

FCC TEST REPORT


Test report No.: EMC- FCC- R0050
FCC ID: ZV5FDN2311
Type of equipment: Z-Wave Wireless Light Switch
Basic Model: FDN2311
Varient Model: -
Applicant: FROSTDALE CO., LTD.
FCC Rule Part(s): FCC Part 15 Subpart C 2008
Section 15.249
Frequency Range: 908.4 MHz
Test result: Complied


The above equipment was tested by EMC compliance Testing Laboratory for compliance with the requirements of FCC Rules and Regulations.

The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Date of test: August 8, 2011 ~ August 11 , 2011

Issued date: August 17 , 2011


Tested by: _____
SON, MIN GI


Approved by: _____
KIM, CHANG MIN

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1. Client information

Applicant : FROSTDALE CO., LTD.
Address : 1640 Mapo Business Center #405, Sangam-dong, Mapo-gu, Seoul, KOREA
Telephone number : +82-70-7430-9307
Facsimile number : +82-2-302-9297
Contact person : Kang Hyung Gu /

Manufacturer: FROSTDALE CO., LTD.
Address : 1640 Mapo Business Center #405, Sangam-dong, Mapo-gu, Seoul, KOREA

2. Laboratory information

Address

EMC Compliance Ltd.

82-1, JEIL-RI, YANGJI-MYUN, CHURINGU, YONGIN-CITY, KYUNGGI-DO, KOREA 449-825

Telephone Number: 82 31 336 9919 Facsimile Number: 82 31 336 4767

Certificate

CBTL Testing Laboratory, KOLAS NO.: 231

FCC Filing No.: 793334

VCCI Registration No.: C-1713, R-1606, T-258

SITE MAP



3. Description of E.U.T.

3.1 Basic description

Applicant :	FROSTDALE CO., LTD.
Address of Applicant:	1640 Mapo Business Center #405, Sangam-dong, Mapo-gu, Seoul, KOREA
Manufacturer:	FROSTDALE CO., LTD.
Address of Manufacturer:	1640 Mapo Business Center #405, Sangam-dong, Mapo-gu, Seoul, KOREA
Type of equipment:	Z-Wave Wireless Light Switch
Basic Model:	FDN2311
Variant model:	-
Serial number:	Engineering Sample

3.2 General description

Frequency	908.4 MHz
Type of Modulation	FSK
Number of Channels	1 channel
Type of Antenna	PCB antenna
Power supply	AC 120 V
Extreme Power supply	Lower voltage: AC 108 V, Upper voltage: AC 132 V
Operating temperature	-20 °C ~ 50 °C *
Operating Humidity	10% to 90% relative humidity non-condensing
Dimension	114.52*72.66*31.55(W*H*D)

3.3 Test frequency

	Frequency
Low frequency	-
Middle frequency	908.4 MHz
High frequency	-

4. Summary of test results

4.1 Standards & results

Rule Reference	Parameter	Report Section	Test Result
15.203	Antenna Requirement	5.1	C
15.209	Field Strength of Fundamental	5.2	C
15.209	Radiated Emissions	5.3	C
15.207	Conducted Emissions	5.4	C
N/A	20dB bandwidth	5.5	N/A*
Note: C=complies NC= Not complies NT=Not tested NA=Not Applicable *The test is not applicable since the EUT is not the device that is designed to be connected to the public utility(AC) power line.			

4.2 Uncertainty

Measurement Item	Combined Standard Uncertainty U _c	Expanded Uncertainty U = KU _c (K = 2)
Conducted RF power	± 0.272 dB	± 0.544 dB
Radiated disturbance	± 1.943 dB	± 3.886 dB
Conducted disturbance	± 1.265 dB	± 2.53 dB

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.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1.2 Result

-Complied

The transmitter has an integral Loop coil antenna.

5.2 Field Strength of Fundamental Emissions

5.2.1 Regulation

According to §15.249, for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength of fundamental (mV/m)	Field strength of harmonics (uV/m)
902-928	50	500

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

Frequency : From 30MHz to 1GHz 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 1GHz).

Freq'	9-90kHz	90-110kHz	150-490kHz	490kHz-30MHz	30MHz-1GHz
Detector type	PK/AV	QP	PK/AV	QP	QP
IF bandwidth	200Hz	200Hz	9kHz	9kHz	120kHz

* Part 15 Section 15.31 (f)(2) (9kHz-30MHz)

[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

-40kbps(data rate)

Measurement Distance: 3m (worst case polarization = vertical)

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
Quasi DATA.							
908.40	120	74.9	V	-3.2	94.0	71.7	22.3

-9.6kbps(data rate)

Measurement Distance: 3m (worst case polarization = vertical)

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
Quasi DATA.							
908.40	120	73.2	V	-3.2	94.0	70.0	24.0

Margin (dB) = Limit – Actual

[Result] = Reading – Amp Gain + Attenuator + AF + CL

1. H = Horizontal, V = Vertical Polarization

* The spurious emission at the frequency does not fall in the restricted bands.

** The measured result is within the test standard limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95 % level of confidence. However, the result indicates that compliance is more probable than non-compliance.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

5.3 Radiated Emissions

5.3.1 Regulation

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

Frequency (MHz)	Field strength ($\mu\text{V/m}$ @ 3m)	Distance(m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	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 the section shall not be located in the frequency bands 54-72MHz. 76-88MHz. 174-216MHz or 470-806MHz. however. Operation within these frequency bands is permitted under other sections of this part. e.g., Section 15.231 and 15.241.

**Distance Correction Factor = $40\log(\text{test distance} / \text{specific distance})$

5.3.2 Measurement Procedure

The spurious emissions from the EuT will be measured on an open area test site in the frequency range of 30 MHz to 1 GHz using a tuned receiver and a bi-log antenna.

frequency range of 1 GHz above using a tuned receiver and a horn antenna.

The antenna was positioned 3, 10 or 30 meters horizontally from the EuT.

Measurements have been made in all three orthogonal axes and 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 measured on the closer distances according to Section 15.31 (f) (2) [2].

The final measurement will be performed with an EMI Receiver set to Quasi Peak detector for frequency bands 30MHz to 1GHz and Peak and Average detector for frequency band over 1GHz will be used according to Section 15.209 (d) [2].

The final level, expressed in dB μ V/m, is arrived at by taking the reading from the EMI receiver (Level dB μ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit. The resolution bandwidth during the measurement is as follows:

30 MHz – 1 GHz: ResBW: 120 kHz

1 GHz above : ResBW: 1 MHz

5.3.3 Test Result

-Complied

-40kbps(data rate)

Measurement Distance: 3m

-30MHz ~1GHz

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
QP DATA.							
480.001	120	49.9	V	-10.5	46.0	39.4	6.6
720.002	120	48.8	V	-6.1	46.0	42.7	3.3
960.011	120	43.4	H	-2.2	54.0	41.2	12.8

-9.6kbps(data rate)

Measurement Distance: 3m

-30MHz ~1GHz

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
QP DATA.							
360.009	120	47.1	H	-13.0	46.0	34.1	11.9
479.998	120	49.9	V	-10.5	46.0	39.4	6.6
720.002	120	48.5	V	-6.1	46.0	42.4	3.6

-40kbps(data rate)

Measurement Distance: 3m

-Above 1GHz (1GHz~10GHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
PK DATA.							
3282.250	1000	59.2	V	1.3	74.0	60.5	13.5
4924.875	1000	52.1	V	6.5	74.0	58.6	15.4
AV DATA.							
3282.250	1000	49.2	V	1.3	54.0	50.5	3.5
4924.875	1000	44.3	V	6.5	54.0	50.8	3.2

-9.6kbps(data rate)

Measurement Distance: 3m

-Above 1GHz (1GHz~10GHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
PK DATA.							
3282.690	1000	55.2	V	1.3	74.0	56.5	17.5
4924.875	1000	54.7	V	6.5	74.0	61.2	12.8
AV DATA.							
3282.690	1000	49.6	V	1.3	54.0	50.9	3.1
4924.875	1000	44.2	V	6.5	54.0	50.7	3.3

Margin (dB) = Limit – Actual

[Result] = Reading – Amp Gain + Attenuator + AF + CL

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.

** The measured result is within the test standard limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95 % level of confidence. However, the result indicates that compliance is more probable than non-compliance.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

5.4 Conducted Emission

5.4.1 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 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50μH/50Ω 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 (MHz)	Conducted limit (dBμV)	
	Quasi-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.

5.4.2 Measurement Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm 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 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

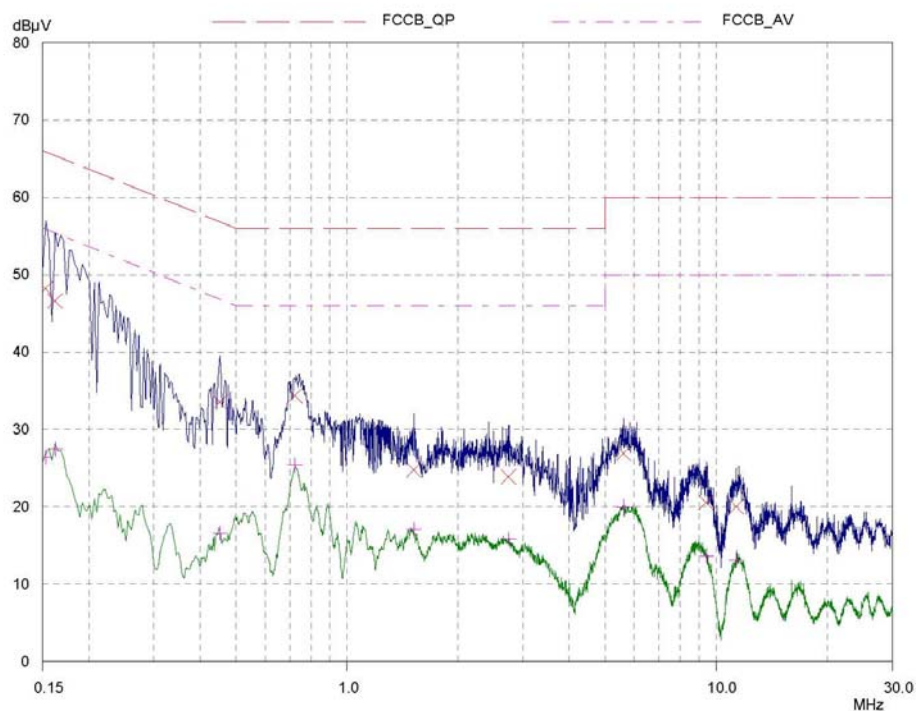
-40Kbps(data rate)

EMC Compliance LTD

EUT: FDN2300
Manuf:
Op Cond: H
Operator:
Test Spec: FCC Class B Conducted Emission
Comment: AC120V, 60Hz
40Kbps
Result File: FDN40_H.dat : New Measurement

Scan Settings				Receiver Settings				
(2 Ranges)								
Frequencies		Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
Start	Stop							
150kHz	3MHz	3kHz	10kHz	PK+AV	10msec	Auto	OFF	60dB
3MHz	30MHz	10kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



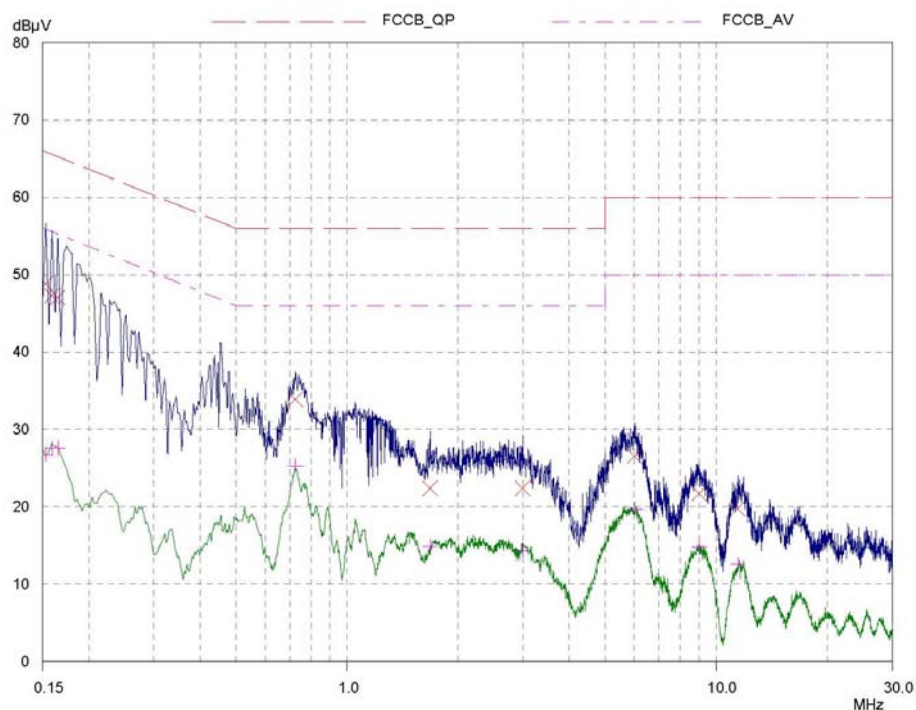
-40Kbps(data rate)

EMC Compliance LTD

EUT: FDN2300
Manuf:
Op Cond: N
Operator:
Test Spec: FCC Class B Conducted Emission
Comment: AC120V, 60Hz
40Kbps
Result File: FDN40_N.dat : New Measurement

Scan Settings		(2 Ranges)		Receiver Settings					
Frequencies		Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
Start	Stop	3kHz	10kHz	PK+AV	10msec	Auto	OFF	60dB	
150kHz	3MHz	10kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB	
3MHz	30MHz								

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



-40Kbps(data rate)

Frequency [MHz]	Correction Factor		Line	Quasi-peak			Average		
	LISN	Cable		Limit	Reading	Result	Limit	Reading	Result
				[dB (μ V)]	[dB(μ V)]	[dB(μ V)]	[dB(μ V)]	[dB(μ V)]	[dB(μ V)]
0.153	0.07	0.03	N	65.84	48.85	48.95	55.84	26.79	26.89
0.159	0.07	0.03	N	65.52	47.27	47.37	55.52	27.55	27.65
0.162	0.07	0.03	H	65.36	46.60	46.70	55.36	27.46	27.56
0.165	0.07	0.03	N	65.21	47.03	47.13	55.21	27.60	27.70
0.453	0.08	0.01	H	56.82	33.54	33.63	46.82	16.59	16.68
0.723	0.08	0.02	H	56.00	34.36	34.46	46.00	25.41	25.51
0.726	0.08	0.02	N	56.00	33.86	33.96	46.00	25.28	25.38
1.518	0.10	0.06	H	56.00	24.73	24.89	46.00	17.09	17.25
1.680	0.09	0.06	N	56.00	22.38	22.53	46.00	14.87	15.02
2.745	0.11	0.07	H	56.00	23.88	24.06	46.00	15.85	16.03
2.994	0.10	0.07	N	56.00	22.38	22.55	46.00	14.39	14.56
5.620	0.18	0.09	H	60.00	26.88	27.15	50.00	19.95	20.22
6.020	0.17	0.09	N	60.00	26.53	26.79	50.00	19.70	19.96
9.000	0.28	0.13	N	60.00	21.73	22.14	50.00	14.80	15.21
9.410	0.31	0.13	H	60.00	20.57	21.01	50.00	13.67	14.11
11.350	0.37	0.15	H	60.00	20.05	20.57	50.00	13.15	13.67
11.450	0.32	0.15	N	60.00	19.73	20.20	50.00	12.58	13.05

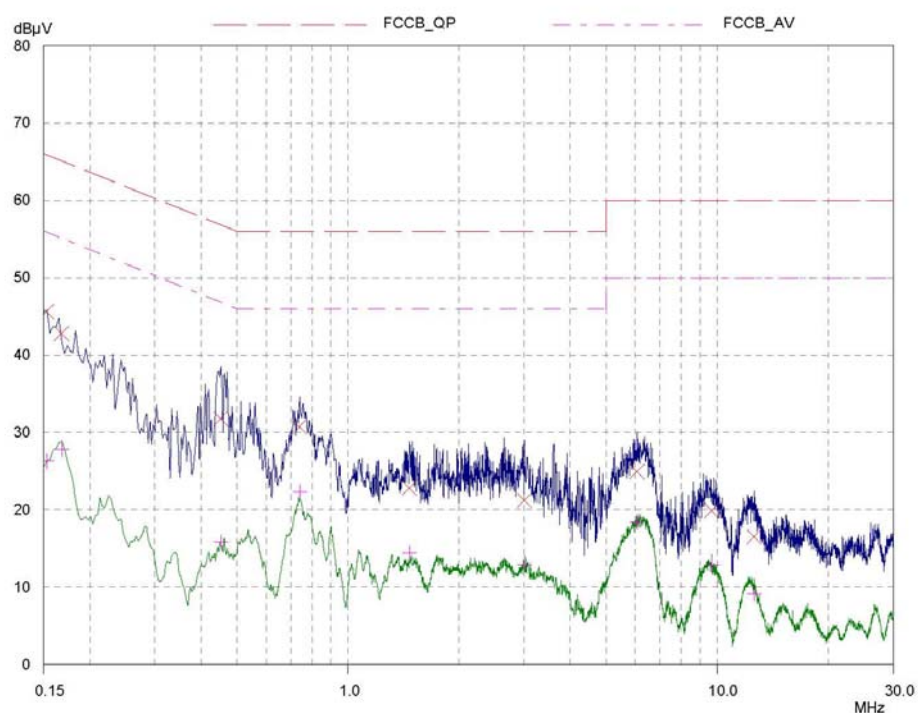
- Minimum limit margin is 16.89 dB at 0.153 MHz. (Quasi-peak)

-9.6Kbps(data rate)

EMC Compliance LTD

EUT: FDN2300
Manuf:
Op Cond: H
Operator:
Test Spec: FCC Class B Conducted Emission
Comment: AC120V, 60Hz
9.6Kbps

Scan Settings		(2 Ranges)		Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
150kHz	3MHz	3kHz	10kHz	PK+AV	10msec	Auto	OFF	60dB	
3MHz	30MHz	10kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB	
Final Measurement:		Detectors:	X QP / + AV						
		Meas Time:	1sec						
		Peaks:	8						
		Acc Margin:	25 dB						



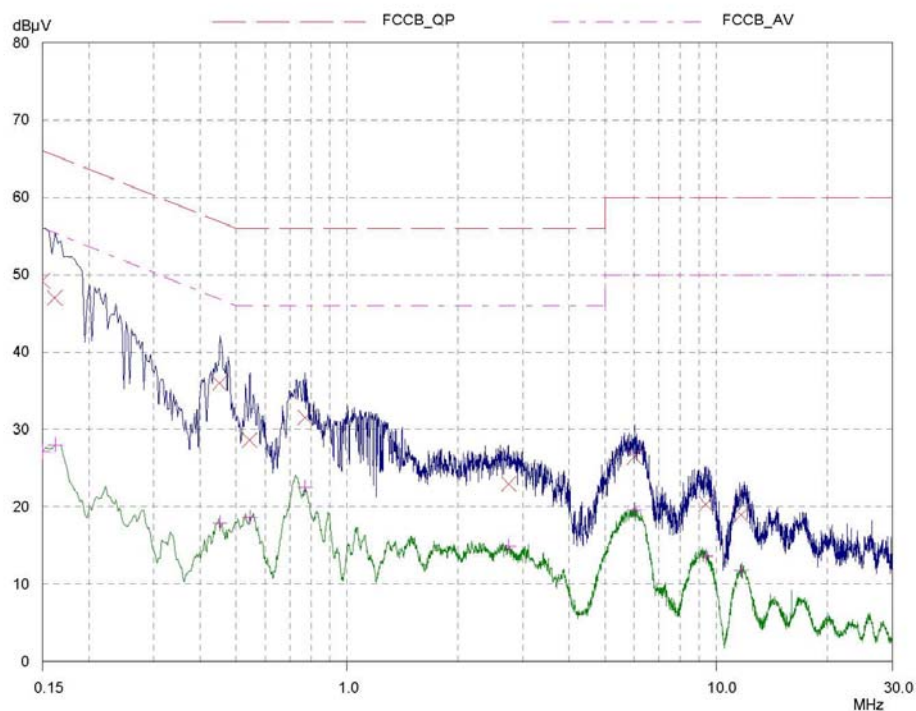
-9.6Kbps(data rate)

EMC Compliance LTD

EUT: FDN2300
Manuf:
Op Cond: N
Operator:
Test Spec: FCC Class B Conducted Emission
Comment: AC120V, 60Hz
9.6Kbps
Result File: FDN9.6_N.dat : New Measurement

Scan Settings				Receiver Settings				
(2 Ranges)								
Frequencies		Step	IF BW	Detector	M-Time	Atten	Preamplifier	OpRge
Start	Stop							
150kHz	3MHz	3kHz	10kHz	PK+AV	10msec	Auto	OFF	60dB
3MHz	30MHz	10kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



-9.6Kbps(data rate)

Frequency [MHz]	Correction Factor		Line	Quasi-peak			Average		
				Limit	Reading	Result	Limit	Reading	Result
	LISN	Cable		[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]
0.150	0.07	0.03	N	66.00	49.17	49.27	56.00	27.10	27.20
0.153	0.07	0.03	H	65.84	45.61	45.71	55.84	26.30	26.40
0.162	0.07	0.03	N	65.36	46.99	47.09	55.36	28.02	28.12
0.168	0.07	0.03	H	65.06	42.78	42.88	55.06	27.84	27.94
0.453	0.07	0.01	N	56.82	35.97	36.05	46.82	17.92	18.00
0.546	0.07	0.01	N	56.00	28.61	28.69	46.00	18.63	18.71
0.741	0.08	0.02	H	56.00	30.73	30.83	46.00	22.32	22.42
0.771	0.08	0.02	N	56.00	31.53	31.63	46.00	22.49	22.59
1.467	0.09	0.03	H	56.00	22.82	22.94	46.00	14.44	14.56
2.742	0.10	0.07	N	56.00	22.95	23.12	46.00	14.92	15.09
3.010	0.11	0.07	H	56.00	21.20	21.38	46.00	12.86	13.04
6.010	0.17	0.09	N	60.00	26.45	26.71	50.00	19.63	19.89
6.080	0.18	0.09	H	60.00	24.95	25.22	50.00	18.48	18.75
6.690	0.24	0.11	H	60.00	19.91	20.26	50.00	12.90	13.25
9.380	0.28	0.13	N	60.00	20.37	20.78	50.00	13.62	14.03
11.710	0.34	0.17	N	60.00	18.95	19.46	50.00	11.83	12.34
12.600	0.42	0.17	H	60.00	16.49	17.08	50.00	9.14	9.73

- Minimum limit margin is 16.73 dB at 0.150 MHz. (Quasi-peak)

5.5 20dB bandwidth

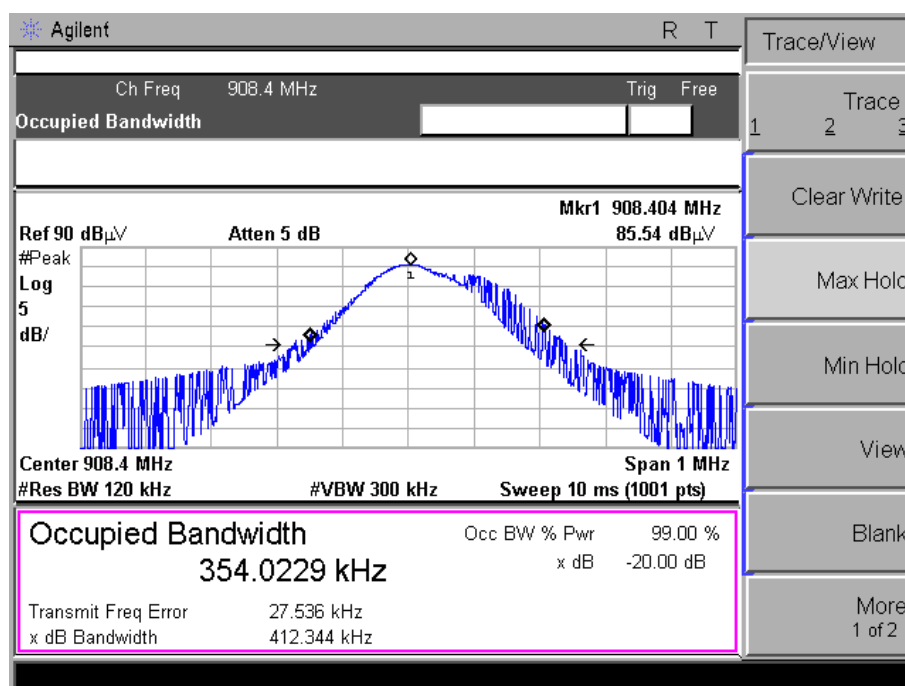
5.5.1 Test Procedure

The measurement was performed in the antenna height to gain the maximum of electric field strength.

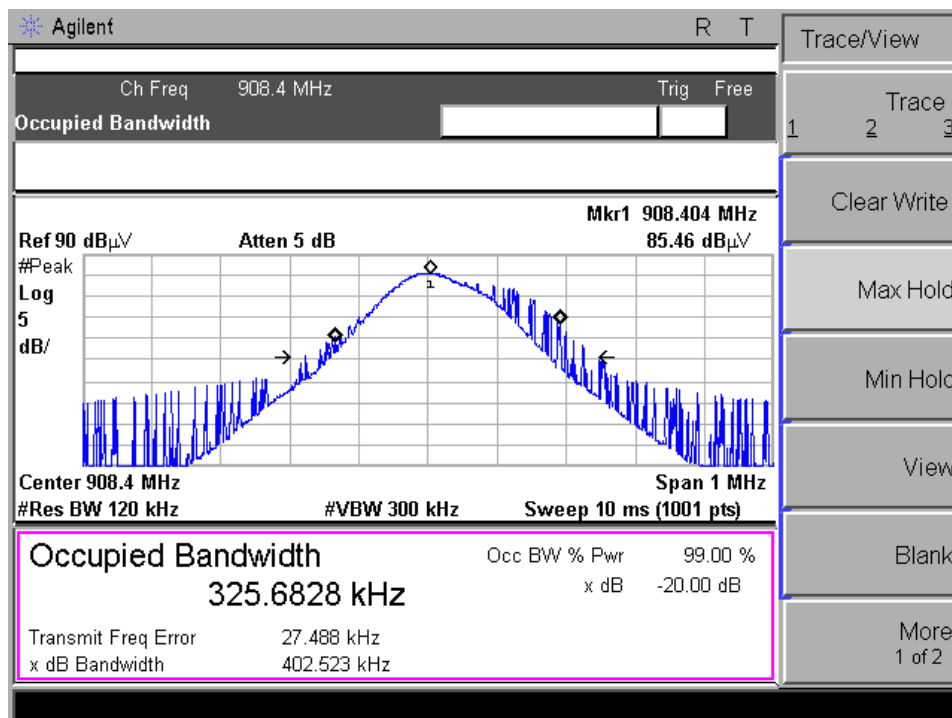
5.5.2 Test Result

-Complied

-40Kbps(data rate)



9Kbps(data rate)



6. Test equipment used for test

	Description	Manufacture	Model No.	Serial No.	Next Cal Date.
<input type="checkbox"/>	Temp & humidity chamber	taekwang	TK-04	TK001	11.12.10
<input checked="" type="checkbox"/>	Spectrum Analyzer	Agilent	E4407B	US39010142	11.11.01
<input checked="" type="checkbox"/>	Signal Generator	HP	E4432B	GB39340611	11.11.01
<input type="checkbox"/>	Modulation Analyzer	HP	8901B	3538A05527	11.11.08
<input type="checkbox"/>	Function Generator	Agilent	33250A	MY4006432	12.02.04
<input type="checkbox"/>	Audio Analyzer	HP	8903B	3729A19213	11.11.04
<input checked="" type="checkbox"/>	AC Power Supply	KIKUSUI	PCR2000W	GB001619	11.11.01
<input type="checkbox"/>	DC Power Supply	Tektronix	PS2521G	TW53135	11.11.01
<input type="checkbox"/>	DC Power Supply	Tektronix	PS2520G	TW50517	12.02.25
<input type="checkbox"/>	EMI Test Receiver	R&S	ESCI	100710	11.12.01
<input checked="" type="checkbox"/>	EMI Test Receiver	R&S	ESCI	100001	12.07.11
<input type="checkbox"/>	Attenuator	HP	8494A	2631A09825	11.11.03
<input type="checkbox"/>	Attenuator	HP	8496A	3308A16640	11.11.03
<input type="checkbox"/>	Attenuator	R&S	RBS1000	D67079	11.11.03
<input type="checkbox"/>	Power sensor	Agilent	E9321A	US40390422	11.11.08
<input checked="" type="checkbox"/>	LOOP Antenna	EMCO	6502	9205-2745	13.05.22
<input checked="" type="checkbox"/>	BILOG Antenna	Schwarzbeck	VULB 9168	375	11.11.30
<input type="checkbox"/>	HORN Antenna	ETS	3115	00062589	11.12.22
<input type="checkbox"/>	Power Divider	Weinschel	1580-1	NX380	11.08.25