TEST REPORT

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR23-SRF0062-A Page (1) of (19)	eurofins | KCTL

1. Client

- Name : TOVIS CO., LTD.
- Address : 92, Gaetbeol-ro, Yeonsu-Gu, Incheon, South Korea
- Date of Receipt : 2022-11-16

2. Use of Report : Certification

3. Name of Product / Model : Wireless Power Transmitter / PTM-710K

4. Manufacturer / Country of Origin : TOVIS CO., LTD. / Korea

5. FCC ID : 2A2GT-PTM-710K

6. IC Certificate No. : 30014-PTM710K

6. Date of Test : 2023-01-05 to 2023-01-13

7. Location of Test : ■ Permanent Testing Lab □ On Site Testing
(Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

8. Test method used : FCC Part 15 Subpart C, 15.209
RSS-216 Issue 2 September 2020
RSS-Gen Issue 5 February 2021

9. Test Result : Refer to the test result in the test report

	Tested by	Technical Manager
Affirmation	Name : Hosung Lee (Signature)	Name : Heesu Ahn (Signature)

2023-02-24

Eurofins KCTL Co.,Ltd.

REPORT REVISION HISTORY

Date	Revision	Page No
2023-02-15	Originally issued	-
2023-02-22	Revised frequency	4, 5

Note. The report No. KR23-SRF0062 is superseded by the report No. KR23-SRF0062-A.

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

CONTENTS

1. General information

Client	:	TOVIS CO., LTD.
Address	:	92, Gaetbeol-ro, Yeonsu-Gu, Incheon, South Korea
Manufacturer	:	POWERLABS CO., LTD.
Address	:	#1025, 220, Bugwang-ro, Bucheon-si, Gyeonggi-do, Republic of Korea
Laboratory	:	Eurofins KCTL Co.,Ltd.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056 CAB Identifier: KR0040 ISED Number: 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	Wireless Charger
Model	:	PTM-710K
Modulation technique	:	ASK
Frequency range	:	111 ㎑ ~ 205 ㎑ (WPT)
Power source	:	DC 12 Ⅴ
Antenna specification	:	Coil Antenna
Software version	:	V0.8
Hardware version	:	V0.2
Test device serial No.	:	0001
Operation temperature	:	-30 ℃ ~ 45 ℃

2.1. Companion device information

Equipment	Manufacturer	Model	Serial No.
Phone	Google	Pixel6 Pro	N/A

2.2. Frequency/channel operations

This device contains the following capabilities:
WPT

Frequency (㎑)
111 ~ 205

Table 2.2.1. WPT System

2.3. Worst-Case configuration and mode

Test Case	Description
1	**Charging from EUT to Phone (<10% Power Charging, Fast charging mode)**
2	Charging from EUT to Phone (50~55% Power Charging, Fast charging mode)
3	Charging from EUT to Phone (90~95% Power Charging, Fast charging mode)

According to current client device's battery level, test results are different. Because the test result were worst when the battery level was below 10%, tests were performed when the battery level was below 10%.(Client device)

Test results of case 1 is worst, so this test report described test case 1.

2.4. Normal and extreme test conditions

- Ambient Conditions

Item	Temperature [℃]	Relative humidity [%]
Requirement for tests	15 to 35	20 to 75
Ambient Conditions	21	51

- Test Conditions

Test condition	Temperature [℃]	Voltage [V]
NTNV	21	DC 12

Note 1 : N:Normal T:Temperature V:Voltage

3. Antenna requirement

Requirement of FCC part section 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.

Requirement of RSS-Gen Section 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

- The transmitter has permanently attached Coil antenna(Internal antenna) on board.

4. Summary of tests

FCC Part section(s)	IC Rule reference	Parameter	Test mode	Test results
15.209	RSS-216	Field Strength of Fundamental and Spurious Emission	Radiated	Pass
2.1049	-	20dB Bandwidth	Conducted	Pass
-	RSS-Gen Issue 5 (6.7)	Occupied Bandwidth		Pass
15.203	RSS-Gen Issue 5 (6.8)	Antenna requirement		Pass
15.207	RSS-Gen Issue 5 (8.8)	AC Conducted Emission		Pass

Notes:

1. The test results shown in the following sections represent the worst case emissions.
2. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that X orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in X orientation.
3. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013
4. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty (±)	
Radiated spurious emissions	9 kHz ~ 30 MHz	2.4 dB
Conducted emissions	9 kHz ~ 150 kHz	1.6 dB
	150 kHz ~ 30 MHz	1.7 dB

6. Classification of WPT Devices

6.1. WPT Source Subassembly

There are three possible types of WPT source subassemblies, as described in this sub-section.

6.1.1. Type 1 (Interference-causing Equipment)

Type 1 includes WPT source subassemblies that are incapable of transmitting any form of intelligent communication wirelessly 9including communication related to power transfer management). Type 1 WPT source subassemblies are classified as interference-causing equipment, specifically Industrial, Scientific and Medical (ISM) equipment.

6.1.2. Type 2 (Category II Radio Apparatus)

Type 2 includes all WPT source subassemblies that use some form of modulation on the wireless power transfer frequency for transmitting information (including WPT source subassemblies using load modulation techniques – see definition in section 4.7) and that comply with the following two conditions:

(i) Fundamental emissions are below 490 ㎑; and

(ii) All emission radiated by the device are at least 40 ㏈ below the general field strength limits for licence-exempt radio apparatus set out in RSS-Gen – General Requirements for Compliance of Radio Apparatus.

Type 2 WPT source subassemblies are classified as Category II radio apparatus, as per RSS-Gen.

6.1.3. Type 3 (Category I Radio Apparatus)

Type 3 includes all WPT source subassemblies that cannot be classified as either Type 1 or Type 2, i.e. WPT source subassemblies that use some form of modulation on the power transfer frequency for transmitting intelligent communication and which do not meet one or both of the conditions listed in section 1.2.1.2.

Type 3 WPT source subassemblies are classified as Category I radio apparatus, as per RSS-Gen, and require certification.

6.2 WPT Client Subassembly

The WPT subassembly of a WPT client device is only able to receive electromagnetic energy and is unable to transmit is (see definition in section 4.2). As such, this subassembly is classified as interference-causing equipment, specifically ISM equipment.

6.3 Wireless Transmitters

A wireless transmitter module or subassembly intentionally transmits radiated electromagnetic energy on a frequency other than the wireless power transfer frequency of the WPT device (i.e. on a secondary frequency, as defined in section 4.9). This type of module or subassembly is designated as a Category II radio apparatus if it satisfies both conditions (i) and (ii) from section 1.2.1.2; otherwise, it is a Category I radio apparatus and it requires certification.

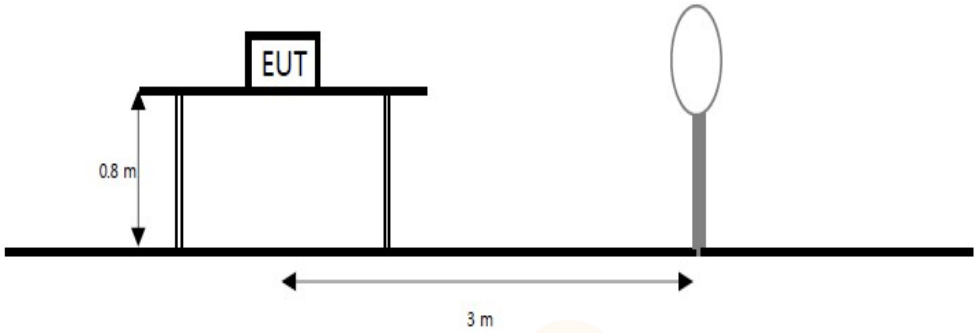
Both WPT sources and WPT clients may include wireless modules.

7. Test results

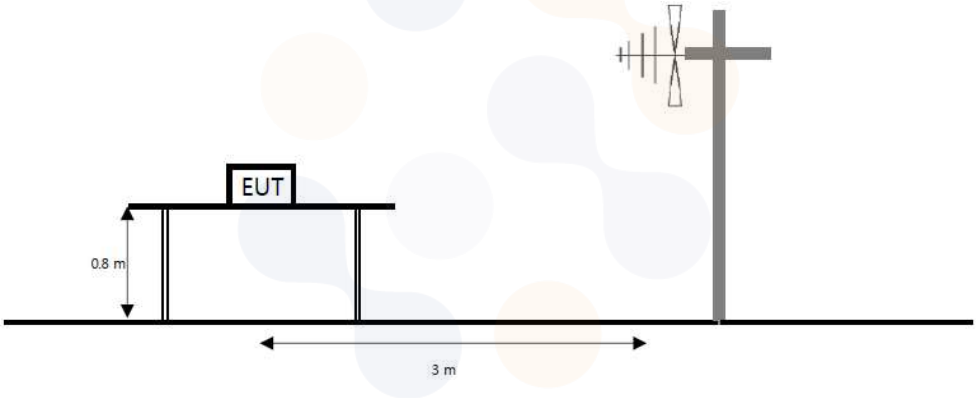
7.1. Field Strength of Fundamental and Spurious Emission

Test setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



Limit

FCC

According to section 15.209(a). Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (㎒)	Field strength (㎶/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(㎑)	300
0.490 - 1.705	24 000/F(㎑)	30
1.705 - 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 ㎒, 76–88 ㎒, 174–216 ㎒ or 470–806 ㎒. However, operation within these frequency bands is permitted under other sections of this part, e.g., Section15.231 and 15.241.

IC

According to section RSS-216(6.2.2.2), the magnetic field radiated emissions within 9 ㎑– 30 ㎒ from the WPT subassembly of WPT source and client devices and WPT systems shall comply with the limits for induction cooking (group 2) equipment, as set out in the CISPR 11 standard referenced in ICES-001. The preferred test method for WPT devices that may be used in residential environments and that have a maximum dimension of less than or equal to 1.6m is the test method using the van Veen loop antenna system, as per the CISPR 11 standard referenced in ICES-001. However, it is acceptable to use the alternate **60 cm loop test method** and corresponding limit for these small residential WPT devices (the same as for commercial / industrial and large residential devices).

Frequency range (㎒)	Limits in dB(㎂/m) at 3m distance Quasi-peak
0.009 to 0.070	69
0.070 to 0.148 5	69 Decreasing linearly with logarithm of frequency to 39
0.148 5 to 4.0	39 Decreasing linearly with logarithm of frequency to 3
4.0 to 30	3
Note. The limits of Table 3b apply to induction cooking appliances for commercial use and those for domestic use with a diagonal diameter of more than 1.6m. Measurements are performed at 3m distance with a 0.6 m loop antenna as described in 5.5.2.1 of CISPR 16-1. The antenna shall be vertically installed, with the lower edge of the loop at 1m height Above the floor.	

Test procedure

ANSI C63.10-2013

Test settings

Test Procedures for emission from 9 ㎑ to 30 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.

b. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.

c. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.

d. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode.

e. Below 30 ㎒ frequency range, all orientations about parallel, perpendicular, and ground-parallel were investigated then reported and the worse orientations of Face-on and Face-off were set for final test.

- Face-on = Parallel, Face-off = Perpendicular

Notes:

1. *f* <30 ㎒, extrapolation factor of 40 ㏈/decade of distance. $F_d = 40\log(D_m/Ds)$
   Where:
   F_d = Distance factor in ㏈
   D_m = Measurement distance in meters
   D_s = Specification distance in meters
2. The test measurement distance is 3 meter
3. Limit (㏈(㎶/m)) = For 0.009 ㎒ - 0.490 ㎒, 20*log(2 400/F(㎑)) ㏈(㎶/m)
   For 0.490 ㎒ - 1.705 ㎒, 20*log(24 000/F(㎑)) ㏈(㎶/m)
   For 1.705 ㎒ - 30 ㎒, 20*log(30) = 29.54 ㏈(㎶/m)

Test results

FCC Radiated Emissions Fundamental & 9 ㎑ to 30 ㎒

[Face-on]

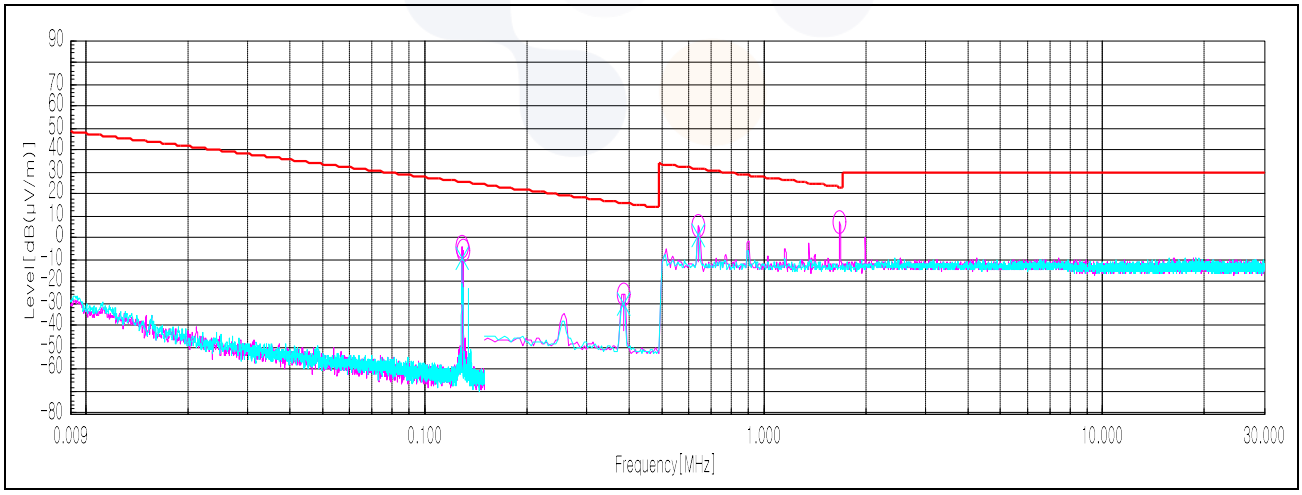
Frequency	Reading	Detector	Ant. Factor	Amp. + Cable	Distance factor	Result	Limit	Margin
(㎒)	(dB(㎶))	Mode	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
0.13	88.00	AV	19.99	-32.42	80.00	-4.43	25.40	29.83
0.13	84.20	AV	19.99	-32.42	80.00	-8.23	25.30	33.53
0.39	64.20	AV	19.90	-32.25	80.00	-28.15	15.90	44.05
0.64	55.60	QP	19.93	-32.20	40.00	3.33	31.40	28.07
1.68	57.60	QP	20.03	-31.93	40.00	5.70	23.10	17.40

[Face-off]

Frequency	Reading	Detector	Ant. Factor	Amp. + Cable	Distance factor	Result	Limit	Margin
(㎒)	(dB(㎶))	Mode	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
0.13	82.40	AV	19.99	-32.42	80.00	-10.03	25.40	35.43
0.39	60.00	AV	19.90	-32.25	80.00	-32.35	15.90	48.25
0.64	50.30	QP	19.93	-32.20	40.00	-1.97	31.40	33.37

Note.

1) -80 is distance factor = 40*log(3/300), -40 is distance factor = 40*log(3/30)



IC Radiated Emissions Fundamental & 9 ㎑ to 30 ㎒

[Face-on]

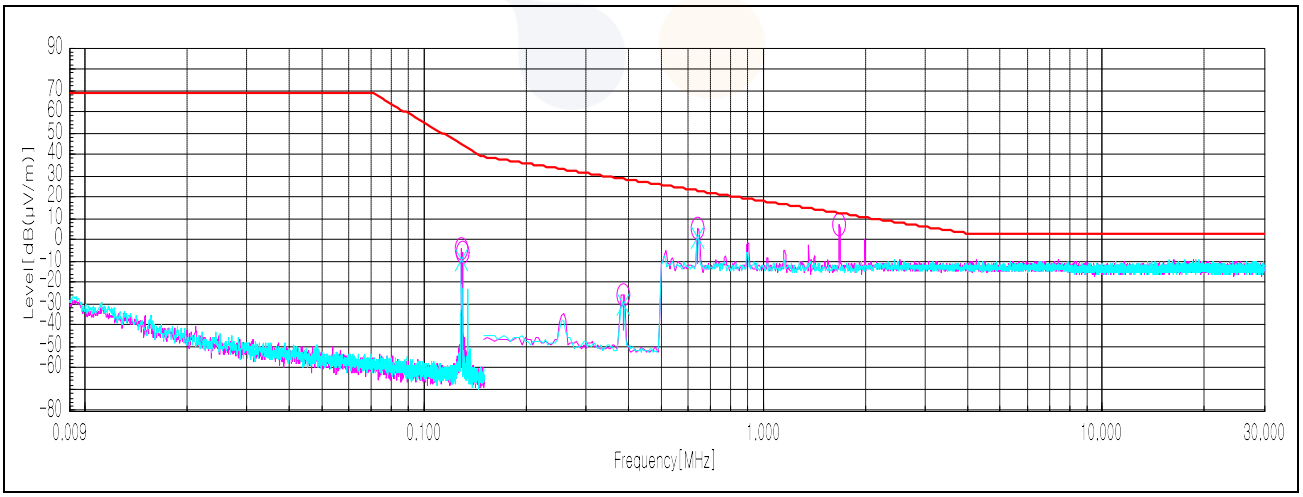
Frequency	Detector	Reading	Ant. Factor	Amp. + Cable	Result	Limit	Margin
(㎒)	Mode	(dB(㎶))	(dB)	(dB)	(dB(㎶/m))	(dB(㎂/m))	(dB)
0.13	AV	88.00	19.99	-32.42	-4.43	44.70	49.13
0.13	AV	84.20	19.99	-32.42	-8.23	44.40	52.63
0.39	AV	64.20	19.90	-32.25	-28.15	28.60	56.75
0.64	QP	55.60	19.93	-32.20	3.33	23.00	19.67
1.68	QP	57.60	20.03	-31.93	5.70	12.50	6.80

[Face-off]

Frequency	Detector	Reading	Ant. Factor	Amp. + Cable	Result	Limit	Margin
(㎒)	Mode	(dB(㎶))	(dB)	(dB)	(dB(㎶/m))	(dB(㎂/m))	(dB)
0.13	AV	82.40	19.99	-32.42	-10.03	44.70	54.73
0.39	AV	60.00	19.90	-32.25	-32.35	28.60	60.95
0.64	QP	50.30	19.93	-32.20	-1.97	23.00	24.97

Note:

1. According to ANSI C63.10:2013, conversion factor from E-field to H-field is considered as free-space Impedance [1㎶/m = (1/377 Ω)* 1㎂/m] = -51.53 dB.
2. Correction Factor(dB) = Antenna Factor + Amp. Gain + Cable Loss + Conversion Factor(dB)

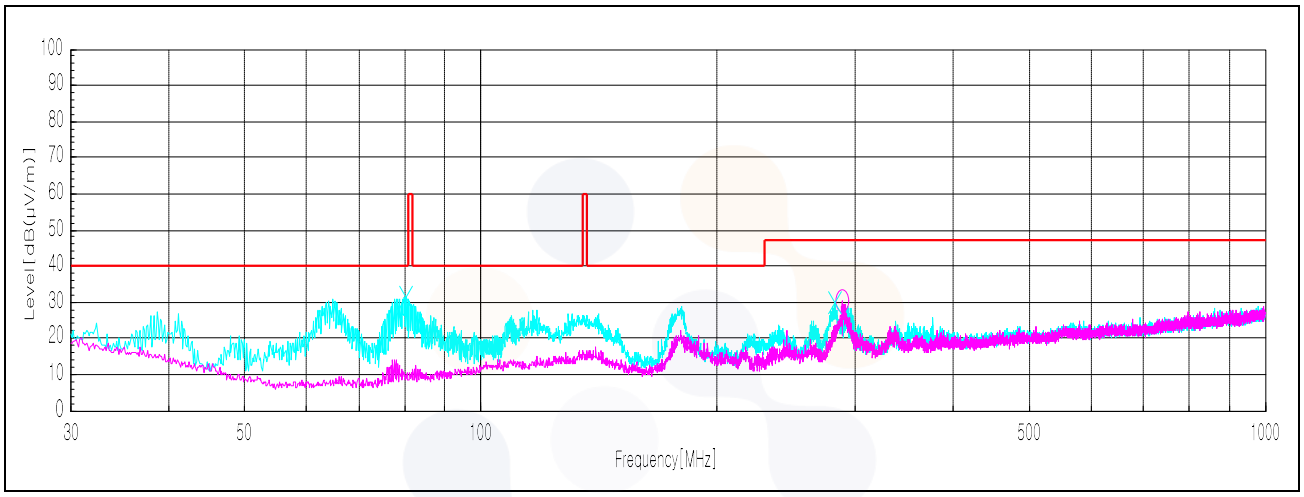


IC Radiated Emissions Fundamental & 30 ㎒ to 1 000 ㎒

Frequency	Pol.	Reading	Ant. Factor	Amp. + Cable	Distance factor	Result	Limit	Margin
(㎒)	[V/H]	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
80.32	V	45.20	13.03	-28.36	-	29.87	40.00	10.13
285.81	V	35.40	18.82	-25.27	-	28.95	40.00	11.05
288.75	H	35.70	18.87	-25.21	-	29.36	40.00	10.64

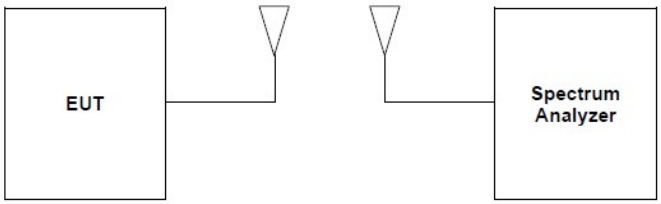
Note:

1. Correction Factor(dB) = Antenna Factor + Amp. Gain + Cable Loss + Conversion Factor(dB)



7.2. 20dB Bandwidth & Occupied Bandwidth

Test setup



Limit

For reporting purpose only

Test settings

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

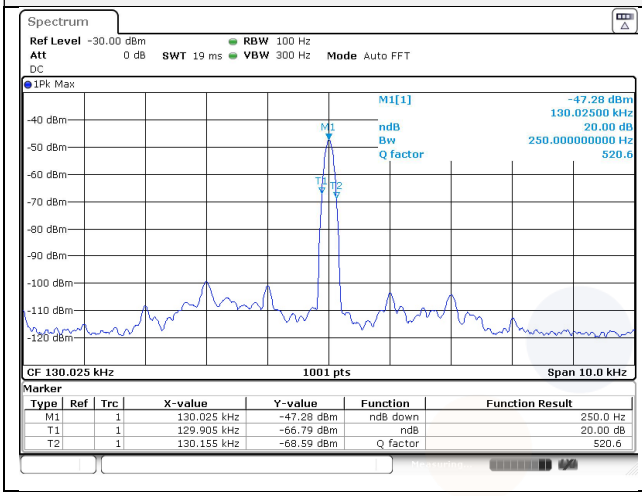
The difference between the two recorded frequencies is the 99% occupied bandwidth.

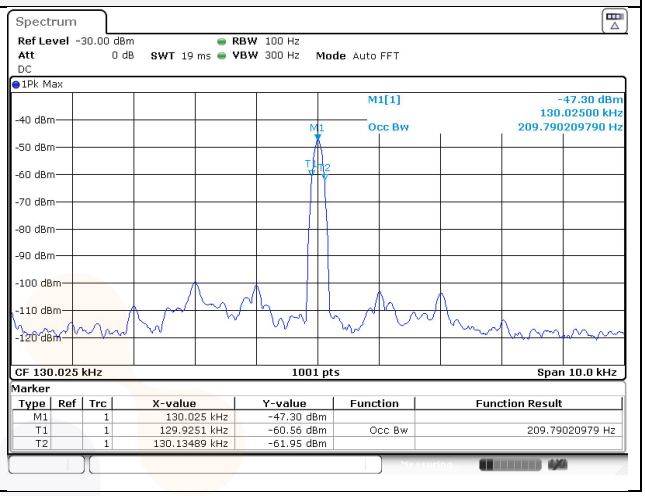
Test results

Frequency (㎑)	20㏈ Bandwidth (㎑)	Occupied Bandwidth (㎑)	Limit
130.025	0.25	0.210	Reporting purpose only

Test Plots

20㏈ Bandwidth	Occupied Bandwidth
130.025 ㎑	130.025 ㎑

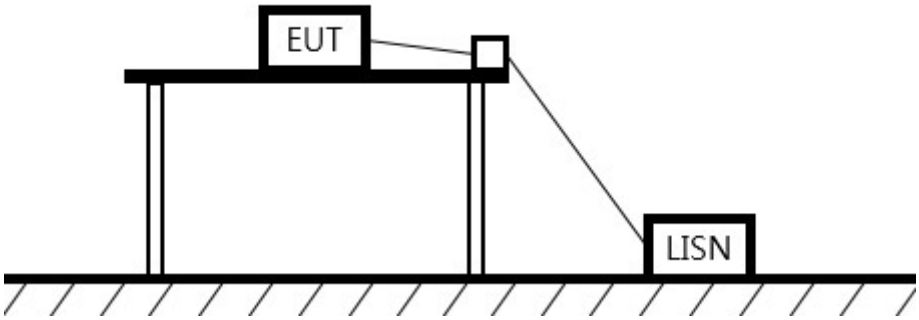




Note. Because the measured signal is CW/CW-like, adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

7.3. AC Conducted emission

Test setup



Limit

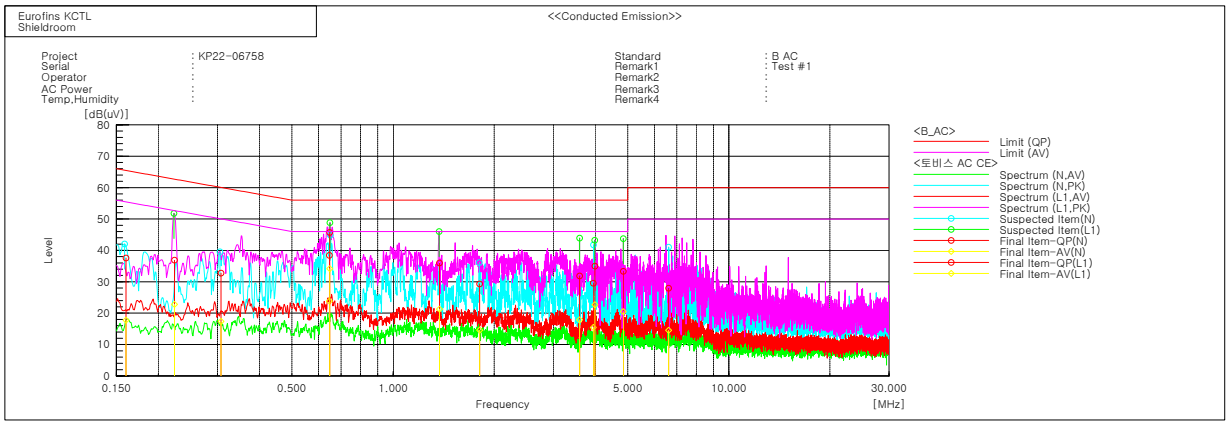
According to 15.207(a) and RSS-Gen(8.8), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (㎒)	Conducted limit (dB㎶/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

Measurement procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 ㎝ in which is located 40 ㎝ away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a spectrum analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 ㎒ to 30 ㎒.
5. The measurements were made with the detector set to peak amplitude within a bandwidth of 10 ㎑ or to quasi-peak and average within a bandwidth of 9 ㎑. The EUT was in transmitting mode during the measurements.

Test results



Final Result

--- N Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.16027	27.6	7.9	9.9	37.5	17.8	65.5	55.5	28.0	37.7
2	0.30755	23.1	7.7	9.7	32.8	17.4	60.0	50.0	27.2	32.6
3	0.6462	28.6	14.0	9.8	38.4	23.8	56.0	46.0	17.6	22.2
4	1.81072	19.6	4.9	9.7	29.3	14.6	56.0	46.0	26.7	31.4
5	3.94971	19.8	5.7	9.7	29.5	15.4	56.0	46.0	26.5	30.6
6	6.62013	18.2	4.8	9.7	27.9	14.5	60.0	50.0	32.1	35.5

--- L1 Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.22343	27.2	13.1	9.7	36.9	22.8	62.7	52.7	25.8	29.9
2	0.64739	35.9	24.4	9.8	45.7	34.2	56.0	46.0	10.3	11.8
3	1.37431	26.3	11.6	9.7	36.0	21.3	56.0	46.0	20.0	24.7
4	3.59411	22.2	8.2	9.7	31.9	17.9	56.0	46.0	24.1	28.1
5	3.99382	25.3	13.0	9.7	35.0	22.7	56.0	46.0	21.0	23.3
6	4.84959	23.6	10.8	9.7	33.3	20.5	56.0	46.0	22.7	25.5

8. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV30	101437	23.07.12
DC Power Supply	AGILENT	E3632A	MY51220373	23.07.11
Attenuator	API Inmet	40AH2W-10	18	23.05.03
Signal Generator	R&S	SMB100A	176206	24.01.19
EMI TEST RECEIVER	R&S	ESCI7	100732	23.03.04
Loop Antenna	R&S	HFH2-Z2	100355	24.08.10
AMPLIFIER	SONOMA	310N	284608	23.08.18
Turn Table	Innco Systems	DT2000	79	N/A
ISOLATION TRANSFORMER	ONETECH CO., LTD	OT-IT500VA	OTR1-16026	23.03.28
TWO-LINE V - NETWORK	R&S	ENV216	101358	23.09.29
EMI TEST RECEIVER	R&S	ESCI3	100001	23.08.18

End of test report