

FCC Part 15 Subpart B&C §15.247

Test Report

Equipment Under Test	DAVV SMART CRADLE 360
Model Name	OP-DP101GL-BK
Variant Model Name	-
FCC ID	2A05Q-OP-DP101GL-BK
Applicant	OPUS ONE INC.
Manufacturer	HANBO ENC CO., LTD.
Date of Test(s)	2019. 07. 30 ~ 2019. 07. 30
Date of Issue	2019. 08. 01

In the configuration tested, the EUT complied with the standards specified above.

Issue to	Issue by
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Revision history

Revision	Date of issue	Description	Revised by
--	Aug. 01, 2019	Initial	-

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1. Applicant Information

1.1. Details of applicant

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1.2. Manufacturer Information

Manufacturer : HANBO ENC CO., LTD.
Address : 10, Nambusunhwan-ro 57-gil, Yangcheon-gu, Seoul, Korea

2. Laboratory Information

Company name : MOVON CORPORATION
Test site number : FCC, IC (KR0151)
FCC Address : 498-2, Geumeo-ro, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, South Korea
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3. Summary of test results

The EUT has been tested according to the following specifications:

Section in FCC part 15	Description	Result
§15.203	Antenna requirement	C
§15.247(a)(2)	DTS Bandwidth & 99 % bandwidth	N/A
§15.247(b)(e)	Maximum peak conducted output power	N/A
§15.247(e)	Peak Power Spectral Density	N/A
§15.205 §15.209 §15.247(d)	Transmitter radiated spurious emissions, Conducted spurious emission	C
§15.207(a)	AC Conducted power line test	C

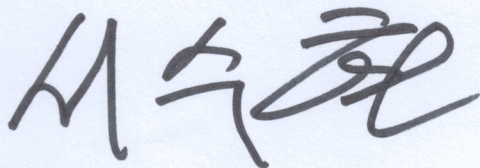
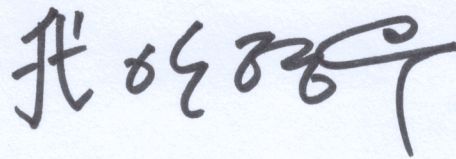
※ Abbreviation

C Complied
N/A Not applicable
F Fail

The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C63.4:2014, ANSI C63.10:2013
FCC Public Notice KDB 558074 D01 v05

Approval Signatories

Test and Report Completed by :	Report Approval by :
	
Suhyun Seo Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

4. EUT Description

Kind of product	DAVV SMART CRADLE 360
Model Name	OP-DP101GL-BK
Variant Model Name	-
FCC ID	2AO5Q-OP-DP101GL-BK
IC Number	-
Power supply	DC 5.0 V
Frequency range	2 412 MHz ~ 2 462 MHz (802.11n_HT20) 2 422 MHz ~ 2 452 MHz (802.11n_HT40)
Modulation technique	OFDM (802.11g/n_HT20, HT40)
Number of channels	11 ch (802.11n_HT20) 7 ch (802.11n_HT40)
Antenna gain	2.82 dB i (Max.)
Test Site Registration Number	FCC (KR0151), IC (24841)

4.1. Table for Test Modes and Frequency (WLAN)

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Mode	Data rate (Worst case)	Frequency (Freq. MHz)
802.11n_HT20	MCS0	Lowest (2 412) / Middle (2 437) / Highest (2 462)
802.11n_HT40	MCS0	Lowest (2 422) / Middle (2 437) / Highest (2 452)

5. Measurement equipment

Equipment	Manufacturer	Model	Serial number	Calibration Interval	Calibration date	Calibration due.
Test Receiver	R&S	ESVS30	829673/015	1 year	2018-12-06	2019-12-06
Signal Generator	R&S	SMB100A	178128	1 year	2018-12-07	2019-12-07
Spectrum Analyzer	R&S	FSV-40	100832	1 year	2019-05-27	2020-05-27
Horn Antenna	R&S	HF906	100236	2 year	2019-04-09	2021-04-09
Horn Antenna	AH Systems	SAS-572	269	2 year	2017-08-01	2020-08-01
Horn Antenna	AH Systems	SAS-573	164	2 year	2018-04-26	2020-04-26
Bi-Log Ant.	S/B	VULB 9161SE	4159	2 year	2018-06-11	2020-06-11
Loop Antenna	ETS LINDGREN	6502	00118166	2 year	2018-10-30	2020-10-30
Power Amplifier	TESTEK	TK-PA18H	170013-L	1 year	2019-05-27	2020-05-27
Power Amplifier	MITEQ	AFS43-01002600	2048519	1 year	2018-10-29	2019-10-29
Power Amplifier	MITEQ	AMF-6F-2600400 0-33-8P-HS	1511665	1 year	2018-12-10	2019-12-10
Controller	INNCO	CO2000	CO2000/064/6961003/ L	N/A	N/A	N/A
Antenna Master	INNCO	MA4000	MA4000/038/6961003/ L	N/A	N/A	N/A
Controller	INNCO	CO3000	CO3000/812/34240914 /L	N/A	N/A	N/A
Antenna Master	INNCO	MA4640-XP-ET	None	N/A	N/A	N/A
RF Cable	SUHNER	SUCOFLEX100	84047746	3 month	2019-06-10	2019-09-10
RF Cable	SUHNER	SUCOFLEX102	801270/2	3 month	2019-06-10	2019-09-10
RF Cable	SUHNER	SUCOFLEX102	801532/2	3 month	2019-06-10	2019-09-10
Band Rejection Filter	Micro-Tonics	BRM50702	064	1 year	2019-05-29	2020-05-29
Test Receiver	R&S	ESR3	101873	1 year	2019-05-27	2020-05-27
Pulse Limiter	R&S	ESH3-Z2	100288	1 year	2019-05-27	2020-05-27
Two Line-V-Network	R&S	ESH3-Z5	100296	1 year	2018-12-06	2019-12-06

※Remark

Support equipment

Description	Manufacturer	Model	Serial number
Notebook computer	DELL	Lattitude D510	-

6. Antenna requirement

6.1. Standard applicable

For intentional device, according to FCC 47 CFR 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. And according to FCC 47 CFR Section §15.247 (c) if transmitting antennas of directional gain greater than 6dBi are used.

6.2. Antenna connected construction

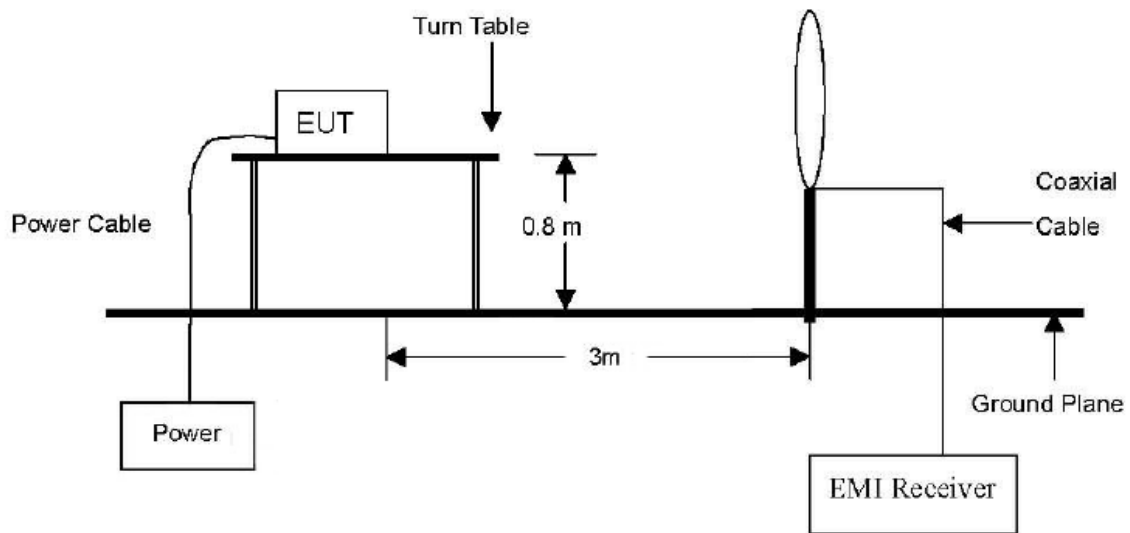
Antenna used in this product is Chip antenna,
Antenna gain is 2.82 dBi.

7. Transmitter radiated spurious emissions and conducted spurious emissions

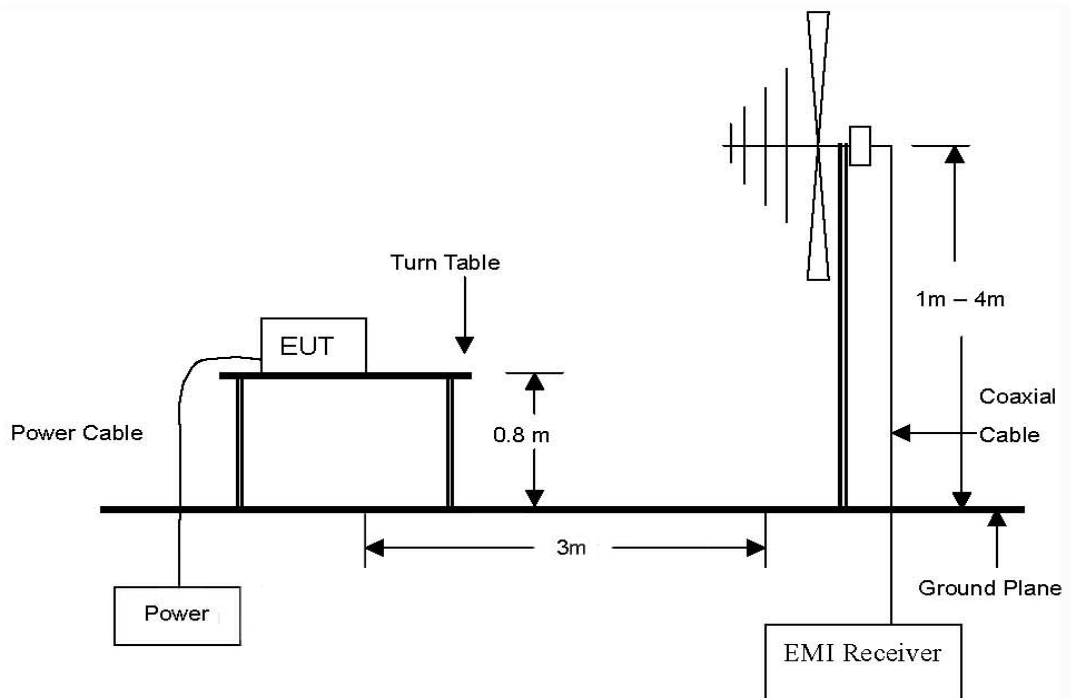
7.1. Test setup

7.1.1. Transmitter radiated spurious emissions

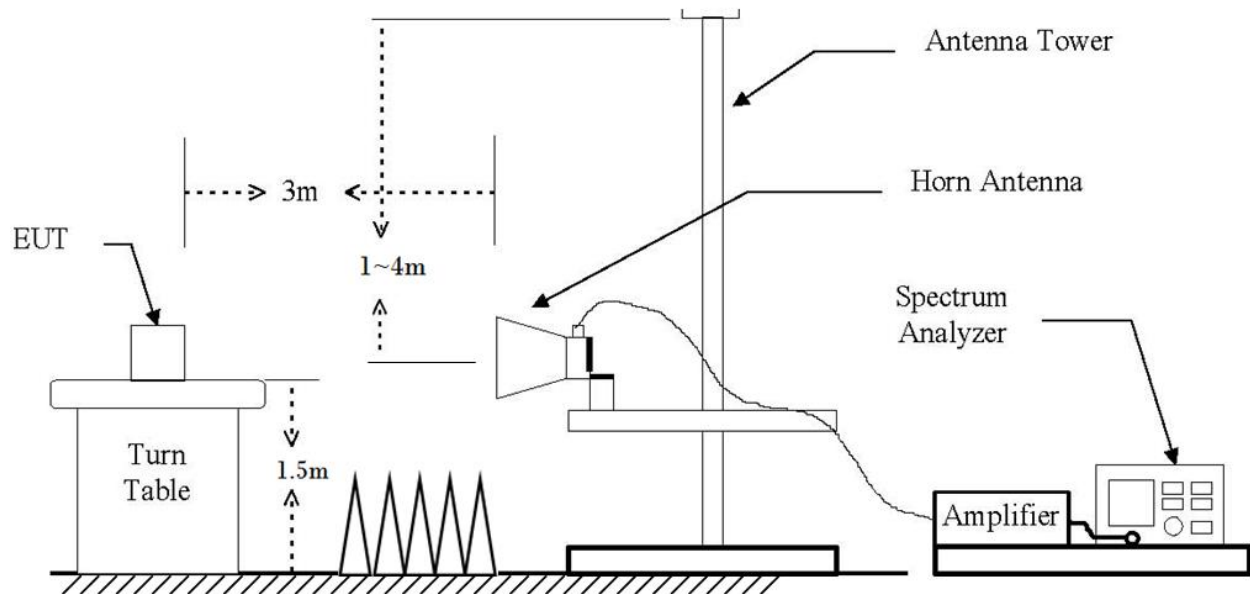
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



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



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 40 GHz emissions.



7.2. Limit

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, 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 section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated at 3M (dBμV/m)	Radiated (μV/m)
0.009–0.490	300	See the remark	2400/F(kHz)
0.490–1.705	30		24000/F(kHz)
1.705–30.0	30		30
30 - 88	3	40.0	100
88 – 216	3	43.52	150
216 – 960	3	46.02	200
Above 960	3	53.97	500

※Remark

1. Emission level in dB uV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Distance extrapolation factor =20log(Specific distance/ test distance)(dB)
Limit line=Specific limits(dB uV) + distance extrapolation factor.

7.3. Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10:2013. In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately.

7.3.1. Test procedures for radiated spurious emissions

1. The EUT is placed on a turntable, which is 0.8 m (Below 1 GHz)/ 1.5 m (Above 1 GHz) above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

※Remark

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for Peak detection (PK) at frequency below 30 MHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

7.3.2. Test procedures for conducted spurious emissions

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=100 kHz, VBW=100 kHz.

7.4. Test results

7.4.1. Radiated spurious emissions (9 kHz to 30 MHz)

The frequency spectrum from 9kHz to 30MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Test mode : 802.11n(HT20)_2 412 MHz (Worst case)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.									

※Remark

1. Actual = Reading + Ant. factor - Amp + CL (Cable loss)

2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

7.4.2. Radiated spurious emissions (30 MHz to 1 000 MHz)

The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Test mode : 802.11n(HT20)_2 412 MHz (Worst case)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
83.93	24.33	QP	V	9.78	2.44	-	36.55	40.00	3.45
Above 100 MHz Not detected									

※Remark

1. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

7.4.3. Radiated spurious emissions & Bandedge (Above 1 000 MHz)

The frequency spectrum above 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Test mode : 802.11n(HT20)

A. Lowest Ch. (2 412 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*2313.00	49.03	Peak	H	28.09	38.78	-	38.34	74.00	35.66
*7254.51	52.82	Peak	V	35.26	32.49	-	55.59	74.00	18.41
*7254.51	41.24	Average	V	35.26	32.49	-	44.01	54.00	9.99
Above 8 000 MHz Not detected									

B. Middle Ch. (2 437 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*7302.96	52.13	Peak	V	35.26	32.49	-	54.90	74.00	19.10
*7302.96	38.67	Average	V	35.26	32.49	-	41.44	54.00	12.56
Above 8 000 MHz Not detected									

※Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
4. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.
5. * is Restricted band.

C. Highest Ch. (2 462 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*2496.68	47.99	Peak	H	28.09	38.78	-	37.30	74.00	36.70
*7346.42	49.42	Peak	V	35.26	32.49	-	52.19	74.00	21.81
Above 8 000 MHz Not detected									

※Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
4. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.
5. * is Restricted band.

Test mode : 802.11n(HT40)

A. Lowest Ch. (2 422 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*2313.00	49.03	Peak	H	28.09	38.78	-	38.34	74.00	35.66
*7254.51	52.82	Peak	V	35.26	32.49	-	55.59	74.00	18.41
*7254.51	41.24	Average	V	35.26	32.49	-	44.01	54.00	9.99
Above 8 000 MHz Not detected									

B. Middle Ch. (2 437 MHz)

Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*7302.96	52.13	Peak	V	35.26	32.49	-	54.90	74.00	19.10
*7302.96	38.67	Average	V	35.26	32.49	-	41.44	54.00	12.56
Above 8 000 MHz Not detected									

※Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
4. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.
5. * is Restricted band.

C. Highest Ch. (2 452 MHz)

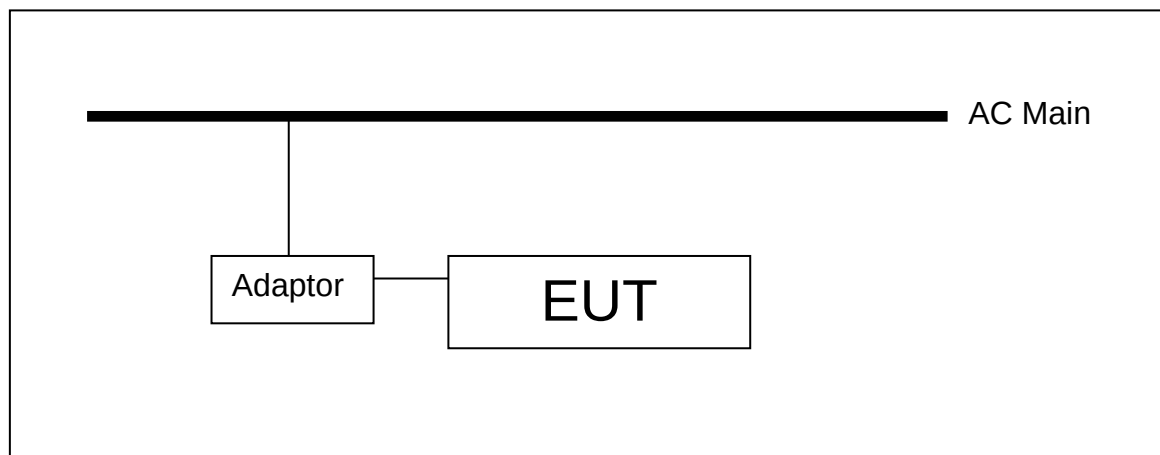
Radiated emissions			Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector Mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Duty factor (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*2496.68	47.99	Peak	H	28.09	38.78	-	37.30	74.00	36.70
*7346.42	49.42	Peak	V	35.26	32.49	-	52.19	74.00	21.81
Above 8 000 MHz Not detected									

※Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
4. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.
5. * is Restricted band.

8. AC Conducted power line test

8.1. Test setup



8.2. Limit

According to §15.107(a) 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 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/50 ohms 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 (MHz)	Conducted limit (dBμV/m)	
	Quasi-peak	Average
0.15 – 0.50	66-56*	56-46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

※Remark

Decreases with the logarithm of the frequency.

8.3. Test procedure

The test procedure is performed in a 6.5 m × 3.6 m × 3.6 m (L×W×H) shielded room. The EUT along with its peripherals were placed on a 1.0m(W)× 1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.

The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

8.4. Test results

Frequency range: 0.15 MHz ~ 30 MHz

Measured bandwidth: 9 kHz

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.15	35.04	---	65.78	30.74	7000.0	9.00	N	GND	9.97
0.16	---	13.79	55.57	41.78	7000.0	9.00	L1	GND	9.98
0.27	---	14.00	51.12	37.12	7000.0	9.00	L1	GND	9.99
0.27	31.30	---	61.00	29.69	7000.0	9.00	N	GND	9.98
0.43	23.79	---	57.25	33.46	7000.0	9.00	N	GND	9.98
0.43	---	10.17	47.18	37.00	7000.0	9.00	L1	GND	9.99
0.69	25.04	---	56.00	30.96	7000.0	9.00	N	GND	10.01
0.70	---	16.55	46.00	29.45	7000.0	9.00	L1	GND	10.01
2.82	---	11.64	46.00	34.36	7000.0	9.00	L1	GND	10.14
2.83	22.15	---	56.00	33.85	7000.0	9.00	L1	GND	10.14
11.32	30.54	---	60.00	29.46	7000.0	9.00	L1	GND	10.95
11.33	---	20.08	50.00	29.92	7000.0	9.00	L1	GND	10.95

※Remark

Line(L1): Hot

Line(N): Neutral

8.4.1 Test plot

