TEST REPORT

Report Number	:	TZ0059241202FRF02
Product Name	:	Bridge Transceiver
Model/Type reference	:	BE1521-433
FCC ID	:	2APAKBE1521
Prepared for	:	Bellman & Symfon Group AB Sodra Langebergsgatan 30, Askim 43632, Sweden

Prepared By	:	Shenzhen Tongzhou Testing Co.,Ltd. 1st Floor, Building 1, Haomai High-tech Park, Huating Road 387, Dalang Street, Longhua, Shenzhen, China
Standards	:	FCC CFR Title 47 Part 15C, ANSI C63.10: 2013
Date of Test	:	Feb. 20, 2025~Mar. 07, 2025
Date of Issue	:	Mar. 07, 2025
Prepared by	:	Lena Wen (File administrators)
Reviewed by	:	Max Zhang (Technical Manager)
Approved by	:	Andy Zhang (General Manager)

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** Report Revise Record **

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Mar. 07, 2025	Valid	Initial release

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1. GENERAL INFORMATION

1.1. Client Information

Applicant	:	Bellman & Symfon Group AB
Address	:	Sodra Langebergsgatan 30, Askim 43632, Sweden
Manufacturer	:	Bellman & Symfon Group AB
Address	:	Sodra Langebergsgatan 30, Askim 43632, Sweden

1.2. Description of Device (EUT)

Product Name	:	Bridge Transceiver
Trade Mark	:	Bellman & Symfon
Model Number	:	BE1521-433
Model Declaration	:	N/A
Test Model	:	BE1521-433
Power Supply	:	DC 5V by adapter or DC 3V by battery
Hardware version	:	BE1521_026LAY1.0
Software version	:	BE1521_033FWA1.0

1.3. Wireless Function Tested in this Report

Bluetooth Low Energy		
Operation Frequency	:	2402 – 2480 MHz
Channel Number	:	40 Channels for BLE (DTS)
Modulation Technology	:	GFSK
Data Rates	:	1Mbps
Antenna Type And Gain	:	Wire Antenna with Gain: -2.03dBi

Note 1: Antenna position refer to EUT Photos.
Note 2: the above information was supplied by the applicant.

1.4. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:
●supplied by the manufacturer

○supplied by the lab

●	Adapter	Model:	ICP06C-050-1000B
		Input:	AC100-240V, 50/60Hz, 0.3A
		Output:	DC 5V, 1A

1.5. Description of Test Facility

FCC

Designation Number: CN1275
Test Firm Registration Number: 167722
Shenzhen Tongzhou Testing Co.,Ltd has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA

Certificate Number: 5463.01
Shenzhen Tongzhou Testing Co.,Ltd has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

IC

ISED#: 22033
CAB identifier: CN0099
Shenzhen Tongzhou Testing Co.,Ltd has been listed by Innovation, Science and Economic Development Canada to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4 and CISPR 16-1-4:2010

1.6. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the Shenzhen Tongzhou Testing Co.,Ltd’s quality system acc. To DIN EN 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.

1.7. Measurement Uncertainty

Test Item		Uncertainty	Note
Radiation Uncertainty(9KHz~30MHz)	:	±3.26dB	(1)
Radiation Uncertainty(30MHz~1000MHz)	:	±3.92dB	(1)
Radiation Uncertainty(1GHz~40GHz)	:	±5.62dB	(1)
Conduction Uncertainty	:	±2.71dB	(1)
Occupied Channel Bandwidth	:	±3.0%	(1)
RF power,conducted	:	±0.16dB	(1)
Power Spectral Density, conducted	:	±1.3dB	(1)
Unwanted Emissions, conducted	:	±1.3dB	(1)
Time	:	±1.0%	(1)
Duty Cycle	:	±3.0%	(1)

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.8. Description of Test Modes

The EUT has been tested under operating condition.

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.
Pre-test AC conducted emission at power adapter mode.

Mode of Operations	Test Frequency (MHz)	Data Rate (Mbps)
Bluetooth(BLE)	2402	1
	2440	1
	2480	1

Pre-test AC conducted emission at both voltage AC 120V/60Hz recorded worst case.
Worst-case mode and channel used for 150 kHz-30 MHz power line conducted emissions was the mode and channel with the highest output power, which was determined to be **BT_LE1M_2440MHz.**

Worst-case mode and channel used for 9kHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be **BT_LE1M_2440MHz.**

1.9. Frequency of Channels

Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	2402	20	2442
1	2404	---	---
2	2406	---	---
---	---	37	2476
---	---	38	2478

18	2438	39	2480
19	2440		

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen Tongzhou Testing Co.,Ltd

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.
According to FCC's request, Test Procedure KDB558074 D01 DTS Meas. Guidance v05r02 and KDB 662911 are required to be used for this kind of FCC 15.247 digital modulation device.
According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

2.3. Test Sample

Sample ID	Description
TZ0059241202–1#	Engineer sample – continuous transmit
TZ0059241202–2#	Normal sample – Intermittent transmit

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

The system was configured for Bluetooth testing in a continuous transmits condition and change test channels by Test software (Direct Test Mode V2.4.0) provided by application.

3.3. Special Accessories

No.	Equipment	Manufacturer	Model No.	Serial No.	Length	shielded/ unshielded	Notes
1	Control Box	USB-TTL	--	/	/	/	/

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen Tongzhou Testing Co.,Ltd has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Sample ID	Result
§15.247(b)	Maximum Peak Conducted Output Power	TZ0059241202–1#	Compliant
§15.247(e)	Power Spectral Density	TZ0059241202–1#	Compliant
§15.247(a)(2)	6dB Bandwidth	TZ0059241202–1#	Compliant
/	Occupied Bandwidth	TZ0059241202–1#	Note 1
§15.209, §15.247(d)	Radiated and Conducted Spurious Emissions	TZ0059241202–1# TZ0059241202–2#	Compliant
§15.205	Emissions at Restricted Band	TZ0059241202–1#	Compliant
§15.207(a)	Conducted Emissions	TZ0059241202–2#	Compliant
§15.203	Antenna Requirements	N/A	Compliant
Note 1: only for report purpose.			

Remark: The measurement uncertainty is not included in the test result.

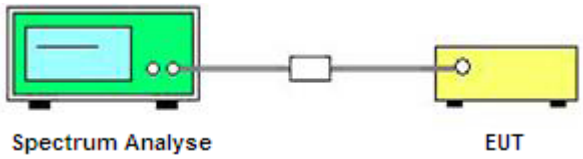
5. TEST RESULT

5.1. On Time and Duty Cycle

5.1.1. Standard Applicable

None. for reporting purpose only.

5.1.2. Block Diagram of Test Setup



5.1.3. Test Procedures

1. Set the center frequency of the spectrum analyzer to the transmitting frequency.
2. Set the span=0MHz, RBW to the largest available value, VBW≥RBW
3. Detector = peak.
4. Trace mode = Single hold.

5.1.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.1.5. Test Result

Pass

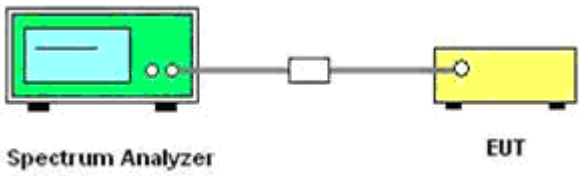
Remark:
1. Please refer to Appendix F of Appendix Test Data for BLE for test data.

5.2. Maximum Peak Conducted Output Power Measurement

5.2.1. Standard Applicable

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

5.2.2. Block Diagram of Test Setup



5.2.3. Test Procedures

The transmitter output (antenna port) was connected to the spectrum analyzer.
According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power 9.1.1.
This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.
a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ 3 × RBW.
c) Set span ≥ 3 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

5.2.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.2.5. Test Result

Pass

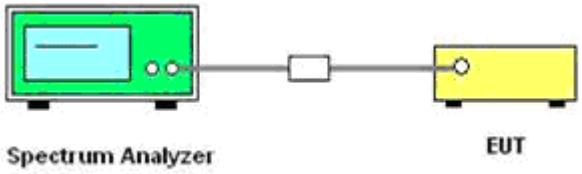
Remark:
1. Test results including cable loss.
2. Please refer to Appendix B of Appendix Test Data for BLE for test data.

5.3. Power Spectral Density Measurement

5.3.1. Standard Applicable

According to §15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.3.2. Block Diagram of Test Setup



5.3.3. Test Procedures

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.
3. Set the RBW = 3kHz.
4. Set the VBW ≥ 3*RBW
5. Set the span to 1.5 times the DTS channel bandwidth.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum power level.
11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
12. The resulting peak PSD level must be less than 8dBm.

5.3.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.3.5. Test Result

Pass

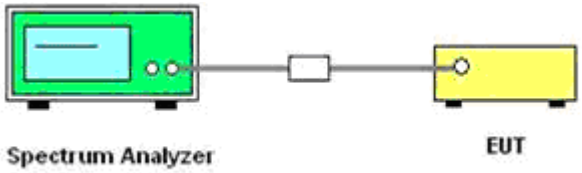
Remark:
1. Test results including cable loss.
2. Please refer to Appendix C of Appendix Test Data for BLE for test data.

5.4. 6 dB Spectrum Bandwidth Measurement

5.4.1. Standard Applicable

According to §15.247(a) (2): For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

5.4.2. Block Diagram of Test Setup



5.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth and the video bandwidth were set according to KDB558074.
3. Measured the spectrum width with power higher than 6dB below carrier.

5.4.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.4.5. Test Result

Pass

Remark:
1. Test results including cable loss.
2. Please refer to Appendix A of Appendix Test Data for BLE for test data.

5.5. Radiated Emissions Measurement

5.5.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
\1\ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.Android 10-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293.	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(\2\)
13.36-13.41			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510MHz.
\2\ Above 38.6
According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (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

5.5.2. Measuring Instruments and Setting

The following table is the setting of spectrum analyzer and receiver.

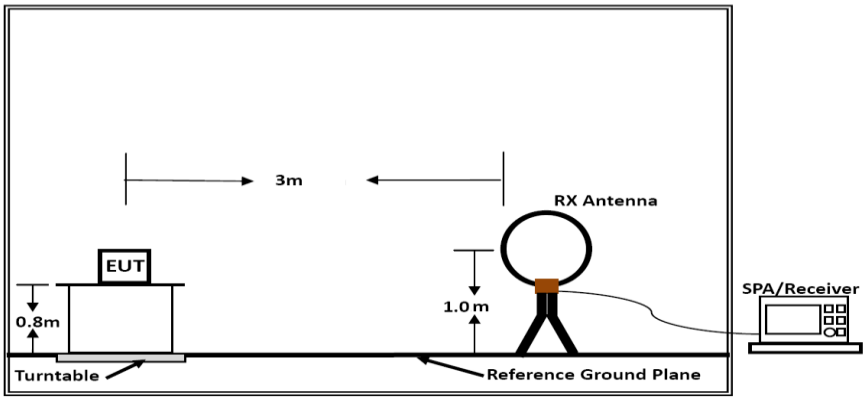
Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 3 MHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 3 MHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG

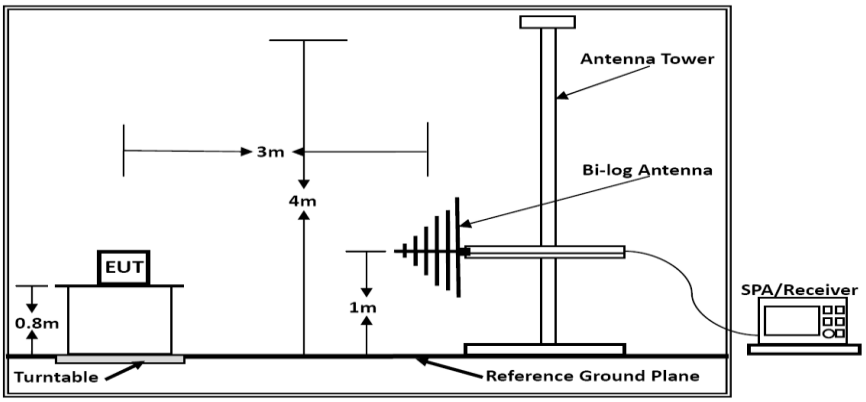
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

5.5.3. Block Diagram of Test Setup

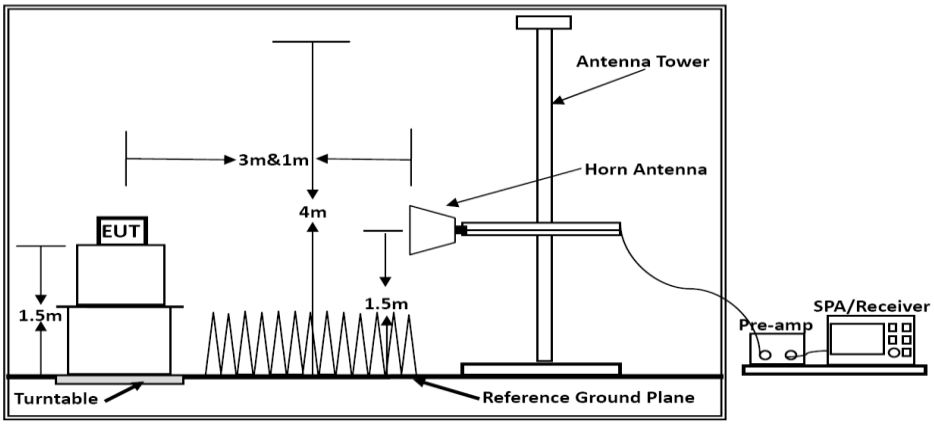
For radiated emissions below 30MHz



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1m.
Distance extrapolation factor = 20 log (specific distanc [3m] / test distance [1m]) (dB).
Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.5.4. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.
Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna height is 1.0 meter.
--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions
Final measurement:
--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.
Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna is polarized vertical and horizontal.
--- The antenna height changes from 1 to 3 meter.
--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.
Final measurement:
--- The final measurement will be performed with minimum the six highest peaks.
--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.
--- The final measurement will be done with QP detector with an EMI receiver.
--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 40 GHz

Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.
Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna is polarized vertical and horizontal.
--- The antenna height scan range is 1 meter to 2.5 meter.
--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.
Final measurement:
--- The final measurement will be performed with minimum the six highest peaks.
--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meters. This procedure is repeated for both antenna polarizations.
--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 1 meter.
--- The EUT was set into operation.
Premeasurement:
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.
Final measurement:
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

5.5.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.5.6. Test Results

Pass

Results of Radiated Emissions (9 KHz~30MHz)

Temperature	22.5℃	Humidity	56%
Test Engineer	Tony Luo	Configurations	BT LE

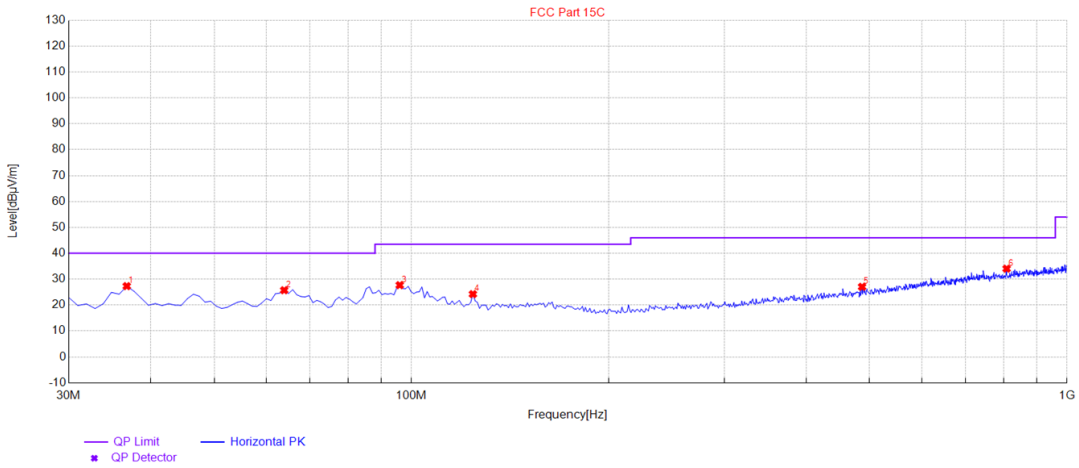
Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:
The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.
Distance extrapolation factor = 40 log (specific distance / test distance) (dB).
Limit line = specific limits (dBuV) + distance extrapolation factor.

Results of Radiated Emissions (30MHz~1GHz)

Temperature	22.5℃	Humidity	56%
Test Engineer	Tony Luo	Configurations	BT LE

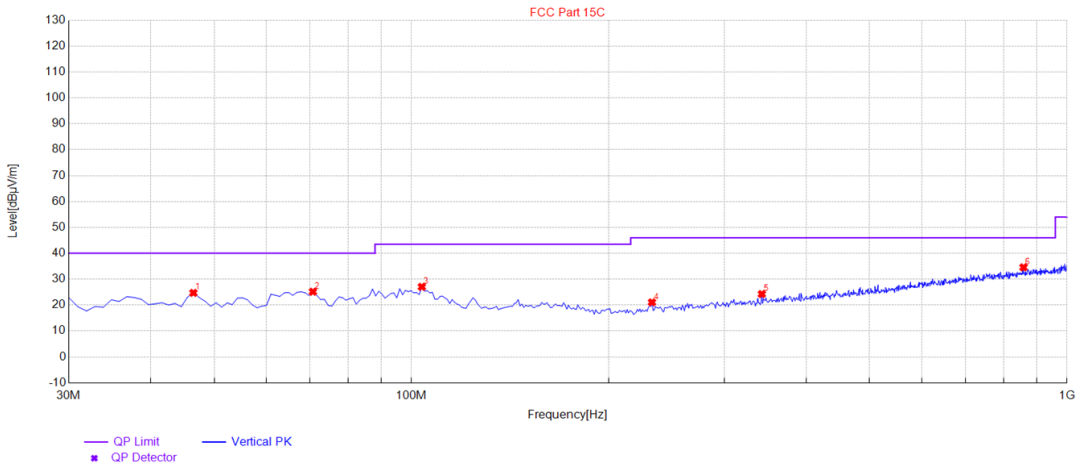
Vertical



Suspected Data List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	36.79	27.32	14.02	40.00	12.68	100	130	Horizontal
2	63.95	25.73	13.29	40.00	14.27	100	250	Horizontal
3	95.96	27.69	11.77	43.50	15.81	100	80	Horizontal
4	124.09	24.23	14.28	43.50	19.27	100	170	Horizontal
5	486.87	27.05	21.67	46.00	18.95	100	190	Horizontal
6	808.91	34.05	27.70	46.00	11.95	100	340	Horizontal

***Note:
1. Level [dBµV/m] = Reading [dBµV] + Factor [dB/m]
2. Margin [dB] = Limit [dBµV/m] - Level [dBµV/m]

Horizontal



Suspected Data List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	46.49	24.71	14.96	40.00	15.29	100	230	Vertical
2	70.74	25.16	12.25	40.00	14.84	100	240	Vertical
3	103.72	27.05	12.57	43.50	16.45	100	70	Vertical
4	232.73	21.06	14.65	46.00	24.94	100	0	Vertical
5	342.34	24.26	18.36	46.00	21.74	100	350	Vertical
6	858.38	34.56	28.50	46.00	11.44	100	340	Vertical

***Note:
1. Level [dBµV/m] = Reading [dBµV] + Factor [dB/m]
2. Margin [dB] = Limit [dBµV/m] - Level [dBµV/m]

Results for Radiated Emissions (1GHz to 25GHz)

Temperature	24℃	Humidity	55.2%
Test Engineer	Tony Luo	Configurations	BT LE

Remark: Measured all modes and recorded worst case.

Channel 0 / 2402 MHz

Freq. MHz	Reading dBμV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Level dBμV/m	Limit dBμV/m	Margin dB	Remark	Pol.
4804.00	54.24	33.06	35.04	3.94	56.20	74.00	17.80	Peak	Horizontal
4804.00	43.85	33.06	35.04	3.94	45.81	54.00	8.19	Average	Horizontal
4804.00	54.72	33.06	35.04	3.94	56.68	74.00	17.32	Peak	Vertical
4804.00	42.20	33.06	35.04	3.94	44.16	54.00	9.84	Average	Vertical

Channel 19 / 2440MHz

Freq. MHz	Reading dBμV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Level dBμV/m	Limit dBμV/m	Margin dB	Remark	Pol.
4880.00	59.47	33.16	35.15	3.96	61.44	74.00	12.56	Peak	Horizontal
4880.00	41.50	33.16	35.15	3.96	43.47	54.00	10.53	Average	Horizontal
4880.00	58.21	33.16	35.15	3.96	60.18	74.00	13.82	Peak	Vertical
4880.00	42.27	33.16	35.15	3.96	44.24	54.00	9.76	Average	Vertical

Channel 39 / 2480 MHz

Freq. MHz	Reading dBμV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Level dBμV/m	Limit dBμV/m	Margin dB	Remark	Pol.
4960.00	54.15	33.26	35.14	3.98	56.25	74.00	17.75	Peak	Horizontal
4960.00	40.24	33.26	35.14	3.98	42.34	54.00	11.66	Average	Horizontal
4960.00	58.59	33.26	35.14	3.98	60.69	74.00	13.31	Peak	Vertical
4960.00	39.65	33.26	35.14	3.98	41.75	54.00	12.25	Average	Vertical

Notes:

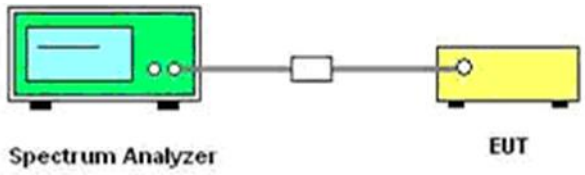
1. Measuring frequencies from 9 KHz - 10th harmonic or 26.5GHz (which is less), No emission found between lowest internal used/generated frequency to 30MHz.
2. Radiated emissions measured in frequency range from 9 KHz ~10th harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.
3. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 30dB below the permissible limits or the field strength is too small to be measured.
4. Level = Reading + Ant. Fac - Pre. Fac. + Cab. Loss. Margin = Limit – Level.

5.6. Conducted Spurious Emissions and Band Edges Test

5.6.1. Standard Applicable

According to §15.247 (d): 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

5.6.2. Block Diagram of Test Setup



5.6.3. Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz
The spectrum from 9 KHz to 26.5GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

5.6.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.6.5. Test Results

PASS

Remark:
1. Test results including cable loss.
2. “---“means that the fundamental frequency not for 15.209 limits requirement.
3. Not recorded values as emission level lower than limit at least 20 dBc.
4. Please refer to Appendix E of Appendix Test Data for BLE.for Conducted Spurious Emissions for test data.
5. Please refer to Appendix D of Appendix Test Data for BLE for Conducted Band Edges for test data.

5.7. AC Power line conducted emissions

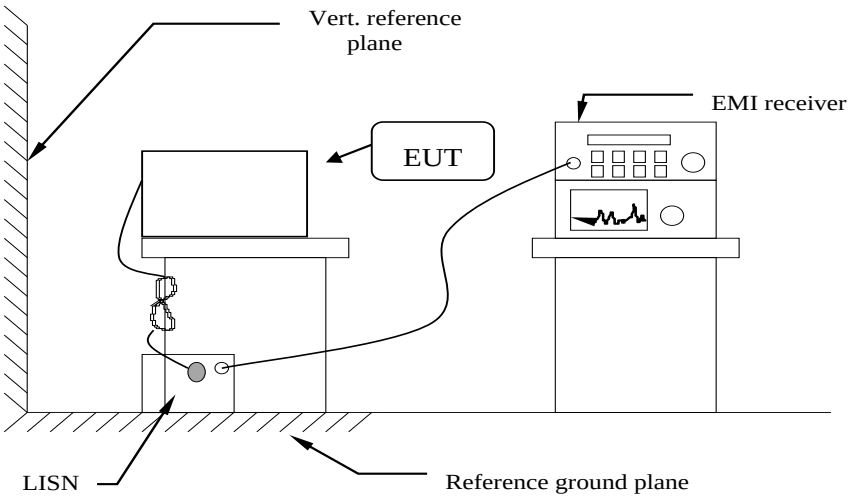
5.7.1. Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

5.7.2. Block Diagram of Test Setup



Note: the distance between LISN and Vertical reference plane is 40 cm and the distance between LISN and EUT is 80 cm.

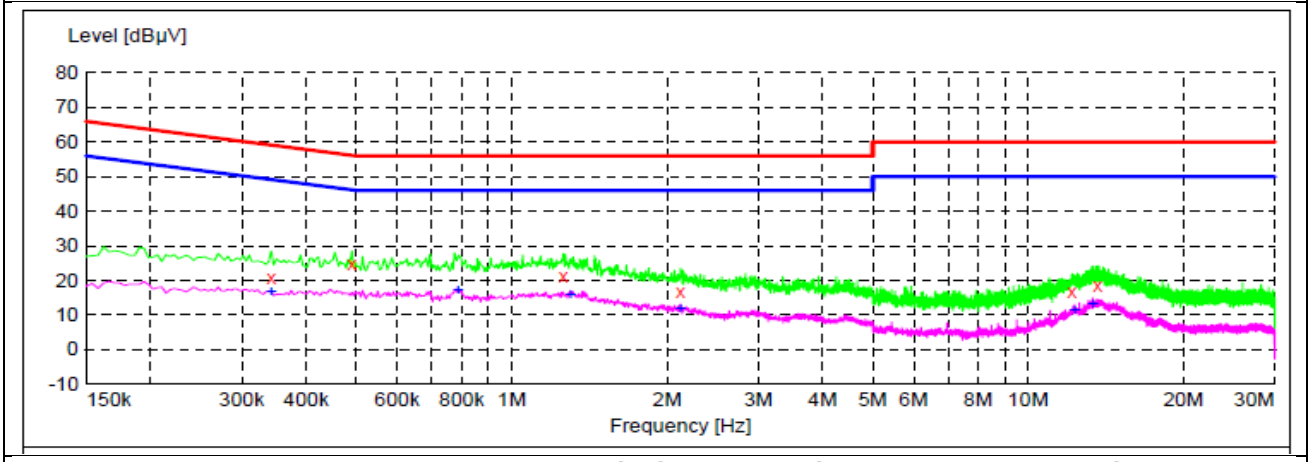
5.7.3. Test Results

Temperature	22.5℃	Humidity	56%
Test Engineer	Allen Lai	Configurations	BT LE

PASS

The test data please refer to following page.

Neutral Line

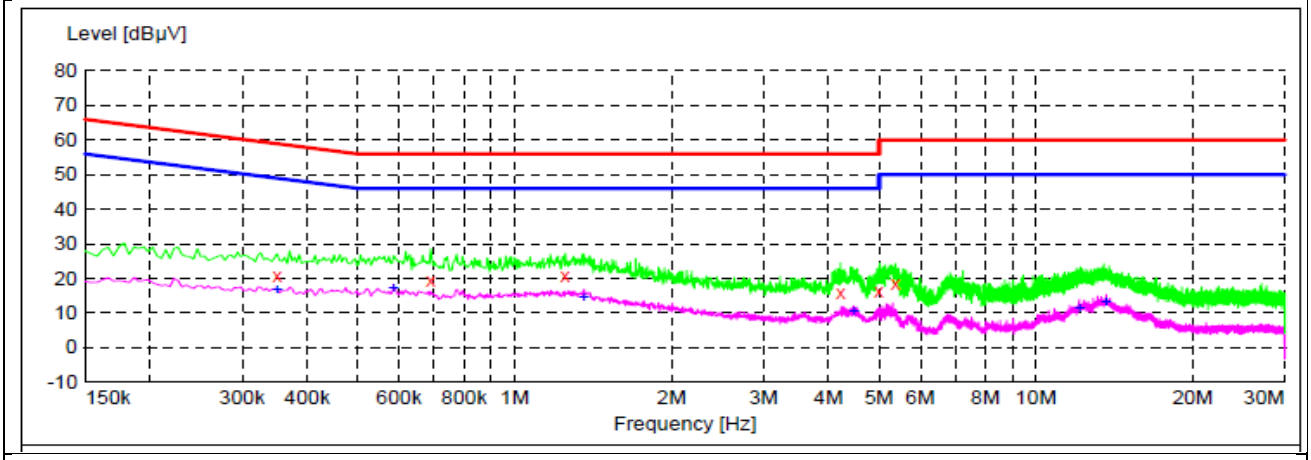


Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.342000	20.70	6.1	59	38.5	QP	N	GND
0.490000	24.60	6.1	56	31.6	QP	N	GND
1.258000	21.10	6.2	56	34.9	QP	N	GND
2.122000	16.60	6.2	56	39.4	QP	N	GND
12.166000	16.50	6.8	60	43.5	QP	N	GND
13.614000	18.70	6.8	60	41.3	QP	N	GND

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.342000	16.70	6.1	49	32.5	AV	N	GND
0.786000	17.10	6.2	46	28.9	AV	N	GND
1.298000	16.00	6.2	46	30.0	AV	N	GND
2.122000	11.80	6.2	46	34.2	AV	N	GND
12.306000	11.50	6.8	50	38.5	AV	N	GND
13.326000	13.00	6.8	50	37.0	AV	N	GND

Note:
1. Margin(dB)= Limit(dBµV) - Level(dBµV)
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 9 kHz (150 kHz—30 MHz), Step size: 4 kHz, Scan time: auto.

Live Line



Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.350000	20.70	6.1	59	38.3	QP	L1	GND
0.690000	19.30	6.2	56	36.7	QP	L1	GND
1.250000	20.90	6.2	56	35.1	QP	L1	GND
4.218000	16.00	6.3	56	40.0	QP	L1	GND
4.994000	16.40	6.3	56	39.6	QP	L1	GND
5.374000	18.60	6.4	60	41.4	QP	L1	GND

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.350000	16.90	6.1	49	32.1	AV	L1	GND
0.586000	17.30	6.2	46	28.7	AV	L1	GND
1.358000	14.60	6.2	46	31.4	AV	L1	GND
4.466000	10.40	6.3	46	35.6	AV	L1	GND
12.102000	11.40	6.8	50	38.6	AV	L1	GND
13.630000	12.90	6.8	50	37.1	AV	L1	GND

Note:
1. Margin(dB)= Limit(dBµV) - Level(dBµV)
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 9 kHz (150 kHz—30 MHz), Step size: 4 kHz, Scan time: auto.

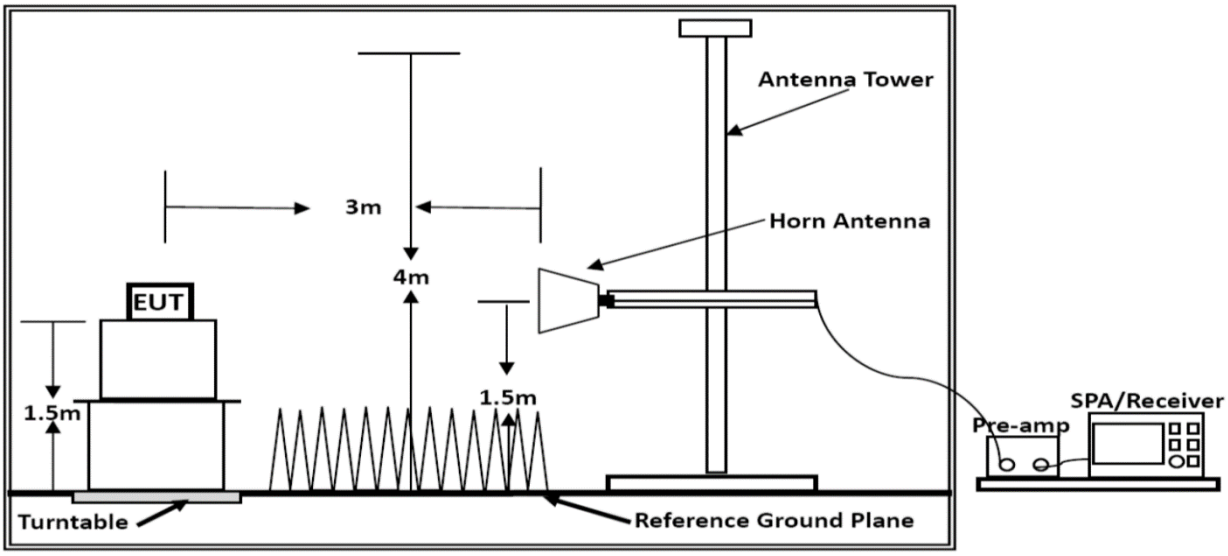
5.8. Band-edge measurements for radiated emissions

5.8.1. Standard Applicable

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)).

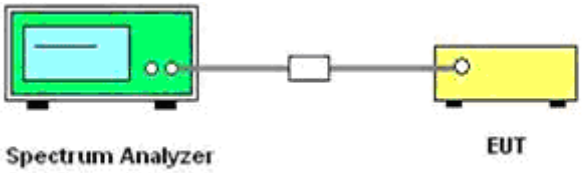
5.8.2. Block Diagram of Test Setup

☒For Radiated



Above 1GHz

☒For Conducted



5.8.3. Test Procedures

☒Radiated Method:

1. The EUT was placed on a turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto	Peak
	Average Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto	Average

☐Conducted Method:

According to KDB 558074 D01 for Antenna-port conducted measurement. Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to an EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=3MHz for AV detector.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.
6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 12.2.2, 12.2.3, and 12.2.4 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Convert the result ant EIRP level to an equivalent electric field strength using the following relationship:

    $E = EIRP – 20\log D + 104.77 = EIRP + 95.23$

    Where:
    E = electric field strength in dBμV/m,
    EIRP = equivalent isotropic radiated power in dBm
    D = specified measurement distance in meters.
11. Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.
12. Per KDB662911 D01 section b) In cases where a combination of conducted measurements and cabinet radiated measurements are permitted to demonstrate compliance with absolute radiated out-of-band and spurious limits (e.g., KDB Publications 558074 for DTS and 789033 for U-NII), the conducted measurements must be combined with directional gain to compute the radiated levels of the out-of-band and spurious emissions as described in this section.
13. Compare the resultant electric field strength level to the applicable regulatory limit.
14. Perform radiated spurious emission test duress until all measured frequencies were complete.

5.8.4. Test Results

Temperature	22.5℃	Humidity	56%
Test Engineer	Tony Luo	Configurations	BT LE

BLE 1Mbps_Channel 0 / 2402 MHz										
Item (Mark)	Freq. MHz	Reading dBµV	Ant. Fac. dB/m	PRM Factor dB	Cable Loss dB	Level dBµV/m	Limit dBµV/m	Margin dB	Detector	Pol.
1	2390.00	56.32	29.99	30.21	8.35	64.45	74	9.55	Peak	Horizontal
1	2390.00	38.82	29.99	30.21	8.35	46.95	54	7.05	AV[1]	Horizontal
2	2390.00	58.82	29.99	30.21	8.35	66.95	74	7.05	Peak	Vertical
2	2390.00	36.63	29.99	30.21	8.35	44.76	54	9.24	AV[1]	Vertical

BLE 1Mbps_Channel 39 / 2480 MHz										
Item (Mark)	Freq. MHz	Reading dBµV	Ant. Fac. dB/m	PRM Factor dB	Cable Loss dB	Level dBµV/m	Limit dBµV/m	Margin dB	Detector	Pol.
3	2483.50	55.01	30.25	30.25	8.5	63.51	74	10.49	Peak	Horizontal
3	2483.50	28.98	30.25	30.25	8.5	37.48	54	16.52	AV[1]	Horizontal
4	2483.50	48.97	30.25	30.25	8.5	57.47	74	16.53	Peak	Vertical
4	2483.50	26.94	30.25	30.25	8.5	35.44	54	18.56	AV[1]	Vertical
5	2484.30	56.38	30.25	30.25	8.5	64.88	74	9.12	Peak	Horizontal
5	2486.02	38.26	30.25	30.25	8.5	46.76	54	7.24	AV[1]	Horizontal
6	2499.15	50.93	30.25	30.25	8.5	59.43	74	14.57	Peak	Vertical
6	2497.45	36.02	30.25	30.25	8.5	44.52	54	9.48	AV[1]	Vertical

Remark:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. Margin = Limit - Emission Level.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=3MHz/Sweep time=Auto/Detector=Average.

5.9. Antenna Requirements

5.9.1. Standard Applicable

According to antenna requirement of §15.203.
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 shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

5.9.2. Antenna Connected Construction

The directional gains of antenna refer to section 1.1 of this report, and the antenna is an Wire antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

5.9.3. Results

Compliance

6. LIST OF MEASURING EQUIPMENTS

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	MXA Signal Analyzer	Keysight	N9020A	MY52091623	2024-12-31	2025-12-30
2	Power Sensor	Agilent	U2021XA	MY5365004	2024-12-31	2025-12-30
3	Power Meter	Agilent	U2531A	TW53323507	2024-12-31	2025-12-30
4	Loop Antenna	schwarzbeck	FMZB1519 B	00023	2022-11-13	2025-11-12
5	Wideband Antenna	schwarzbeck	VULB 9163	958	2022-11-13	2025-11-12
6	Horn Antenna	schwarzbeck	BBHA 9120D	01989	2022-11-13	2025-11-12
7	EMI Test Receiver	R&S	ESCI	100849/003	2024-12-31	2025-12-30
8	Controller	MF	MF7802	N/A	N/A	N/A
9	Amplifier	schwarzbeck	BBV 9743	209	2024-12-31	2025-12-30
10	Amplifier	Tonscend	TSAMP-05 18SE	--	2024-12-31	2025-12-30
11	RF Cable(below 1GHz)	HUBER+SUHN ER	RG214	N/A	2024-12-31	2025-12-30
12	RF Cable(above 1GHz)	HUBER+SUHN ER	RG214	N/A	2024-12-31	2025-12-30
13	Artificial Mains	ROHDE & SCHWARZ	ENV 216	101333-IP	2024/1/4	2025/1/3
14	Horn Antenna	A-INFO	LB-180400-KF	J211020657	2023-10-12	2025-10-11
15	Amplifier	Chengyi	EMC18404 5SE	980508	2024-09-20	2025-09-19
16	Spectrum Analyzer	R&S	FSP40	100550	2024-06-07	2025-06-06

Test software used:

Item	Test Software	Manufacturer	Name	Version
1	EMI Test Software	ROHDE & SCHWARZ	ES-K1	V1.71
2	RE Test software	Tonscend	JS32-RE	V5.0.0.0
3	RF Test software	MAX	Wireless LAN&BT Auto Test	V2.0

7. TEST SETUP PHOTOGRAPHS OF EUT

Please refer to separated files for Test Setup Photos of the EUT.

8. EXTERIOR PHOTOGRAPHS OF EUT

Please refer to separated files for External Photos of the EUT.

9. INTERIOR PHOTOGRAPHS OF EUT

Please refer to separated files for Internal Photos of the EUT.

----------THE END OF REPORT----------