FCC - TEST REPORT

Report Number	:	**709502408752-00C**	Date of Issue:	October 22, 2024

Model	:	CM-03
Product Type	:	Tubular motor
Applicant	:	Coulisse B.V.
Address	:	Vonderweg 48, 7468 DC Enter,
		THE NETHERLANDS
Production Facility	:	Ningbo Dooya Mechanical & Electronic Technology Co., Ltd.
Address	:	No.168 Shengguang Road, Luotuo, Zhenhai 315202 Ningbo,
		Zhejiang province, People's republic of China

Test Result	:	■ **Positive** ☐ **Negative**
Total pages including Appendices	:	45

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1 Table of Contents

1 Table of Contents 2
2 Details about the Test Laboratory 3
3 Description of the Equipment under Test 4
4 Summary of Test Standards 6
5 Summary of Test Results 7
6 General Remarks 8
7 Test Setups 9
8 Systems test configuration 12
9 Technical Requirement 13
9.1 Conducted Emission 13
9.2 Conducted peak output power 16
9.3 6dB bandwidth 18
9.4 Power spectral density 20
9.5 Spurious RF conducted emissions 22
9.6 Band edge 26
9.7 Spurious radiated emissions for transmitter 29
10 Test Equipment List 42
11 System Measurement Uncertainty 43
12 Photographs of Test Set-ups 44
13 Photographs of EUT 45

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch No.16 Lane, 1951 Du Hui Road, Shanghai 201108, P.R. China
Telephone:	+86 21 6141 0123
Fax:	+86 21 6140 8600
FCC Registration No.:	820234
FCC Designation Number:	CN1183
ISED CAB identifier	CN0101
IC Registration No.:	31668

3 Description of the Equipment under Test

Description of the Equipment Under Test

Product:	Tubular motor
Model no.:	CM-03
FCC ID:	ZY4CM03B1
Options and accessories:	NA
Rating:	5V DC
RF Transmission Frequency:	SRD transceiver: 433.92MHz; 2.4GHz BLE: 2402~2480 MHz
No. of Operated Channel:	SRD transceiver: 1; 2.4GHz BLE: 40
Modulation:	SRD transceiver: FSK; 2.4GHz BLE: GFSK
Channel list:	SRD transceiver: 433.92MHz; 2.4GHz BLE:

Bluetooth Low Energy							
Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(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

Antenna Type:	SRD transceiver: Line Antenna; 2.4GHz BLE: Line Antenna
Antenna Gain:	SRD transceiver: -4dBi;

	2.4GHz BLE: 2.2dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Tubular motor with BLE function and SRD function (transceiver). We tested it and listed the worst data in this report.
Test sample no.:	SHA-816506-4 (Conducted sample), SHA-816506-5 (Radiated sample)

The sample's mentioned in this report is/are submitted/ supplied/ manufactured by client. The laboratory therefore assumes no responsibility for accuracy of information on the brand name, model number, origin of manufacture, consignment, antenna gain or any information supplied.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2023 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 15.247 Measurement Guidance v05r02 and ANSI C63.10-2013.

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5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port	13-15	Site 1	☒	☐	☐
§15.247 (b) (3)	Conducted peak output power	16-17	Site 1	☒	☐	☐
§15.247(a)(1)	20dB bandwidth and 99% Occupied Bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Dwell Time - Average Time of Occupancy	---	---	☐	☐	☒
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	18-19	Site 1	☒	☐	☐
§15.247(e)	Power spectral density	20-21	Site 1	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	22-25	Site 1	☒	☐	☐
§15.247(d)	Band edge	26-28	Site 1	☒	☐	☐
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter	29-41	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A – Not Applicable.
Note 1: The EUT uses a Line Antenna, which gain is -4dBi for SRD transceiver and 2.2dBi for 2.4GHz BLE. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: ZY4CM03B1 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules.

This report is only for the 2.4GHz BLE test report, for the 433.92MHz test report please refer to 709502408752-00B.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date:	May 24, 2024
Testing Start Date:	June 27, 2024
Testing End Date:	October 9, 2024

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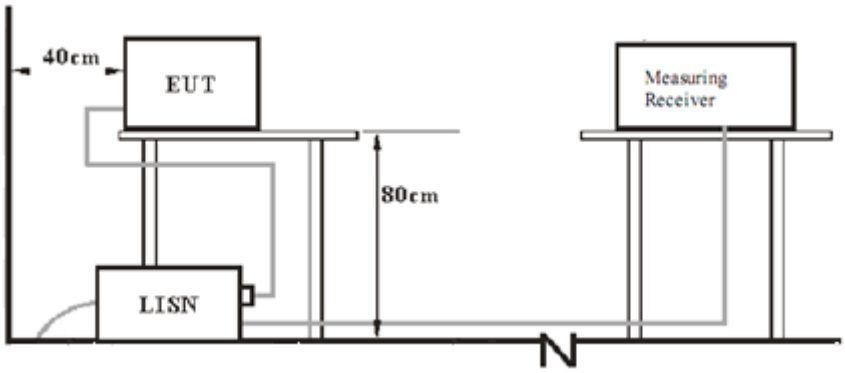
Reviewed by:	Prepared by:	Tested by:
Hui TONG	Wenqiang LU	Chengjie GUO
EMC Section Manager	EMC Project Engineer	EMC Test Engineer

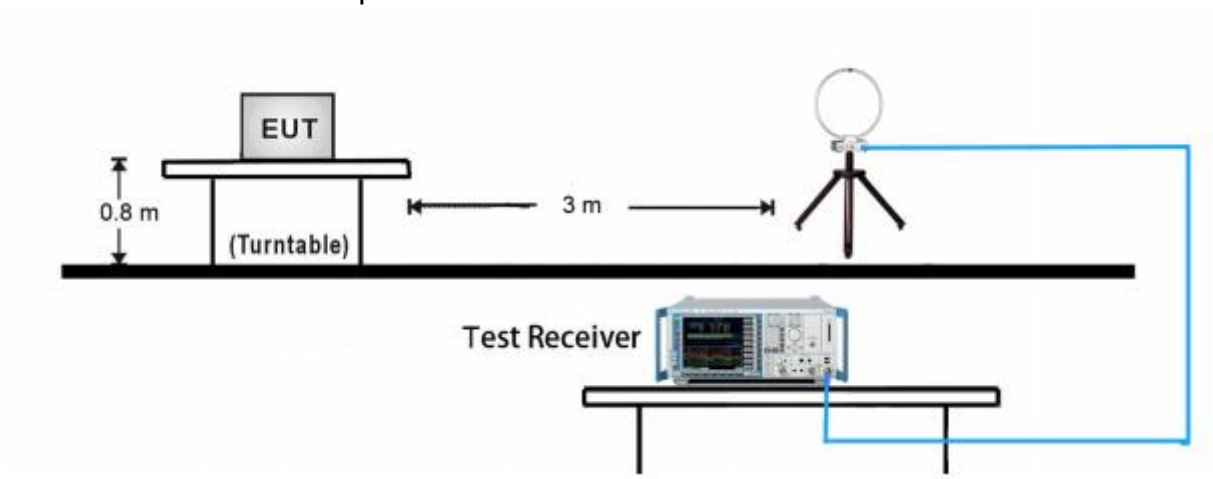
7 Test Setups

7.1 AC Power Line Conducted Emission test setups



7.2 Radiated test setups

9kHz ~ 30MHz Test Setup:



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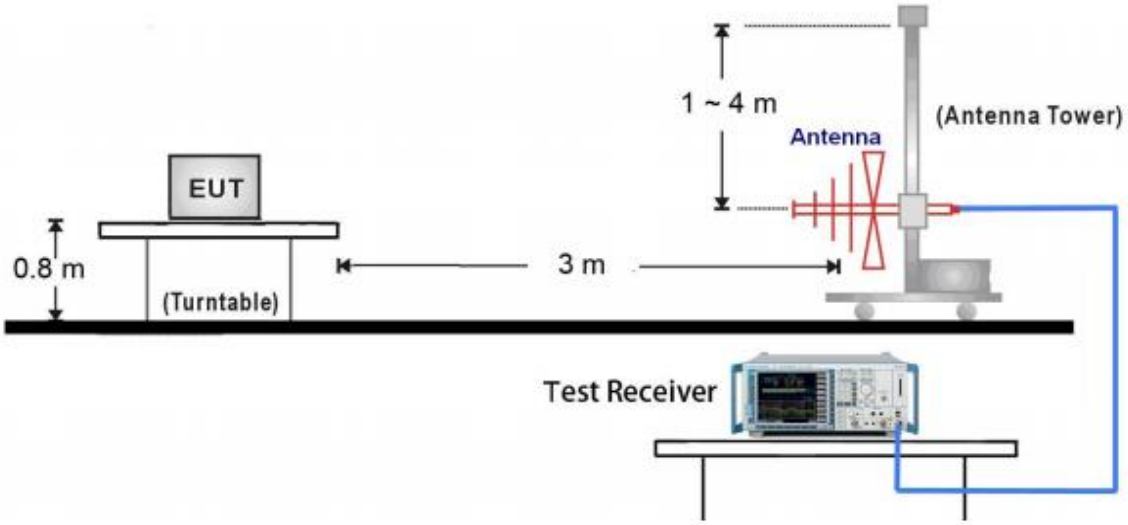
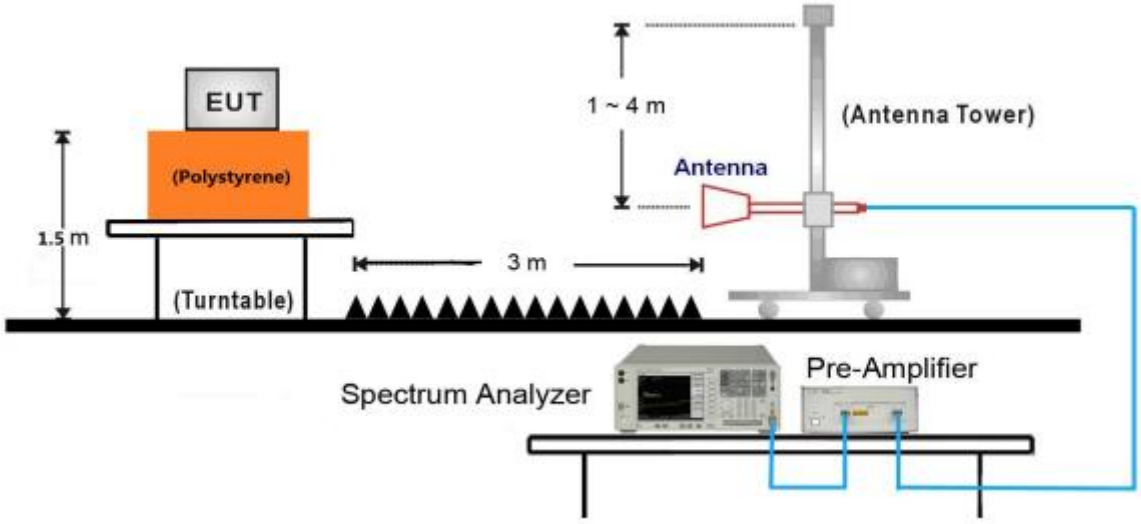
30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



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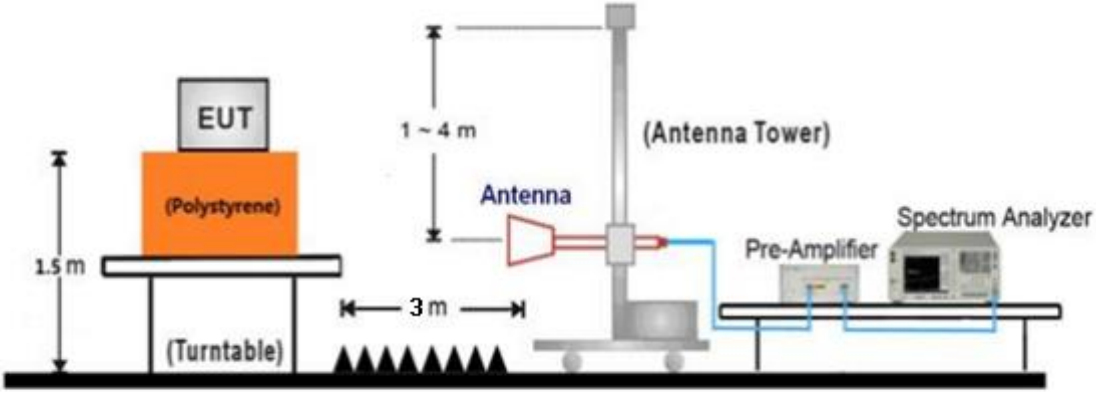
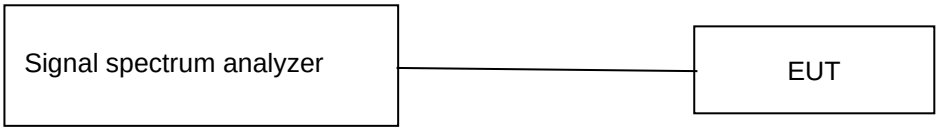
18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenove	X240	Notebook

Test software: BlueNRG GUI v4.0.0

The system was configured to channel 0, 19, and 39 for the test.

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

Test Mode Applicability and Tested Channel Detail:

Mode	Tested Channel	Data Rate (Mbps)	Modulation	Index Value (Power level setting)
Bluetooth LE	0	1	GFSK	25
	19	1	GFSK	25
	39	1	GFSK	25

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9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. An EMI test receiver is used to test the emissions from both sides of AC line

Limit

According to §15.207, conducted emissions limit as below:

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency

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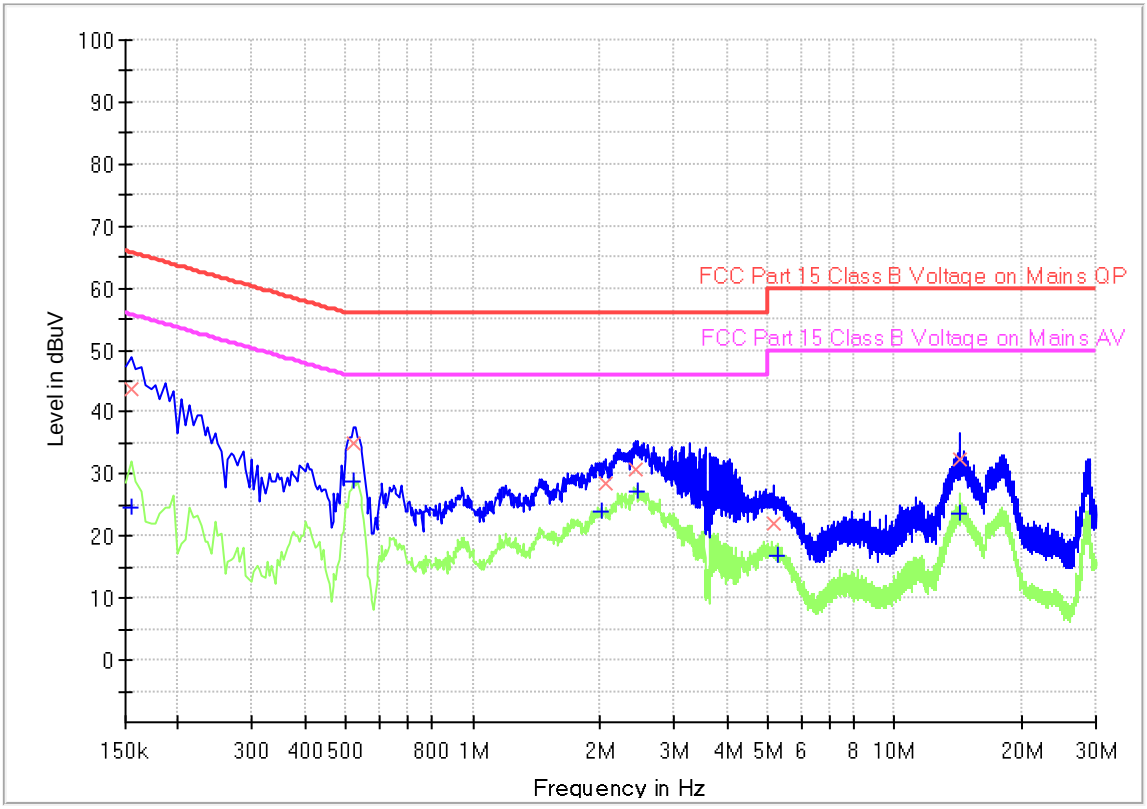
Product Type	:	Tubular motor
M/N	:	CM-03
Operating Condition	:	Mode 1: Tx_2402MHz (worst case)
Test Specification	:	L-line
Comment	:	5VDC (powered by notebook whose input is 120V~, 60Hz)



Final_Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.154500	---	24.50	55.75	31.25	1000.0	9.000	L1	19.4
0.154500	43.78	---	65.75	21.97	1000.0	9.000	L1	19.4
0.519000	35.13	---	56.00	20.87	1000.0	9.000	L1	19.4
0.523500	---	28.80	46.00	17.20	1000.0	9.000	L1	19.4
2.022000	---	23.96	46.00	22.04	1000.0	9.000	L1	19.5
2.058000	28.58	---	56.00	27.42	1000.0	9.000	L1	19.5
2.431500	30.80	---	56.00	25.20	1000.0	9.000	L1	19.5
2.454000	---	27.07	46.00	18.93	1000.0	9.000	L1	19.5
5.181000	22.04	---	60.00	37.96	1000.0	9.000	L1	19.6
5.298000	---	16.81	50.00	33.19	1000.0	9.000	L1	19.6
14.311500	---	23.50	50.00	26.50	1000.0	9.000	L1	20.0
14.311500	32.41	---	60.00	27.59	1000.0	9.000	L1	20.0

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

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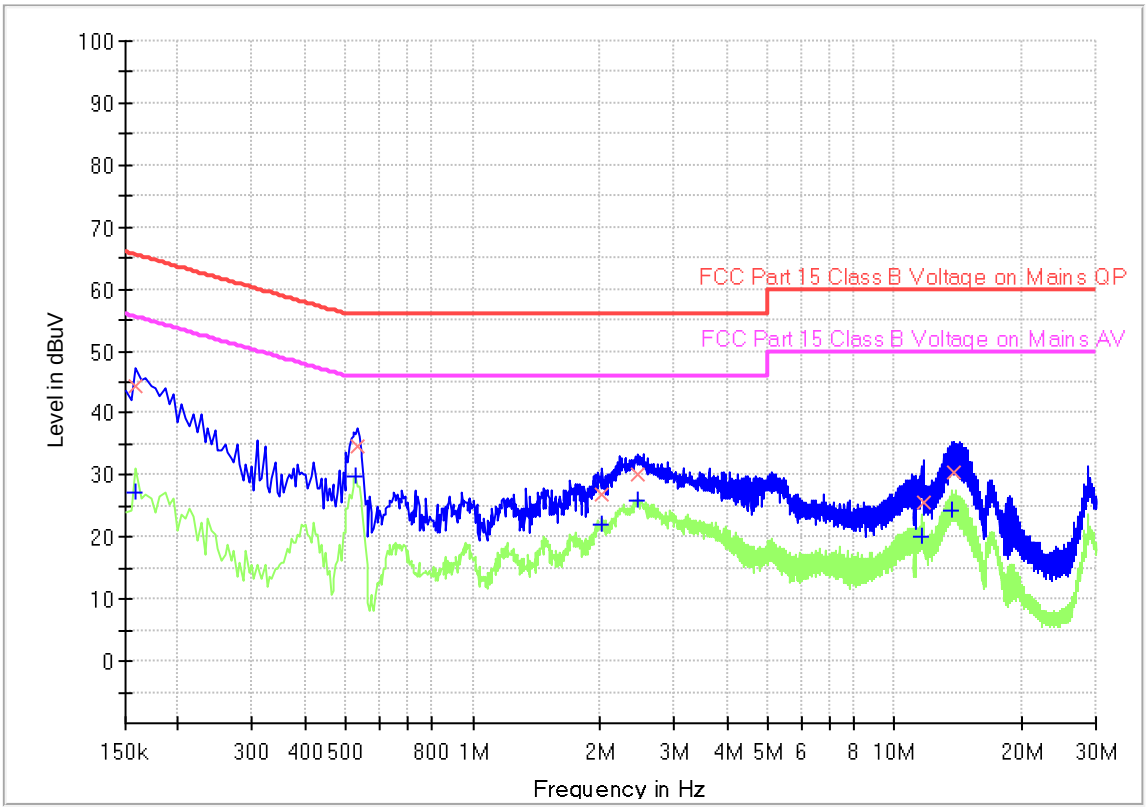
Product Type	:	Tubular motor
M/N	:	CM-03
Operating Condition	:	Mode 1: Tx_2402MHz (worst case)
Test Specification	:	N-line
Comment	:	5VDC (powered by notebook whose input is 120V~, 60Hz)



Final_Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.159000	---	27.27	55.52	28.25	1000.0	9.000	N	19.4
0.159000	44.23	---	65.52	21.29	1000.0	9.000	N	19.4
0.528000	---	29.71	46.00	16.29	1000.0	9.000	N	19.5
0.532500	34.61	---	56.00	21.39	1000.0	9.000	N	19.5
2.017500	---	22.11	46.00	23.89	1000.0	9.000	N	19.5
2.026500	26.82	---	56.00	29.18	1000.0	9.000	N	19.5
2.467500	30.20	---	56.00	25.80	1000.0	9.000	N	19.5
2.467500	---	25.80	46.00	20.20	1000.0	9.000	N	19.5
11.580000	---	20.00	50.00	30.00	1000.0	9.000	N	19.8
11.665500	25.59	---	60.00	34.41	1000.0	9.000	N	19.8
13.681500	---	24.31	50.00	25.69	1000.0	9.000	N	19.8
13.762500	30.35	---	60.00	29.65	1000.0	9.000	N	19.8

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

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9.2 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
   RBW > the 6 dB bandwidth of the emission being measured, VBW≥3RBW, Span≥3RBW
   Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

Limits

According to §15.247 (b) (3), conducted peak output power limit as below:

	Frequency Range	Limit	Limit
	MHz	W	dBm
Conducted peak output power	2400-2483.5	≤1	≤30

Test result as below table

Frequency	Conducted Peak Output Power	Result
MHz	dBm	
Low channel 2402MHz	-2.26	Pass
Middle channel 2440MHz	-2.4	Pass
High channel 2480MHz	-2.48	Pass

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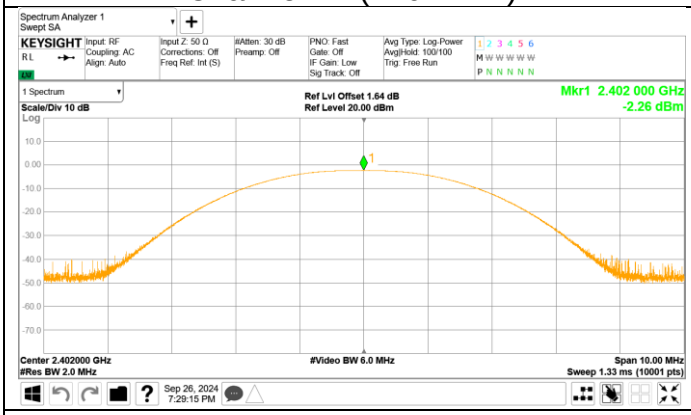
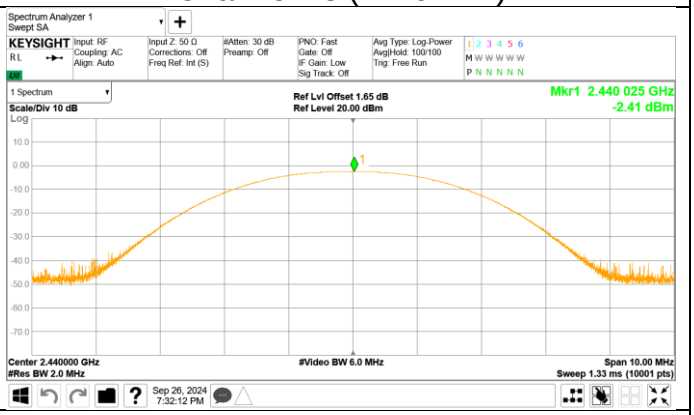
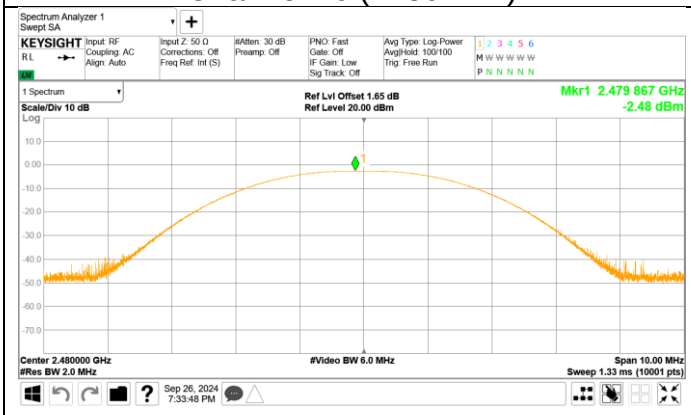
Peak output power	
Channel 11 (2402MHz)	Channel 18 (2440MHz)
	
Channel 26 (2480MHz)	
	

9.3 6dB bandwidth

Test Method for 6 dB Bandwidth

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   RBW=100KHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Use the automatic bandwidth measurement capability of an instrument, use the X dB bandwidth mode with X set to 6 dB.
5. Allow the trace to stabilize, record the 6 dB Bandwidth value.

Limit

According to §15.247(a)(2), 6dB bandwidth limit as below:

6dB bandwidth Limit [kHz]
≥500

Test result

Frequency MHz	6dB bandwidth kHz	Result
Top channel 2402MHz	663	Pass
Middle channel 2440MHz	630	Pass
Bottom channel 2480MHz	667	Pass

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6dB Bandwidth

BLE_1M_Ant1_2402

BLE_1M_Ant1_2440

BLE_1M_Ant1_2480

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9.4 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
4. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
5. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
6. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm/3KHz]
≤8

Test result

Frequency **MHz**	Power spectral density **dBm/3kHz**	Result
Top channel 2402MHz	-16.89	Pass
Middle channel 2440MHz	-17.31	Pass
Bottom channel 2480MHz	-17.82	Pass

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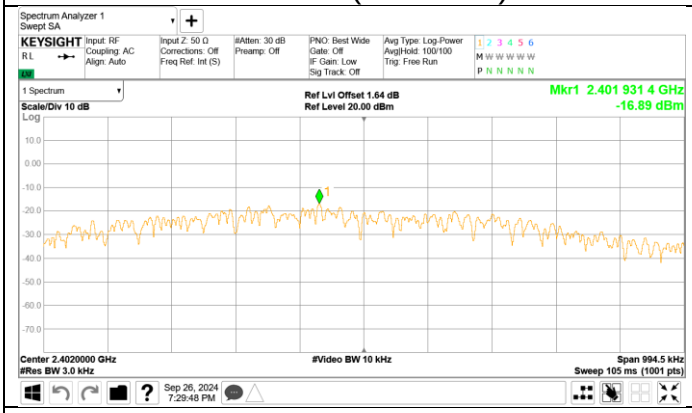
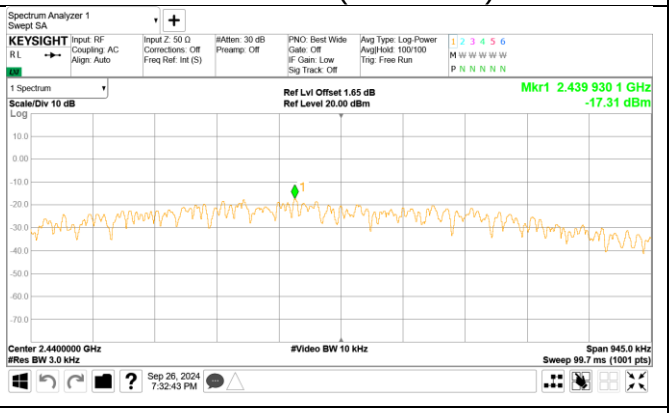
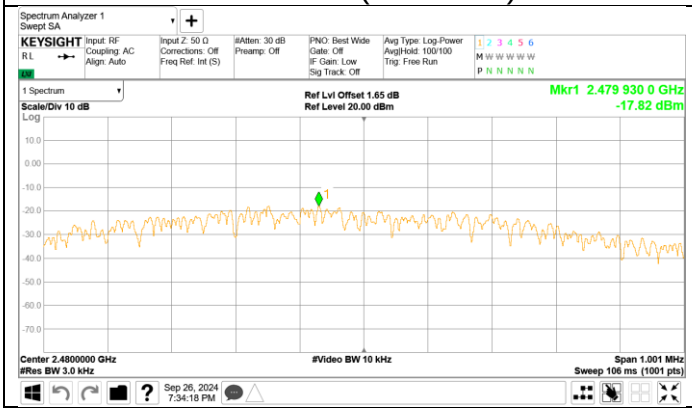
PK PSD (1Mbps)	
Channel 0 (2402MHz)	Channel 19 (2440MHz)
	
Channel 39 (2480MHz)	
	

9.5 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
5. The level displayed must comply with the limit specified in this Section. Submit these plots.
6. Repeat above procedures until all frequencies measured were complete.

Limit

According to §15.247(d), spurious RF conducted emissions limit as below:

Frequency Range MHz	Limit (dBc)
30-25000	-20

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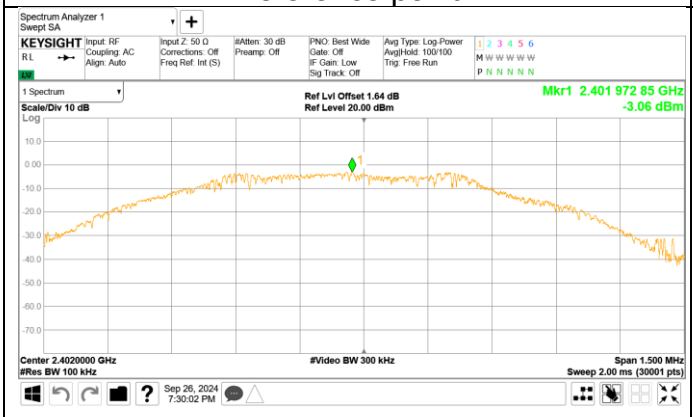
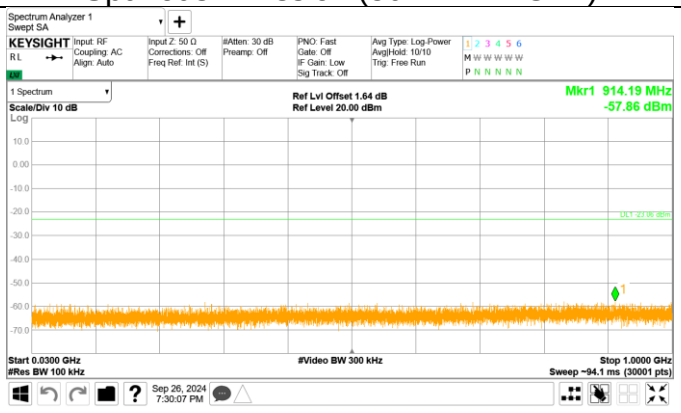
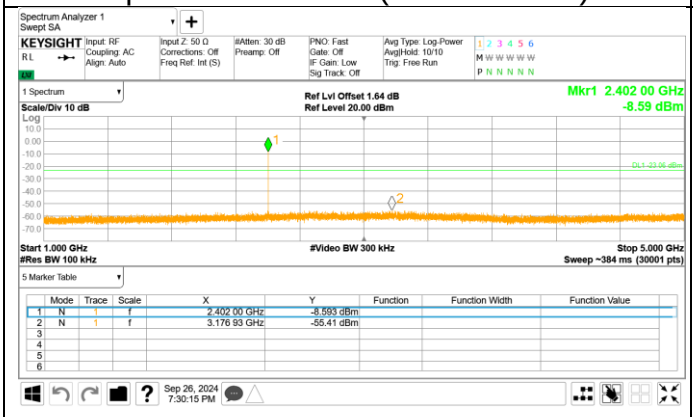
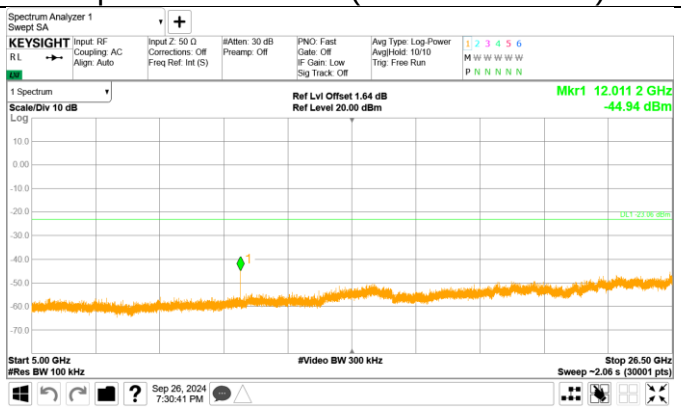
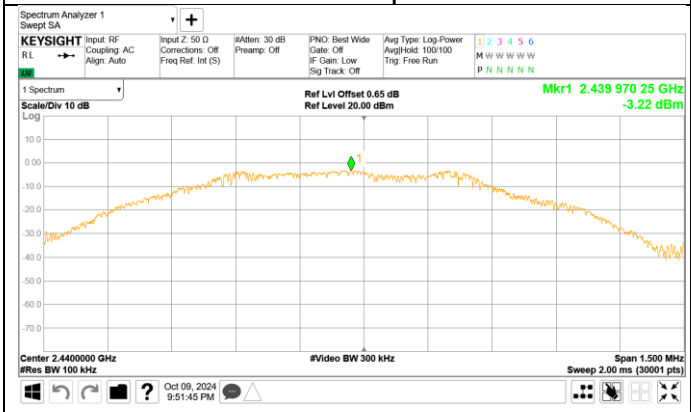
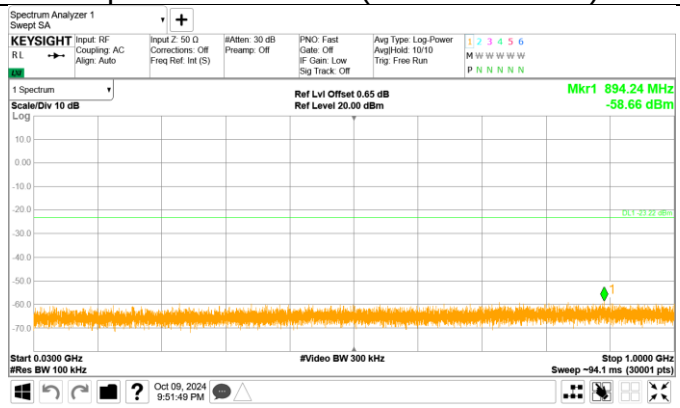
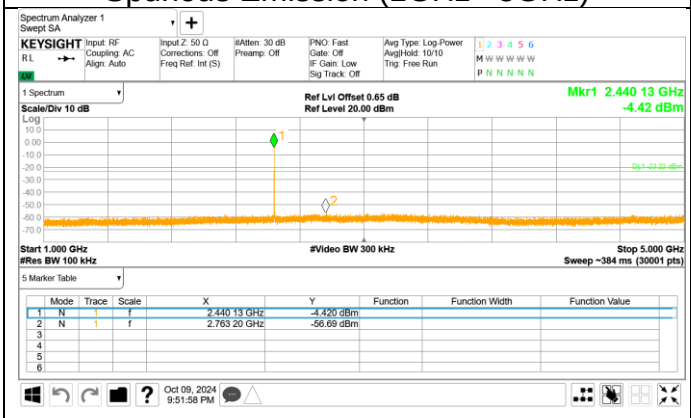
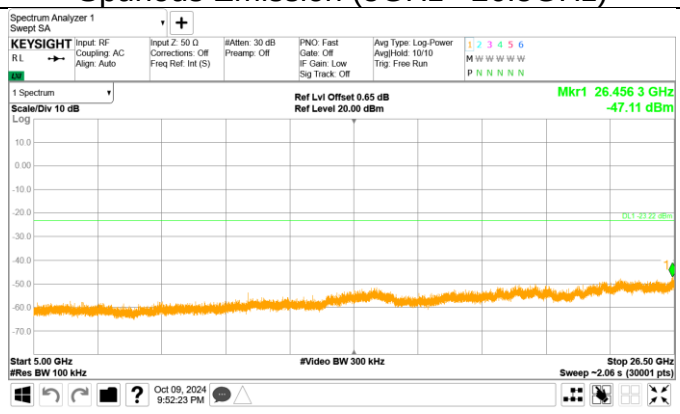
Spurious RF conducted emissions

Out-of-Band Emissions (1Mbps)	
Channel 0 (2402MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

Out-of-Band Emissions (1Mbps)	
Channel 19 (2440MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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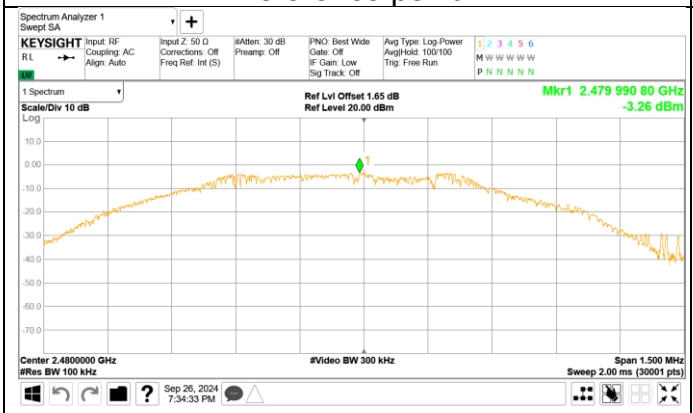
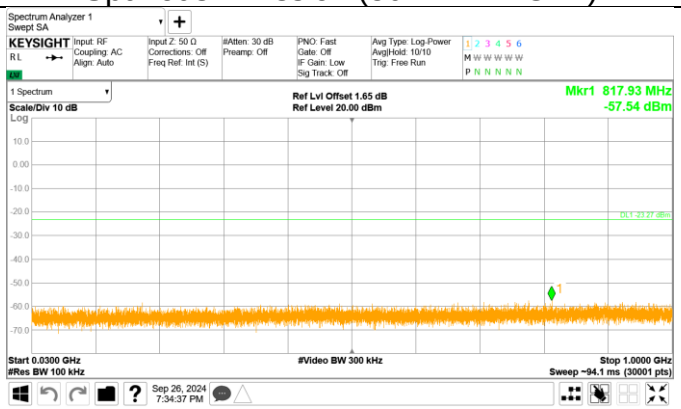
Out-of-Band Emissions (1Mbps)

Channel 39 (2480MHz)

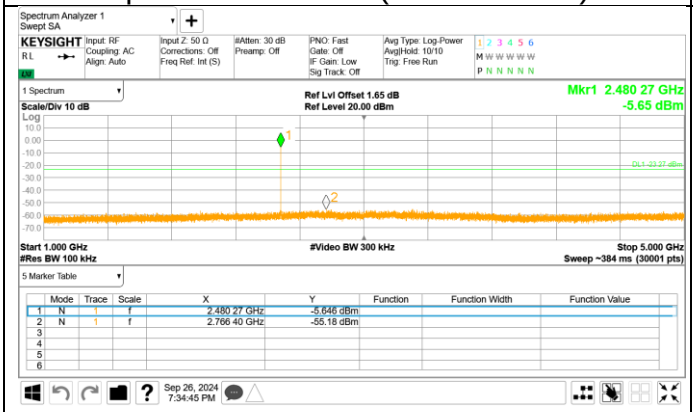
Reference point



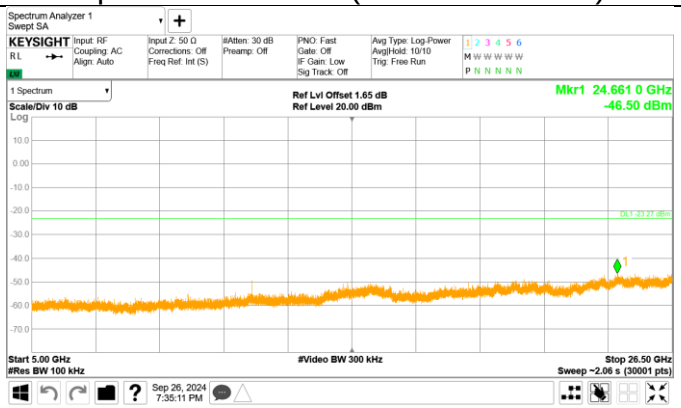
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)



9.6 Band edge

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious
   RBW = 100 kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize, use the peak and delta measurement to record the result.
5. The level displayed must comply with the limit specified in this Section.
6. Repeat above procedures until all frequencies measured were complete and submit all the plots.

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3) and RSS-247 section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB.

According to §15.247(d), band edge limit as below:

Frequency Range MHz	Limit (dBc)
30-25000	-20

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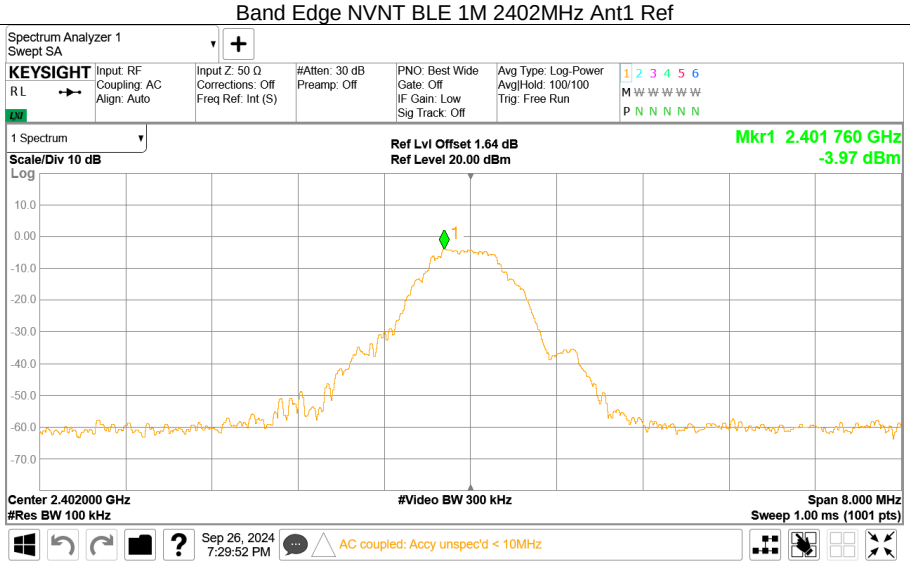
Test result

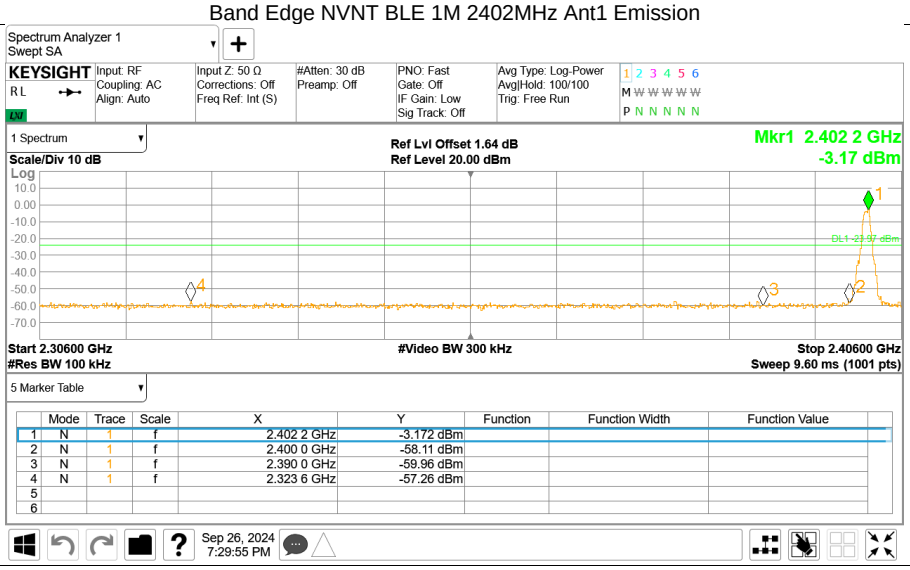
1Mbps

Test Graphs

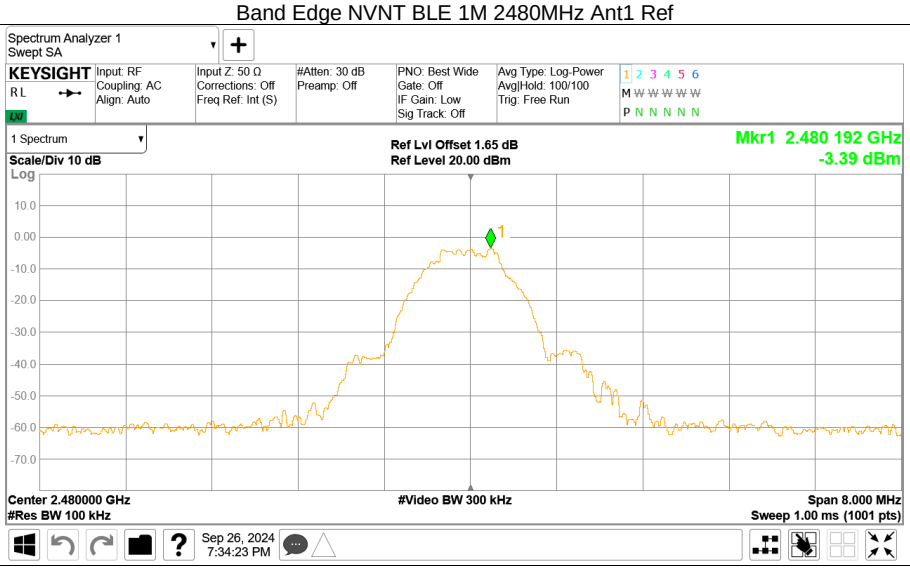
Band Edge NVNT BLE 1M 2402MHz Ant1 Ref



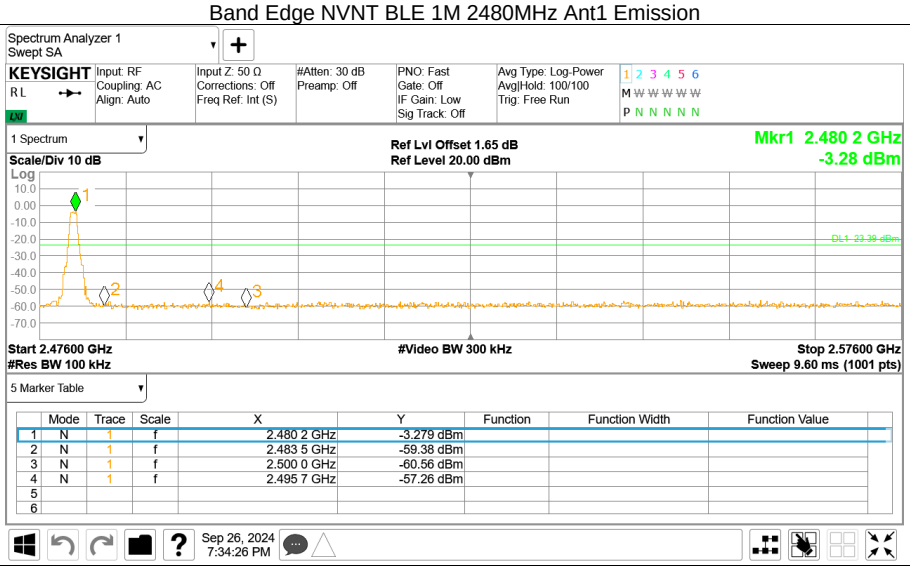
Band Edge NVNT BLE 1M 2402MHz Ant1 Emission



Band Edge NVNT BLE 1M 2480MHz Ant1 Ref



Band Edge NVNT BLE 1M 2480MHz Ant1 Emission



9.7 Spurious radiated emissions for transmitter

Test Method

1. The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. 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.
4. 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.
5. Use the following spectrum analyzer settings According to C63.10

   1) Procedure for Unwanted Emissions Measurements Below 1000 MHz

   Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 kHz to 120kHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

   2) For Peak unwanted emissions Above 1GHz:

   Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

   Procedures for average unwanted emissions measurements above 1GHz

   a) RBW = 1MHz.

   b) VBW \ [3 × RBW].

   c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.

   d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)

   e) Sweep time = auto.

   f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)

   g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

   1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission (AV) at frequency above 1GHz.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength 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).

Frequency MHz	Field Strength μV/m	Field Strength dBμV/m	Detector	Measurement distance meters
0.009-0.490	2400/F(kHz)	48.5-13.8	AV	300
0.490-1.705	24000/F(kHz)	33.8-23.0	QP	30
1.705-30	30	29.5	QP	30
30-88	100	40	QP	3
88-216	150	43.5	QP	3
216-960	200	46	QP	3
960-1000	500	54	QP	3
Above 1000	500	54	AV	3
Above 1000	5000	74	PK	3

Note 1: Limit 3m(dBμV/m)=Limit 300m(dBμV/m)+40Log(300m/3m) (Below 30MHz)
Note 2: Limit 3m(dBμV/m)=Limit 30m(dBμV/m)+40Log(30m/3m) (Below 30MHz)

Spurious Radiated Emissions for Transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.
Data of measurement within frequency range 9kHz-30MHz is the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report.

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Test result

The worst case of Radiated Emission below 1GHz: Only the worst case listed as below.

30-1000MHz Radiated Emission

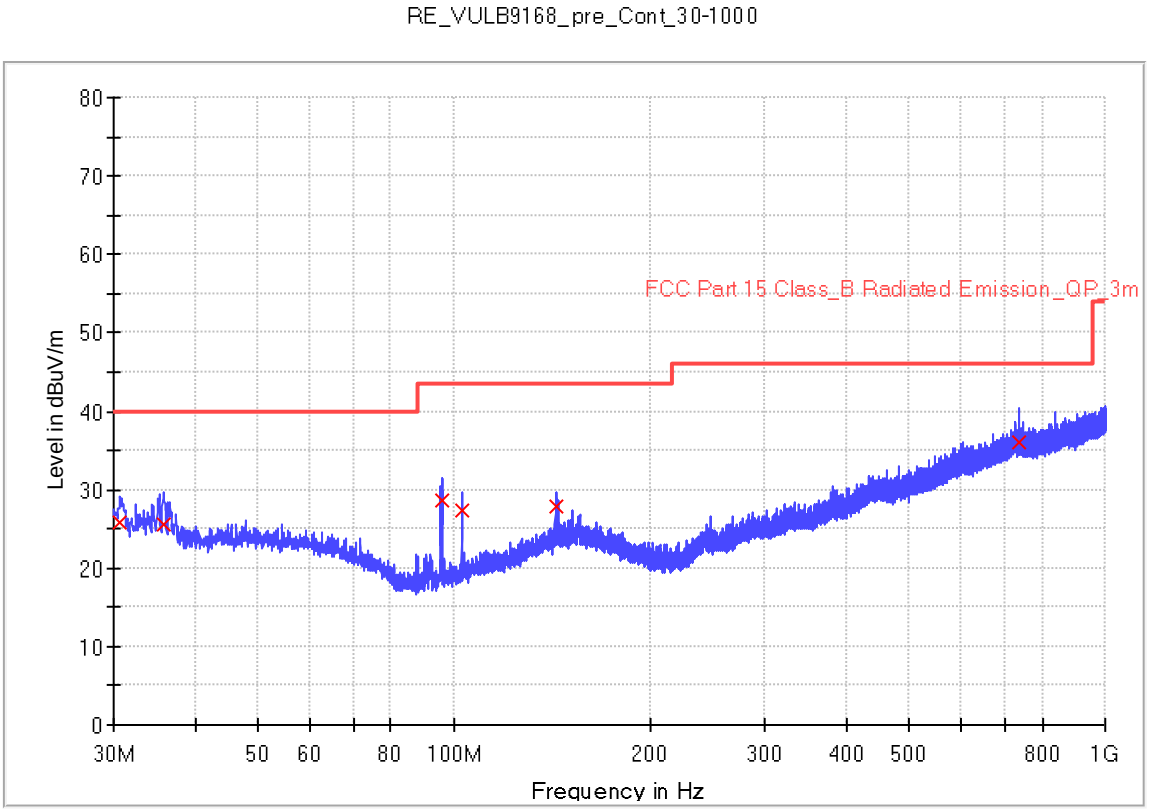
EUT Information

EUT Name:	Tubular motor
Model:	CM-03
Client:	Coulisse B.V.
Op Cond:	Power on and TX at 2402MHz
Operator:	Chengjie GUO
Test Spec:	FCC Part 15.209(a)
Sample No:	SHA-816506-5

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup:	RE_VULB9168
Receiver:	[ESR 3]
Level Unit:	dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB



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Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)
30.720000	25.8	1000.0	120.000	118.6	H	132.0	19.3	14.2
35.760000	25.5	1000.0	120.000	201.2	H	113.0	19.7	14.5
95.800000	28.7	1000.0	120.000	169.6	H	213.0	15.6	14.8
102.720000	27.4	1000.0	120.000	169.1	H	213.0	16.3	16.1
143.440000	28.0	1000.0	120.000	163.0	H	215.0	20.6	15.5
734.960000	36.1	1000.0	120.000	151.1	H	116.0	31.6	9.9

(continuation of the "Limit and Margin" table from column 16 ...)

Frequency (MHz)	Limit - QPK (dBuV/m)
30.720000	40.0
35.760000	40.0
95.800000	43.5
102.720000	43.5
143.440000	43.5
734.960000	46.0

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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30-1000MHz Radiated Emission

EUT Information

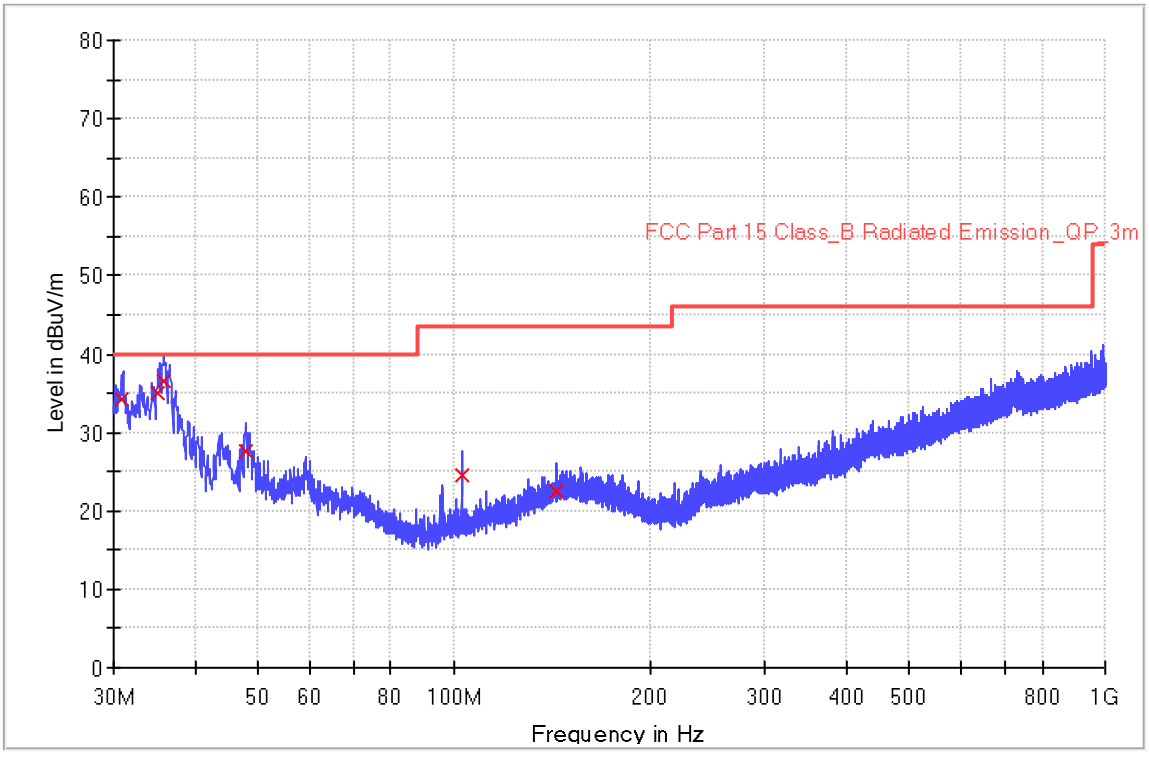
EUT Name:	Tubular motor
Model:	CM-03
Client:	Coulisse B.V.
Op Cond:	Power on and TX at 2402MHz
Operator:	Chengjie GUO
Test Spec:	FCC Part 15.209(a)
Sample No:	SHA-816506-5

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup:	RE_VULB9168
Receiver:	[ESR 3]
Level Unit:	dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB

RE_VULB9168_pre_Cont_30-1000



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Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)
30.880000	34.3	1000.0	120.000	124.3	V	142.0	19.3	5.7
35.080000	34.9	1000.0	120.000	114.2	V	221.0	19.5	5.1
35.800000	36.7	1000.0	120.000	147.5	V	42.0	19.7	3.3
47.800000	27.6	1000.0	120.000	124.2	V	124.0	20.5	12.4
102.640000	24.6	1000.0	120.000	125.3	V	142.0	16.3	18.9
143.720000	22.5	1000.0	120.000	174.8	V	224.0	20.6	21.0

(continuation of the "Limit and Margin" table from column 16 ...)

Frequency (MHz)	Limit - QPK (dBuV/m)
30.880000	40.0
35.080000	40.0
35.800000	40.0
47.800000	40.0
102.640000	43.5
143.720000	43.5

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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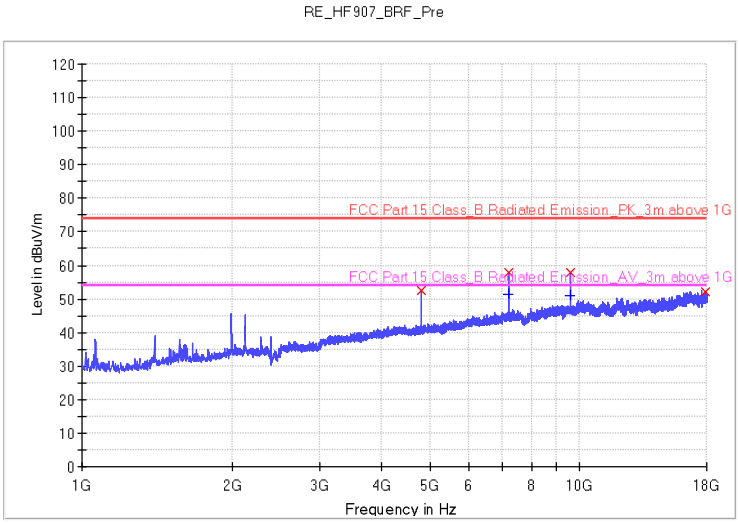
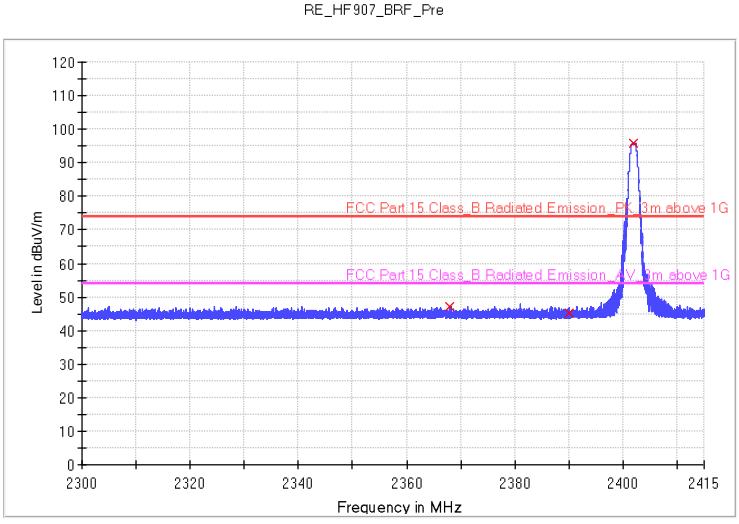
Radiated Emission 1-18GHz

Frequency:2402MHz



Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - RMS (dB)	Limit - RMS (dBuV/m)
4802.200000	52.4	---	153.3	H	138.0	-2.7	21.6	74.0	---	---
7206.400000	57.9	51.2	154.4	H	16.0	0.8	16.1	74.0	2.8	54.0
9609.100000	58.0	51.0	163.8	H	249.0	2.9	16.0	74.0	3.0	54.0
17900.800000	52.0	---	203.3	H	105.0	7.8	22.0	74.0	---	---



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
2368.032000	47.1	148.4	H	152.0	-0.8	26.9	74.0
2390.000000	45.2	101.8	H	177.0	-0.8	28.8	74.0
2402.000000	95.7	107.8	H	173.0	-0.8	/	/

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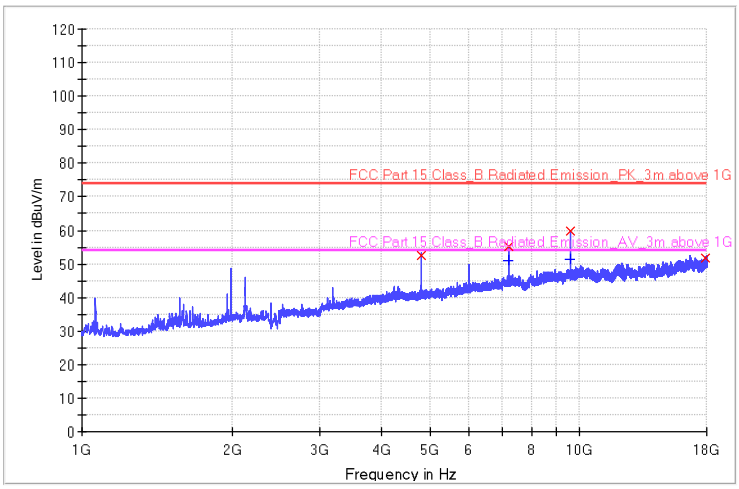
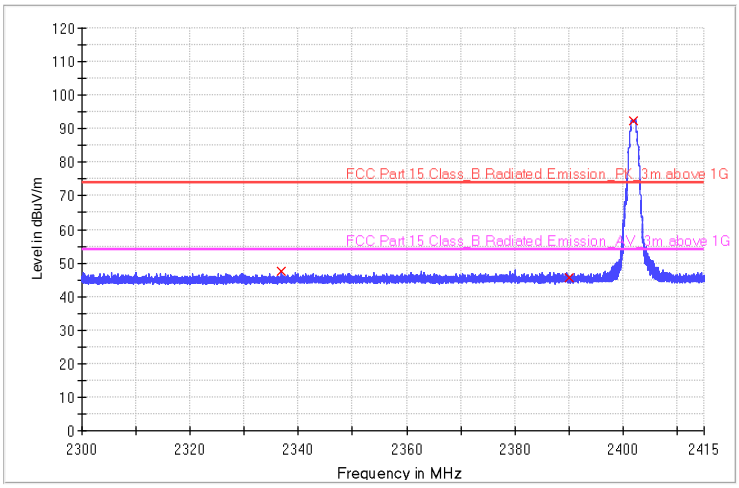
RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - RMS (dB)	Limit - RMS (dBuV/m)
4803.700000	52.5	---	196.5	V	138.0	-2.7	21.5	74.0	---	---
7206.400000	55.3	50.8	138.8	V	168.0	0.8	18.7	74.0	3.2	54.0
9606.100000	59.6	51.3	148.9	V	152.0	2.9	14.4	74.0	2.7	54.0
17855.500000	51.9	---	117.2	V	109.0	7.7	22.1	74.0	---	---

RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
2336.742500	47.4	217.7	V	176.0	-1.0	26.6	74.0
2390.000000	45.7	160.3	V	157.0	-0.8	28.3	74.0
2402.000000	92.4	211.5	V	77.0	-0.8	/	/

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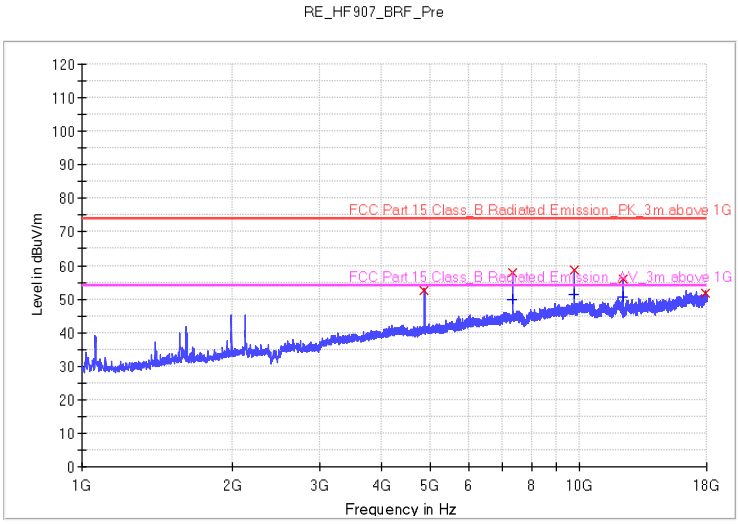
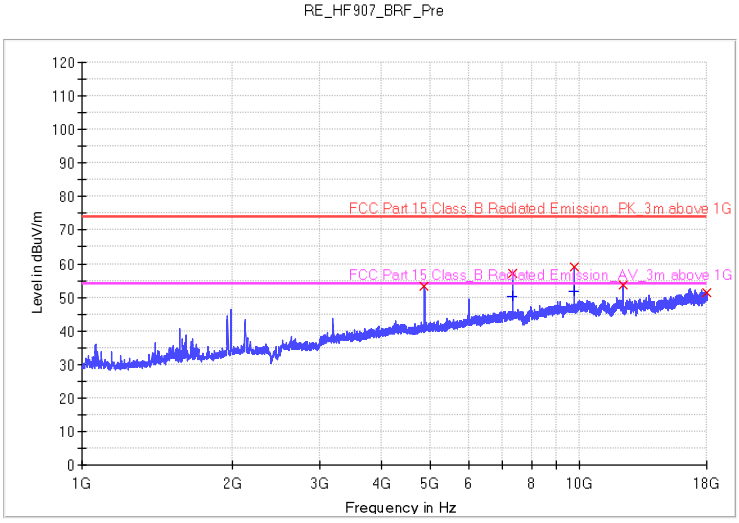
Frequency:2440MHz

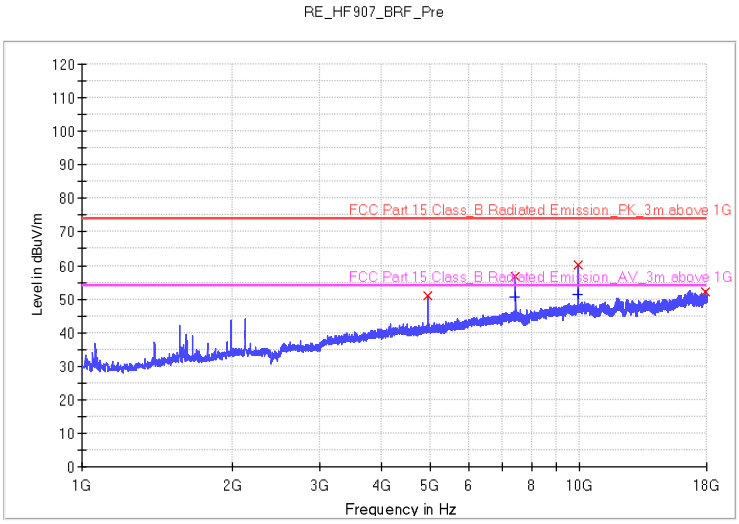


Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - RMS (dB)	Limit - RMS (dBuV/m)
4878.700000	52.6	---	205.7	H	168.0	-2.4	21.4	74.0	---	---
7319.800000	57.9	49.8	215	H	166.0	0.8	16.1	74.0	4.2	54.0
9760.600000	58.8	51.5	199.1	H	240.0	3.1	15.2	74.0	2.5	54.0
12201.700000	55.8	50.7	136.1	H	159.0	5.0	18.2	74.0	3.3	54.0
17905.000000	51.9	---	121.5	H	190.0	7.8	22.1	74.0	---	---

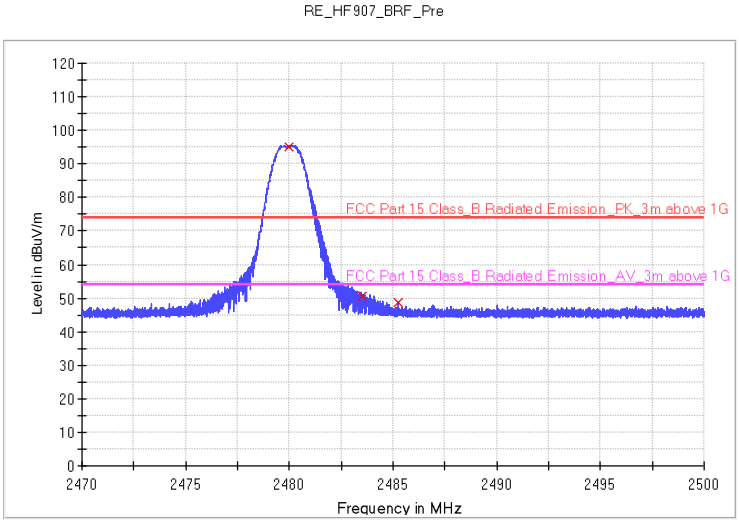


Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - RMS (dB)	Limit - RMS (dBuV/m)
4878.700000	53.3	---	107.8	V	138.0	-2.4	20.7	74.0	---	---
7319.800000	57.3	50.3	143.9	V	154.0	0.8	16.7	74.0	3.7	54.0
9759.100000	58.9	51.9	143.9	V	195.0	3.1	15.1	74.0	2.1	54.0
12201.700000	53.7	---	166.5	V	160.0	5.0	20.3	74.0	---	---
17995.600000	51.3	---	173.8	V	124.0	7.9	22.7	74.0	---	---

Frequency:2480MHz



Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - RMS (dB)	Limit - RMS (dBuV/m)
4959.700000	51.1	---	203.4	H	166.0	-2.3	22.9	74.0	---	---
7438.600000	56.7	50.5	214.5	H	135.0	0.8	17.3	74.0	3.5	54.0
9920.800000	60.4	51.4	133.9	H	130.0	3.4	13.6	74.0	2.6	54.0
17848.477700	52.0	---	121.6	H	195.0	7.9	22	74.0	---	---



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
2480.000000	95.0	132.9	H	138.0	-0.3	/	/
2483.500000	50.7	157.7	H	165.0	-0.3	23.3	74.0
2485.227500	48.7	146.6	H	191.0	-0.3	25.3	74.0

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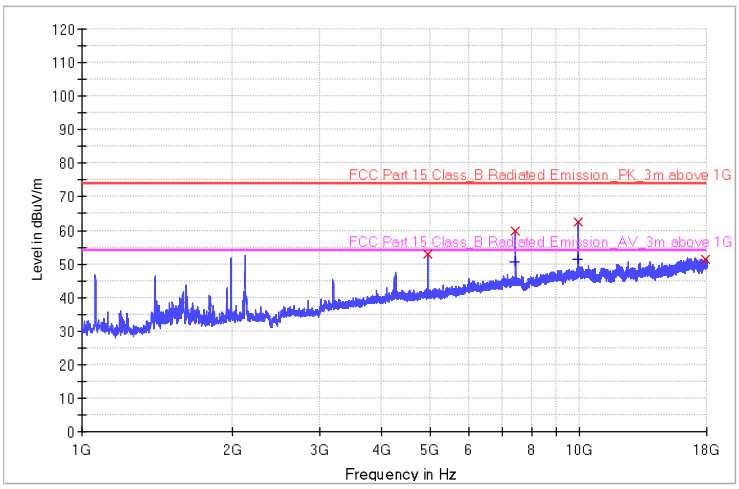
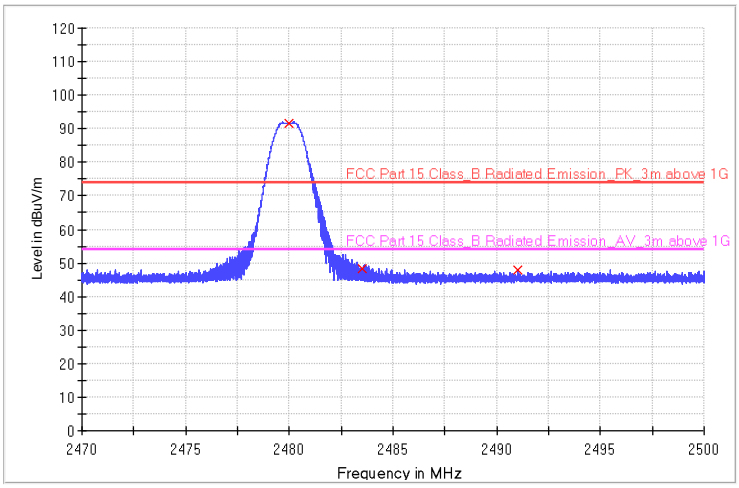
RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - RMS (dB)	Limit - RMS (dBuV/m)
4959.700000	52.9	---	101.3	V	168.0	-2.3	21.1	74.0	---	---
7440.100000	59.7	50.5	198.6	V	251.0	0.8	14.3	74.0	3.5	54.0
9919.300000	62.4	51.4	157.2	V	139.0	3.4	11.6	74.0	2.6	54.0
17906.500000	51.6	---	131.9	V	176.0	7.8	22.4	74.0	---	---

RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
2480.000000	91.8	190	V	135.0	-0.3	/	/
2483.500000	48.2	146.2	V	125.0	-0.3	25.8	74.0
2491.020000	47.9	111.1	V	137.0	-0.3	26.1	74.0

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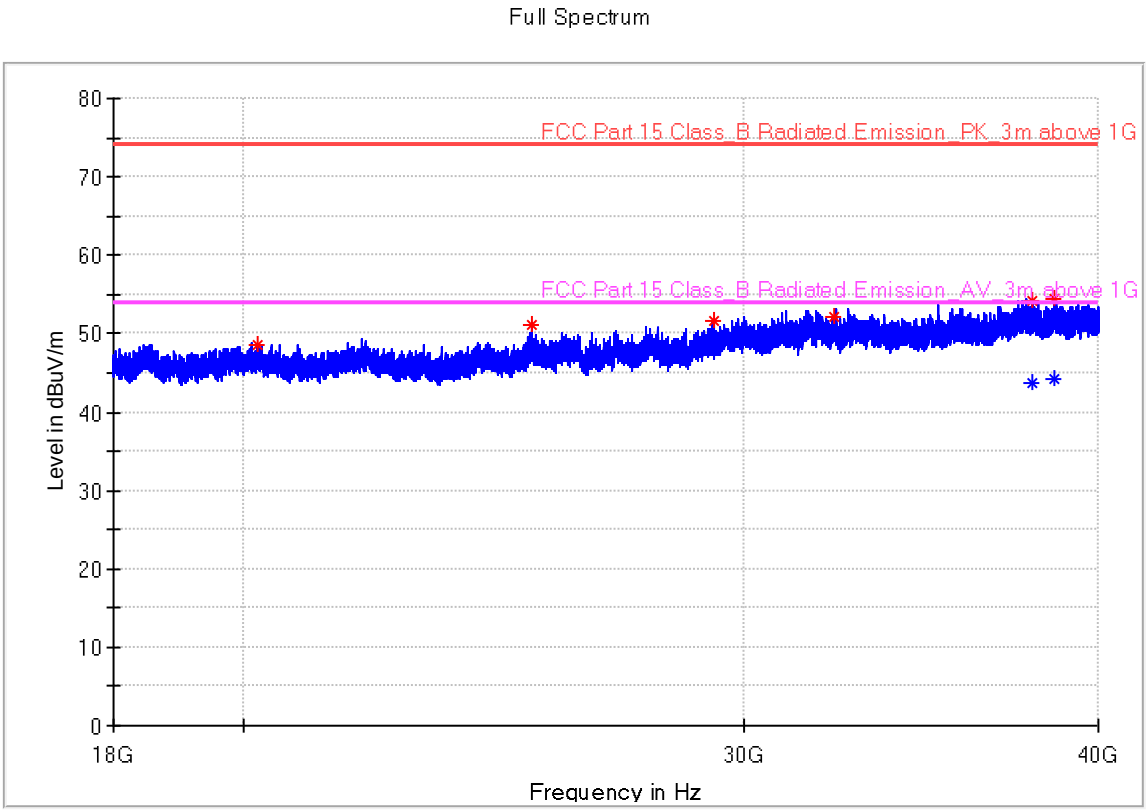
The worst case of Radiated Emission Above 18GHz

Frequency:2480MHz



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20231.625000	48.60	---	74.00	25.40	193	H	166.0	12.6
25266.187500	51.20	---	74.00	22.80	275	H	231.0	13.2
29292.875000	51.65	---	74.00	22.35	194	H	346.0	19.3
32298.625000	52.16	---	74.00	21.84	224	H	324.0	18.9
37915.500000	---	43.82	54.00	10.18	159	H	346.0	18.1
37915.500000	54.24	---	74.00	19.76	178	H	217.0	19.6
38585.125000	---	44.33	54.00	9.67	113	H	346.0	18.1
38585.125000	54.56	---	74.00	19.44	193	H	339.0	18.1

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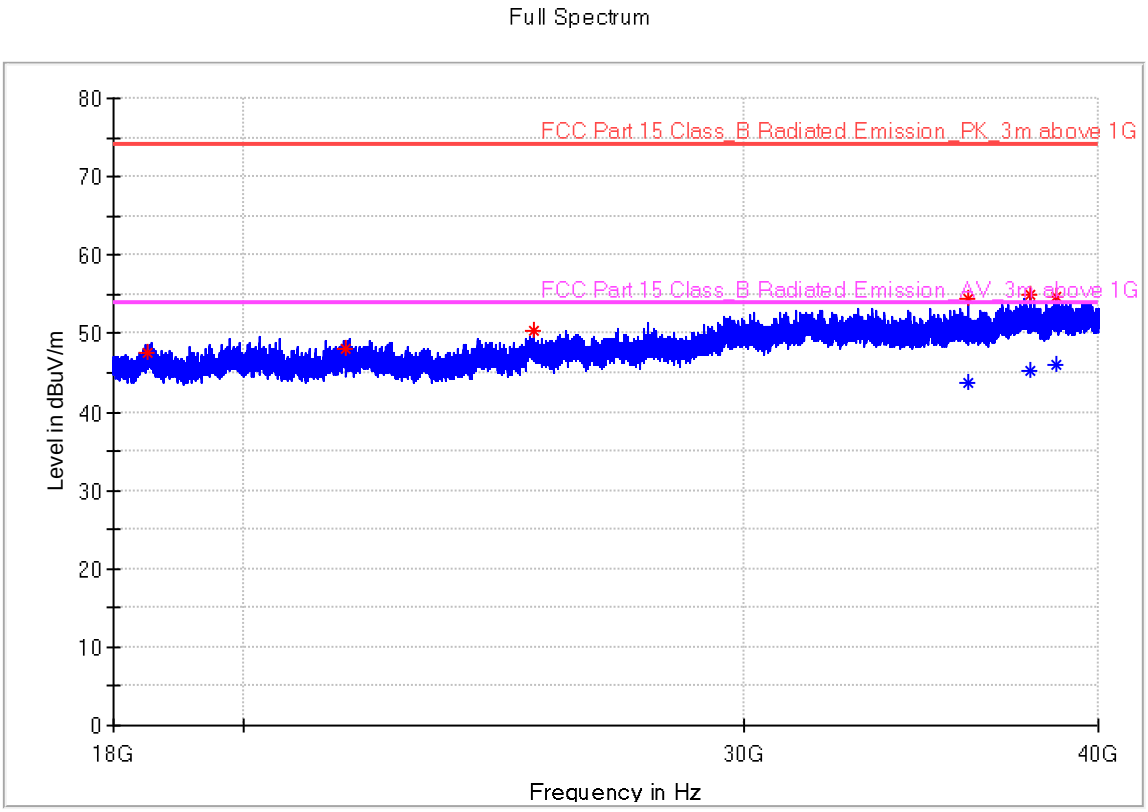

Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18515.625000	47.47	---	74.00	26.53	184	V	126.0	9.7
21741.375000	48.14	---	74.00	25.86	230	V	81.0	15.4
25303.312500	50.33	---	74.00	23.67	240	V	300.0	13.8
36022.150000	54.55	---	74.00	19.45	196	V	227.0	17.5
36022.150000	---	43.75	54.00	10.25	177	V	307.0	17.5
37882.500000	---	45.24	54.00	8.76	129	V	220.0	19.7
37882.500000	54.91	---	74.00	19.09	287	V	198.0	19.6
38655.250000	---	46.17	54.00	7.83	184	V	88.0	15.6
38655.250000	54.65	---	74.00	19.35	230	V	103.0	17.9

Remark:

(1) Emission level= Original Receiver Reading + Correct Factor
(2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
(3) Margin = limit – Corrected Reading

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10 Test Equipment List

List of Test Instruments
Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE	CAL. DUE DATE
C	Signal spectrum analyzer	Agilent	N9020B	MY59050168	2024-2-19	2025-2-18
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2023-8-1	2024-7-31
	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2024-8-1	2025-7-31
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2023-8-1	2024-7-31
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2024-8-1	2025-7-31
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2021-9-23	2024-9-22
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2024-8-30	2025-8-29
	Double-ridged waveguide horn antenna	Rohde & Schwarz	HF907	102393	2024-4-14	2027-4-13
	Pre-amplifier	Shenzhen HzEMC	HPA-081843	HYPA23026	2024-4-16	2025-4-15
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2024-6-26	2025-6-25
	Double Ridged Horn Antenna	ETS-Lindgren	3116C	00246076	2023-7-7	2026-7-6
	3m Semi-anechoic chamber	TDK	9X6X6	----	2024-5-8	2027-5-7
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2023-8-1	2024-7-31
	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2024-8-1	2025-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2023-8-1	2024-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2024-8-1	2025-7-31

Measurement Software Information			
Test Item	Software	Manufacturer	Version
C	MTS 8310	MWRFtest	3.0.0.0
RE	EMC 32	Rohde & Schwarz	V10.50.40
CE	EMC 32	Rohde & Schwarz	V9.15.03

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Band edge

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Items	Extended Uncertainty
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, 3.16dB
Radiated Disturbance	9kHz to 30MHz, 3.52dB 30MHz to 1GHz, 5.03dB (Horizontal) 5.12dB (Vertical) 1GHz to 18GHz, 5.49dB 18GHz to 40GHz, 5.63dB
RF Conducted Measurement	Power related： 1.16dB Frequency related： 6.00×10^{-8}

Measurement Uncertainty Decision Rule:

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2023, clause 4.3.3.

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12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.

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13 Photographs of EUT

Refer to the < External Photos > & < Internal Photos >.

THE END

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