TEST REPORT

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1. Client

- Name : JVM Co., Ltd.
- Address : 121, Hosandong-ro, Dalseo-gu, Daegu, Korea
- Date of Receipt : 2017-12-06

2. Use of Report : -

3. Name of Product and Model : WRITER / ACRS RFID WRITER

4. Manufacturer and Country of Origin : JVM Co., Ltd. / Korea

5. FCC ID : 2AF6G-ACRS-WRITER

6. IC : 23605-ACRSWRITER

7. Date of Test : 2017-12-14 to 2017-12-15

8. Test Standards : FCC Part 15 Subpart C 15.225
RSS-210 Issue 9 August 2016
RSS GEN Issue 4 November 2014

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

Affirmation	Tested by Name : Euijung Kim (Signature)	Technical Manager Name : Jongha Choi (Signature)

2017-12-21

KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2017-12-21	Originally issued	-

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1. Client information

Applicant:	JVM Co., Ltd.
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Manufacturer:	JVM Co., Ltd.
Address:	121, Hosandong-ro, Dalseo-gu, Daegu, Korea

2. Laboratory information

Address

KCTL Inc.

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea

Telephone Number: 82 31 285 0894

Facsimile Number: 82 505 299 8311

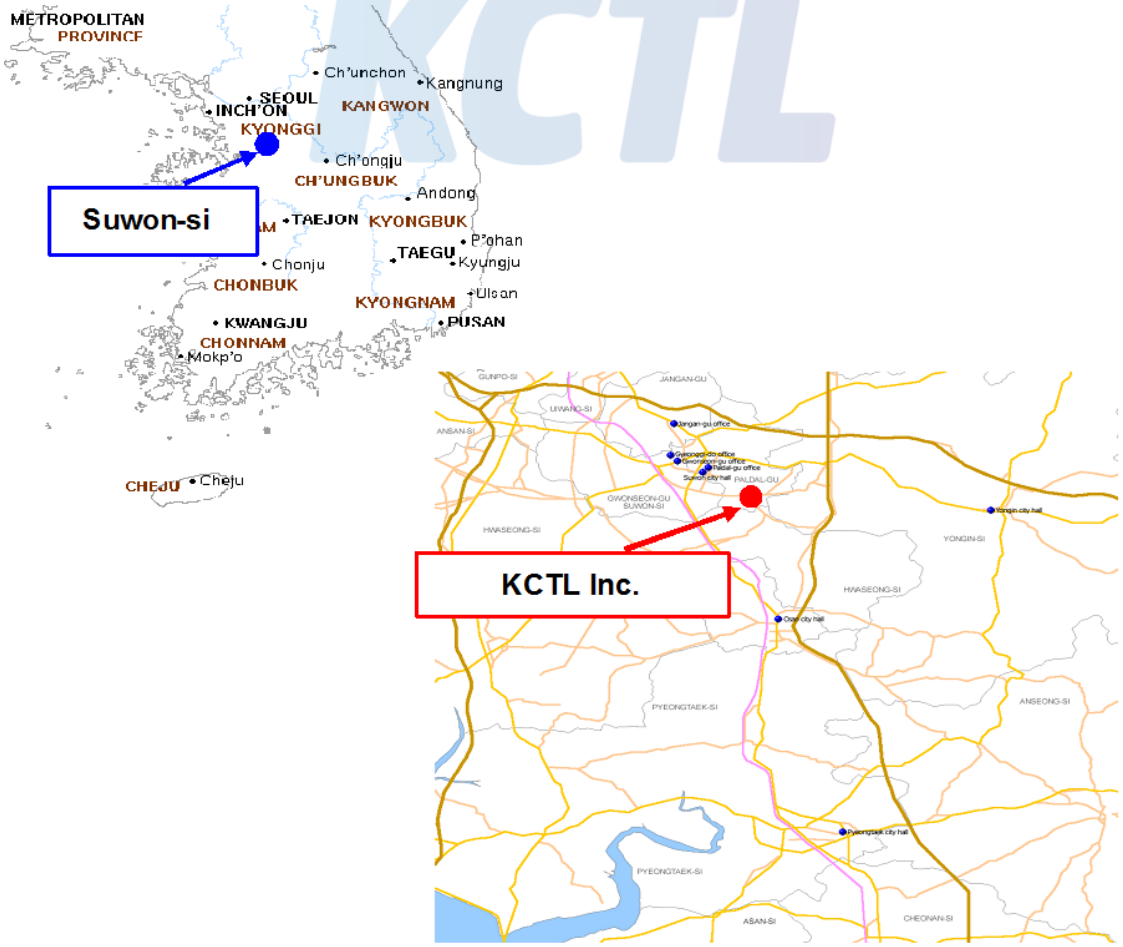
FCC Site Designation No: KR0040, FCC Site Registration No: 687132

VCCI Registration No. : R-3327, G-198, C-3706, T-1849

Industry Canada Registration No. : 8035A

KOLAS NO.: KT231

SITE MAP



3. Description of E.U.T.

3.1 Basic description

Applicant	JVM Co., Ltd.
Address of Applicant	121, Hosandong-ro, Dalseo-gu, Daegu, Korea
Manufacturer	JVM Co., Ltd.
Address of Manufacturer	121, Hosandong-ro, Dalseo-gu, Daegu, Korea
Type of equipment	WRITER
Basic Model	ACRS RFID WRITER
Serial number	N/A

3.2 General description

Frequency Range	13.56 ㎒
Type of Modulation	ASK
The number of channels	1 ch
Type of Antenna	PCB Loop Antenna
Power supply	DC 5.00 V
Product SW/HW version	31BN1-0008-01 / 31BN1-0009-01
Radio SW/HW version	31BN1-0008-01 / 31BN1-0009-01
Test SW Version	Terminal v1.9b
RF power setting in TEST SW	default

Note : The above EUT information was declared by the manufacturer.

3.3 Test frequency

Frequency	13.56 ㎒

4. Summary of test results

4.1 Standards & results

Rule Reference	Parameter	Report Section	Test Result
15.203	Antenna Requirement	5.1	C
15.225 (a), RSS-210, Issue 9, B.6 (a)	In-band Fundamental Emission	5.2	C
15.225 (b), RSS-210, Issue 9, B.6 (b)	In-band Spurious Emission	5.3	C
15.225 (c), RSS-210, Issue 9, B.6 (c)	In-band Spurious Emission	5.4	C
15.225 (d), 15.209, RSS-210, Issue 9, B.6 (d) RSS-GEN, 8.9	Out-of–band Spurious Emission	5.4	C
15.225 (e), RSS-210, Issue 9, B.6	Frequency Stability Tolerance	5.5	C
15.207, RSS-GEN, 8.8	Conducted Emissions	5.6	C
RSS-GEN, 6.6	Occupied Bandwidth	5.7	C

Note1) : C = complies, NC = Not complies, NT = Not tested, NA = Not Applicable
Note2) : The worst case is Y scheme(Please refer to the “Test setup photos” to check X, Y, Z configuration).

4.2 Measurement Uncertainty

Measurement Item	Expanded Uncertainty U = *k*Uc (*k* = 2)	
Radiated Spurious Emissions	30 ㎒ ~ 300 ㎒:	+4.94 ㏈, -5.06 ㏈
		+4.93 ㏈, -5.05 ㏈
	300 ㎒ ~ 1 000 ㎒:	+4.97 ㏈, -5.08 ㏈
		+4.84 ㏈, -4.96 ㏈
	1 ㎓ ~ 25 ㎓:	+6.03 ㏈, -6.05 ㏈
Conducted Emissions	9 ㎑ ~ 150 ㎑:	3.75 ㏈
	150 ㎑ ~ 30 ㎒:	3.36 ㏈

5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

According to §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 replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.1.2 Result

-Complied

The PCB Loop antenna is permanantely attached on PCB board.

5.2 In-band Fundamental Emission

5.2.1 Regulation

15.225 (a) The field strength of any emission within the band 13.553-13.567 ㎒ shall not exceed 15, 848 microvolts/meter at 30 meters.

5.2.2 Measurement Procedure

Test Procedure The Radiated Electric Field Strength intensity has been measured on semi anechoic chamber with a ground plane and at a distance of 3m.

Frequency : From 9 ㎑ to 30 ㎒ at distance 3m The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

Frequency : From 30 ㎒ to 1 ㎓ at distance 3m The measuring antenna height varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for both vertical and horizontal antenna polarization.

Measurements were performed with a QP, PK, and AV detector. The radiated emission measurements were made with the following detector function of the test receiver (below 1 ㎓).

Frequency	9 - 90 ㎑	90 - 110 ㎑	110 - 490 ㎑	490 ㎑ - 30 ㎒	30 ㎒ -1 ㎓
Detecter type	PK/AV	QP	PK/AV	QP	QP
IF bandwidth	200 ㎐	200 ㎐	9 ㎑	9 ㎑	120 ㎑

- Part 15 Section 15.31 (f)(2) (9 ㎑ - 30 ㎒)
[Limit at 3m]=[Limit at 300m]-40 x log(3[m]/300[m])
[Limit at 3m]=[Limit at 30m]-40 x log (3[m]/30[m])

5.2.3 Test Result

- Complied

Voltage [v]	Frequency [㎒]	Reading [dB㎶]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Correction Factor [dB]	field strength dB㎶/m at 3 m	Limit dB㎶/m at 3 m	Margin [dB]
PK DATA.									
5	13.56	52.80	0.91	-32.67	19.56	-12.20	40.60	124.00	83.40

Note : This test was performed by using peak detector mode.
If peak result meets the limit, QP measurement is skipped.

5.3 In-band Spurious Emission

5.3.1 Regulation

15.225 (b) With in the bands 13.410-13.553 ㎒ and 13.567-13.710 ㎒, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

15.225 (c) With in the bands 13.110-13.410 ㎒ and 13.710-14.010 ㎒, the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

5.3.2 Test Result

- Complied

Measurement Distance: 3 m

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB(㎶)]	Pol. [V/H]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
PK DATA.										
13.25	9	39.60	H	1.00	-32.67	19.57	-12.10	27.50	80.50	53.00
13.55	9	42.70	H	0.91	-32.67	19.56	-12.20	30.50	90.50	60.00
13.57	9	46.60	H	0.91	-32.67	19.56	-12.20	34.40	90.50	56.10
13.81	9	41.20	H	0.92	-32.67	19.55	-12.20	29.00	80.50	51.50

Margin (dB) = Limit - Actual
[Result = Reading + Amp Gain + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss
3. Factor = CL+AF+AG

5.4 Out-of-band Spurious Emission

5.4.1 Regulation

15.225 (d) The Field Strength of any emissions appearing outside of the 13.110-14.010 ㎒ band shall not exceed the general radiated emission limits in 15.209

Frequency (㎒)	Field Strength (㎶/m)	Measurement distance (meters)
0.009-0.490	2400/F(㎑)	300
0.490-1.705	24000/F(㎑)	30
1.705-30.0	30(29.54 dB㎶/m)	30
30.0-88.0	100(40 dB㎶/m)	3
88-216	150(43.5 dB㎶/m)	3
216-960	200 (46 dB㎶/m)	3
Above 960	500 (53.98 dB㎶/m)	3

5.4.2 Measurement Procedure

The spurious emissions from the EUT will be measured on an 10 m Anechoic chamber in the frequency range of 9 ㎑ to 30 ㎒ using a tuned receiver and a shielded loop antenna.
The antenna was positioned 3, 10 or 30 meters horizontally from the EUT.
Measurements haver been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions.
In the case where larger measuring distances are required the results will extrapolated based on the values measuring on the closer distances according to Section 15.31 (f) (2) [2].

The final measurement will be performed with an EMI Riceiver set to Quasi Peak detector except for the frequency bands 9 ㎑ to 90 ㎑ and 110 to 490 ㎑ where an average detector will be used according to Section 15.209 (d) [2].

The final lever, expressed in dB㎶/m, is arrived at by taking the reading from the EMI receiver (Level dB㎶) and adding the antenna correction factor and cable loss fator (Factor dB) to it. This result then has to be compared with the relevant FCC limit. The resolution bandwith during the measurement is as follows:
9 ㎑ – 150 ㎑: ResBW: 200 ㎐
150 ㎑ – 30 ㎒: ResBW: 9 ㎑

The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.

The EUT was placed on the top of the 0.8 meter height, 1 x 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
The antenna polarization was also changed from vertical to horizontal. The spectrum was canned from 30 to 1 000 ㎒ using the BILOG antenna. To obain the final measurement data, the EUT was arranged on a turntable situated on a 10 m chamber. The EUT was tested at a distance 3 meters.
Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

5.4.3 Test Result

- Complied

Measurement Distance: 3 m

-Below 30 ㎒

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB(㎶)]	Pol. [V/H]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
PK DATA.										
2.09	9	44.40	H	0.98	-32.71	19.63	-12.10	32.30	69.50	37.20
12.11	9	42.60	H	0.85	-32.67	19.62	-12.20	30.40	69.50	39.10

-Above 30 ㎒

Frequency [㎒]	Receiver Bandwidth [㎑]	Reading [dB(㎶)]	Pol. [V/H]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
QP DATA.										
33.27	120	41.90	V	1.15	-29.58	12.43	-16.00	25.90	40.00	14.10
54.25	120	42.10	V	1.52	-29.25	13.43	-14.30	27.80	40.00	12.20
501.78	120	35.60	V	5.14	-28.38	17.94	-5.30	30.30	46.00	15.70
786.48	120	36.40	H	6.54	-27.94	22.40	1.00	37.40	46.00	8.60
887.97	120	30.80	H	6.97	-27.15	23.48	3.30	34.10	46.00	11.90

5.5 Frequency tolerance

5.5.1 Regulation

15.225 (e) The frequency tolerance of the carrier signal shall be maintained within ±0.01 % of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.5.2 Test Result

- Complied

VOLTAGE [%]	POWER [V]	TEMP [℃]	FREQ [㎐]	FREQ.DEV [㎐]	Deviation [%]
100	5.00	-20	13 560 055.9	55.90	0.000 41
		-10	13 560 057.9	57.90	0.000 43
		0	13 560 042.0	42.00	0.000 31
		10	13 560 067.9	67.90	0.000 50
		20	13 560 038.0	38.00	0.000 28
		25	13 559 986.0	-14.00	-0.000 10
		30	13 559 988.0	-12.00	-0.000 09
		40	13 559 966.0	-34.00	-0.000 25
		50	13 559 902.1	-97.90	-0.000 72
85	4.25	20	13 559 960.0	-40.00	-0.000 29
115	5.75	20	13 559 982.0	-18.00	-0.000 13

5.6 Conducted Emission

5.6.1 Regulation

According to §15.207(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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω line impedance stabilization network (LISN).
Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (㎒)	Conducted limit (㏈㎶)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.6.2 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.

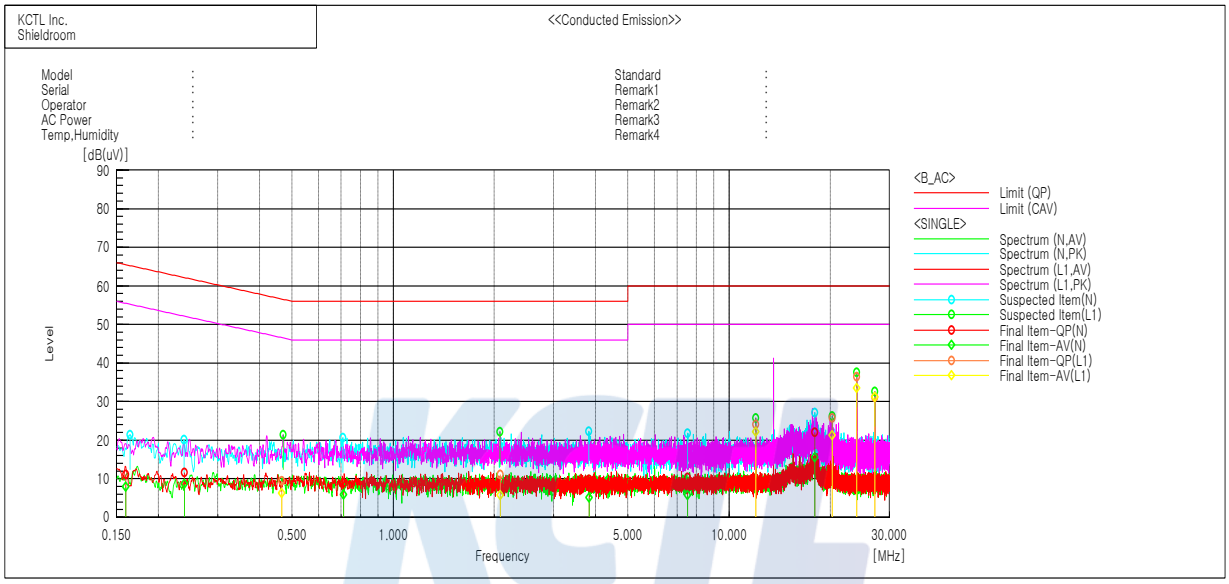
4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 ㎒ to 30 ㎒.

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.

5.6.3 Test Result

- Complied

Figure 4. The plot of Conducted Emission



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	0.15973	1.1	-2.1	10.0	11.1	7.9	65.5	55.5	54.4	47.6
2	0.23901	2.0	-1.0	9.6	11.6	8.6	62.1	52.1	50.5	43.5
3	0.7118	-0.9	-3.9	9.8	8.9	5.9	56.0	46.0	47.1	40.1
4	3.82675	0.0	-4.7	9.8	9.8	5.1	56.0	46.0	46.2	40.9
5	7.52707	0.5	-4.2	9.9	10.4	5.7	60.0	50.0	49.6	44.3
6	17.97246	12.0	5.6	10.0	22.0	15.6	60.0	50.0	38.0	34.4

--- 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	0.46511	-0.5	-3.7	9.9	9.4	6.2	56.6	46.6	47.2	40.4
2	2.08139	1.4	-3.9	9.7	11.1	5.8	56.0	46.0	44.9	40.2
3	12.00004	14.1	12.2	10.0	24.1	22.2	60.0	50.0	35.9	27.8
4	20.26094	15.6	11.1	10.1	25.7	21.2	60.0	50.0	34.3	28.8
5	24.00038	26.4	23.3	10.1	36.5	33.4	60.0	50.0	23.5	16.6
6	27.12126	21.0	21.2	10.0	31.0	31.2	60.0	50.0	29.0	18.8

5.7 Occupied Bandwidth

5.7.1 Regulation

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.
When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

5.7.2 Measurement procedure

- 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.

5.7.3 Test Result

- Complied

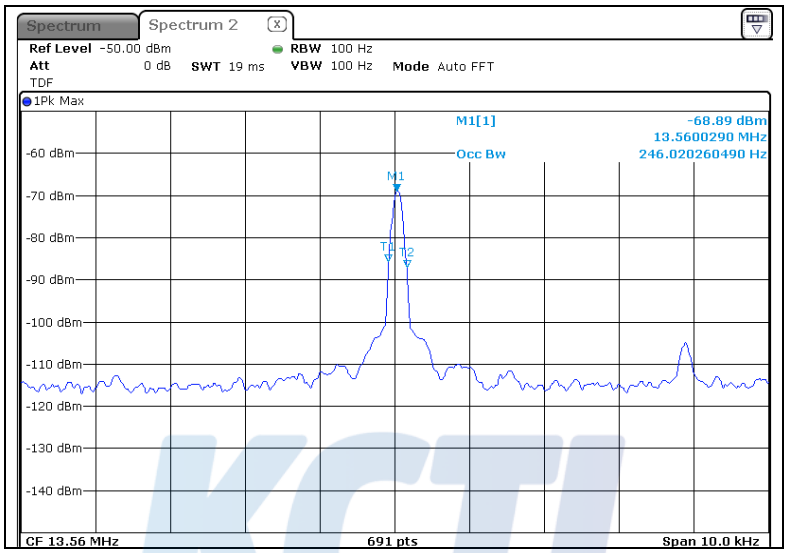
Voltage [V]	Frequency [㎒]	Occupied Bandwidth (99 % BW) [㎑]
DC 5.00	13.56	0.25

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.7.4 Test Plot

Figure 2. Plot of the Occupied Bandwidth (Conducted)

- Occupied Bandwidth



6. Test equipment used for test

	Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
■	Spectrum Analyzer	R&S	FSV30	100810	18.08.01
■	DC Power Supply	Agilent	E3632A	MY40017108	18.05.15
■	Temp & Humid Chamber	Myeongseong R&P	CTHC-50P-DT	20150824-1	18.08.01
■	Signal Generator	R & S	SMR40	100007	18.05.15
■	Vector Signal Generator	R&S	SMBV100A	257566	18.01.06
■	Loop Antenna	R&S	HFH2-Z2	100355	18.03.03
■	Bilog Antenna	SCHWARZBECK	VULB9168	440	19.10.23
■	Attenuator	HP	8491B	22891	18.08.24
■	Amplifier	SONOMA	310N	-	18.08.25
■	EMI Test Receiver	R&S	ESCI7	100732	18.08.24
■	EMI Test Receiver	R&S	ESCI	100710	18.08.24
■	Turn Table	Innco Systems	DT2000	79	-
■	Antenna Mast	Innco Systems	MA4000-EP	303	-
■	TWO-LINE V-Network	R&S	ENV216	101352	18.08.25
■	Cable Assembly	Radiall	2301762000PJ	1724.66	-
■	Cable Assembly	Gigalane	RF-400	-	-