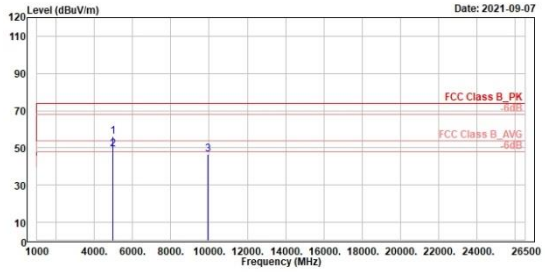


	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4880.00	59.52	68.88	-9.36	74.00	-14.48	138	184	Peak	Vertical	
2 !	4880.00	52.82	62.18	-9.36	54.00	-1.18	138	184	Average	Vertical	CF
3	7320.00	52.62	59.25	-6.63	74.00	-21.38	182	11	Peak	Vertical	
4	7320.00	45.92	52.55	-6.63	54.00	-8.08	182	11	Average	Vertical	CF

BLE_1M

High Channel (Horizontal)

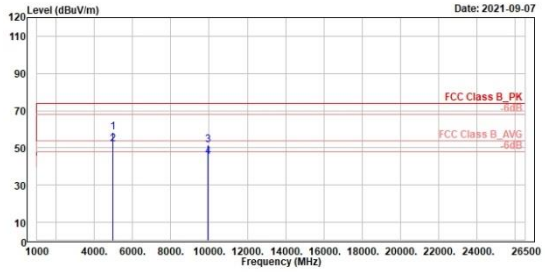
TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4960.00	56.01	65.28	-9.27	74.00	-17.99	315	298	Peak	Horizontal	
2 !	4960.00	49.43	58.70	-9.27	54.00	-4.57	315	298	Average	Horizontal	
3	9920.00	46.48	49.72	-3.24	67.15	-20.67	100	46	Peak	Horizontal	

High Channel (Vertical)

TÜV Rheinland Taiwan Ltd.
No. 458-18, Sec 2, Fenliao., Linkou Dist., New Taipei City 244, Taiwan(R.O.C.)
Tel:+886-2172-1000 Fax:+886-2172-1322



	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4960.00	58.47	67.74	-9.27	74.00	-15.53	154	182	Peak	Vertical	
2 !	4960.00	51.89	61.16	-9.27	54.00	-2.11	154	182	Average	Vertical	
3	9920.00	51.56	54.80	-3.24	71.85	-20.29	100	139	Peak	Vertical	
4	9920.00	44.98	48.22	-3.24	65.27	-20.29	100	139	Average	Vertical	CF

Mains Conducted Emission, 150kHz ~ 30MHz

Worst Band

(Line)

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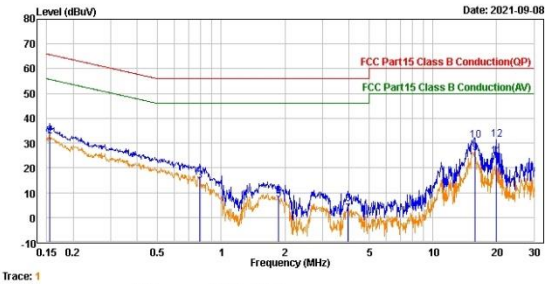
Tel:+886-2172-1000 Fax:+886-2172-1322



Trace: 1

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark	Pol/Phase	Note
	MHz	dBuV	dBuV	dB	dBuV	dB			
1	0.16	31.66	22.00	9.66	55.71	-24.05	Average	line1	
2	0.16	32.78	23.12	9.66	65.71	-32.93	QP	line1	
3	0.79	14.69	5.03	9.66	46.00	-31.31	Average	line1	
4	0.79	16.52	6.86	9.66	56.00	-39.48	QP	line1	
5	1.87	7.23	-2.45	9.68	46.00	-38.77	Average	line1	
6	1.87	8.49	-1.19	9.68	56.00	-47.51	QP	line1	
7	3.99	1.30	-8.40	9.70	46.00	-44.70	Average	line1	
8	3.99	5.35	-4.35	9.70	56.00	-50.65	QP	line1	
9	15.77	25.78	16.04	9.74	50.00	-24.22	Average	line1	
10	15.77	30.98	21.24	9.74	60.00	-29.02	QP	line1	
11	19.94	24.46	14.73	9.73	50.00	-25.54	Average	line1	
12	19.94	31.49	21.76	9.73	60.00	-28.51	QP	line1	

(Neutral)

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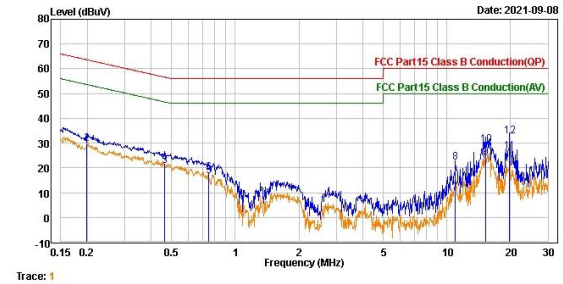
Tel:+886-2172-1000 Fax:+886-2172-1322



Trace: 1

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark	Pol/Phase	Note
	MHz	dBuV	dBuV	dB	dBuV	dB			
1	0.20	28.53	18.86	9.67	53.68	-25.15	Average	neutral	
2	0.20	29.64	19.97	9.67	63.68	-34.04	QP	neutral	
3	0.47	20.88	11.22	9.66	46.60	-25.72	Average	neutral	
4	0.47	21.71	12.05	9.66	56.60	-34.89	QP	neutral	
5	0.75	16.81	7.14	9.67	46.00	-29.19	Average	neutral	
6	0.75	18.20	8.53	9.67	56.00	-37.80	QP	neutral	
7	10.96	9.79	-0.01	9.80	50.00	-40.21	Average	neutral	
8	10.96	22.05	12.25	9.80	60.00	-37.95	QP	neutral	
9	15.31	24.33	14.52	9.81	50.00	-25.67	Average	neutral	
10	15.31	29.51	19.70	9.81	60.00	-30.49	QP	neutral	
11	19.74	26.62	16.80	9.82	50.00	-23.38	Average	neutral	
12	19.74	32.61	22.79	9.82	60.00	-27.39	QP	neutral	