TEST REPORT

Part 15 Subpart C 15.225

1. Applicant	
Name	: EndoSolution
Address	: #1712 Hanla Sigma Valley 545, Dunchon-daero, Jungwon-gu, Seongnam-si, Gyeonggi-do, Korea
FCC ID	: 2AIKKETS-1000L
2. Products	
Name	: ENDO TRACKER
Model/Type	: ETS-1000L/RFID
Manufacturer	: EndoSolution
3. Test Standard	: 47 CFR FCC Part 15 Subpart C:2011 section 15.225
4. Test Method	: ANSI C63.10:2009
5. Test Result	: Positive
6.Dates of Test	: May 19, 2016 to May 23, 2016
7. Date of Issue	: May 25, 2016
8. Test Laboratory	: Standard Engineering Co. Ltd. FCC Designation Number : 624439

Tested by	Approved by
	
SoonHo, Kim / Test Engineer	SeongSeok, Seo / Compliance Engineer

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Revision History

Issue Report No.	Issued Date	Revisions	Effect Section
STD-FCC-16025	May 25, 2016	Initial Release	All

1. VERIFICATION OF COMPLIANCE

-. APPLICANT : EndoSolution

-. ADDRESS : #1712 Hanla Sigma Valley 545, Dunchon-daero, Jungwon-gu, Seongnam-si, Gyeonggi-do, Korea

-. CONTACT PERSON : DAEMYUNG, CHOI / CEO

-. TELEPHONE NO : +82-31-745-9466
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-. FCC ID : 2AIKKETS-1000L

DEVICE TYPE	FCC: DXX – Low Power Communication Device Transmitter
E.U.T. DESCRIPTION	ENDO TRACKER
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	FCC: ANSI C63.10: 2009
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C:2011, Section 15.225
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	N/A
FINAL TEST WAS CONDUCTED ON	3 m open area test site

2. GENERAL INFORMATION

2.1 Product Description

The EndoSolution, Model ETS-1000L (referred to as the EUT in this report) is a ENDO TRACKER that is included a RF card reader. The product specification described herein was obtained from product data sheet or user's manual.

CHASSIS TYPE	Non-Metal
TX FREQUENCY	13.5607 MHz
MODULATION	ASK
LIST OF EACH OSC. OR CRY. FREQ.(FREQ.>=1 MHz)	Main Board: 27.12MHz , 64MHz, RFID Board: 13.56MHz
ANTENNA TYPE	Inserted into the main board (Pattern Antenna)
RATED SUPPLY VOLTAGE	Input: AC100-240V~50/60Hz, 0.8A Output: DC5.0V, 1A
NUMBER OF PCB LAYERS	2 Layers: Main Board, RFID Antenna Board

2.2 Model Differences:

-. None

2.3 Related Submittal(s) / Grant(s)

-. Original

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in section 15.225

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2009 Radiated testing was performed at a distance of 3 m from EUT to the antenna.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	EndoSolution	ETS-1000L	N/A
LAN PORT Board	WIZnet	-	N/A
RF Board	EndoSolution	-	N/A

3.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	FCC ID	Description	Connected to
-	-	-	-	-
-	-	-	-	-

3.3 Mode of operation during the test

-. To get a maximum radiated emission from the EUT, the EUT was continuously transmitted RF carrier and the card shall be used with the EUT and tested with together. And the ping testing mode was performed at the same time during the test.

3.4 Cable Description for the EUT

Ports Name	Shielded	Ferrite Bead	Metal Shell	Length (m)	Connected to
-	-	-	-	-	-

3.5 Equipment Modifications

N/A

3.6 Configuration of Test System

Line Conducted Test: The power of EUT was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission tests were performed by using the procedure in ANSI C63.10: 2009 7.3.3 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2009 8.3.1.1 and 13.1.4.1 to determine the worse operating conditions. The radiated emissions measurements were performed on the 3 m, EMI chamber and open-field test site. The EUT was placed on the ground plane as typical applications. For frequencies from 150 kHz to 30 MHz measurements were made of the magnetic H field. The measuring antenna is an electrically screened loop antenna. The frequency spectrum from 30 MHz to 1 000 MHz was scanned and maximum emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

3.7 Antenna Requirement

For intentional device, according to §15.203 intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Construction:

The transmitter antenna of the EUT is a PCB pattern antenna in the EUT, so there is no consideration of replacement by the user.

4. PRELIMINARY TEST

4.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
Standby Mode	-
TX mode	X

4.2 Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Standby Mode	-
TX mode	X

5. FINAL RESULT OF MEASURMENT

5.1 Conducted Emission Test

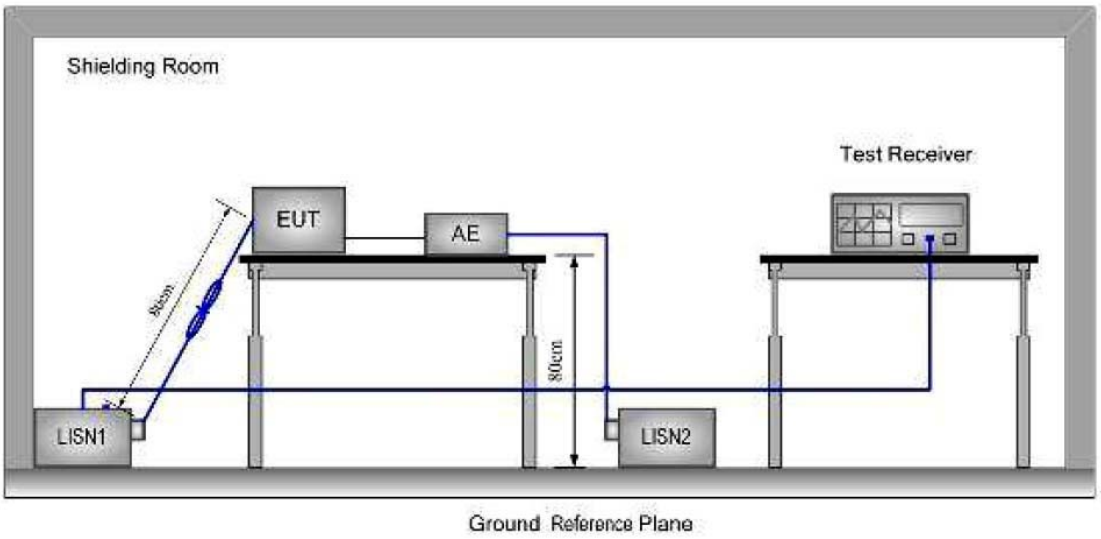
Humidity Level : 52 % R.H. Temperature: 25°C
Limits apply to : FCC CFR 47, PART 15 Section 15.207
Result : PASS

EUT Operating : ENDO TRACKER Date: May 20, 2016
Condition : Transmitting Mode
Detector : CISPR Quasi-Peak (6 dB Bandwidth: 9 kHz)

Limits for conducted disturbance at the mains ports of class B

Frequency Range (MHz)	Class B Limit dB(μV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

Test Configuration:



Test procedure:
1. The mains terminal disturbance voltage test was conducted in a shielded room.
2. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50/50μH + 5linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane.

And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.

4. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane.
This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN 2.

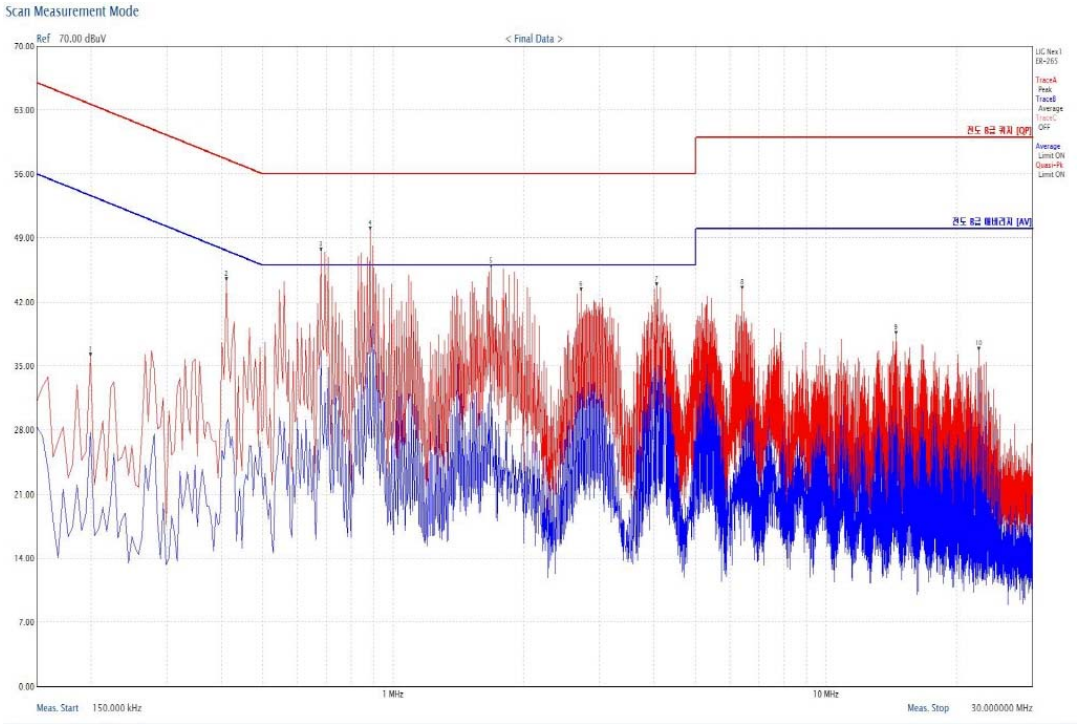
Measured values of the Conducted Emissions

Frequency (MHz)	Correction Factor	Line	Quasi-Peak			Average		
			Limit [dBuV]	Reading [dBuV]	Result [dBuV]	Limit [dBuV]	Reading [dBuV]	Result [dBuV]
0.681	10.09	L	56.00	37.41	47.50	46.00	26.66	36.75
0.883	10.11	L	56.00	39.68	49.79	46.00	28.85	38.96
4.060	10.33	L	56.00	33.41	43.74	46.00	23.27	33.60
22.533	11.34	L	60.00	25.34	36.68	50.00	22.09	33.43
0.681	10.09	N	56.00	39.2	49.29	46.00	26.38	36.47
0.897	10.11	N	56.00	37.34	47.45	46.00	26.52	36.63
3.925	10.32	N	56.00	31.66	41.98	46.00	24.06	34.38
11.769	10.78	N	60.00	33.47	44.25	50.00	25.33	36.11

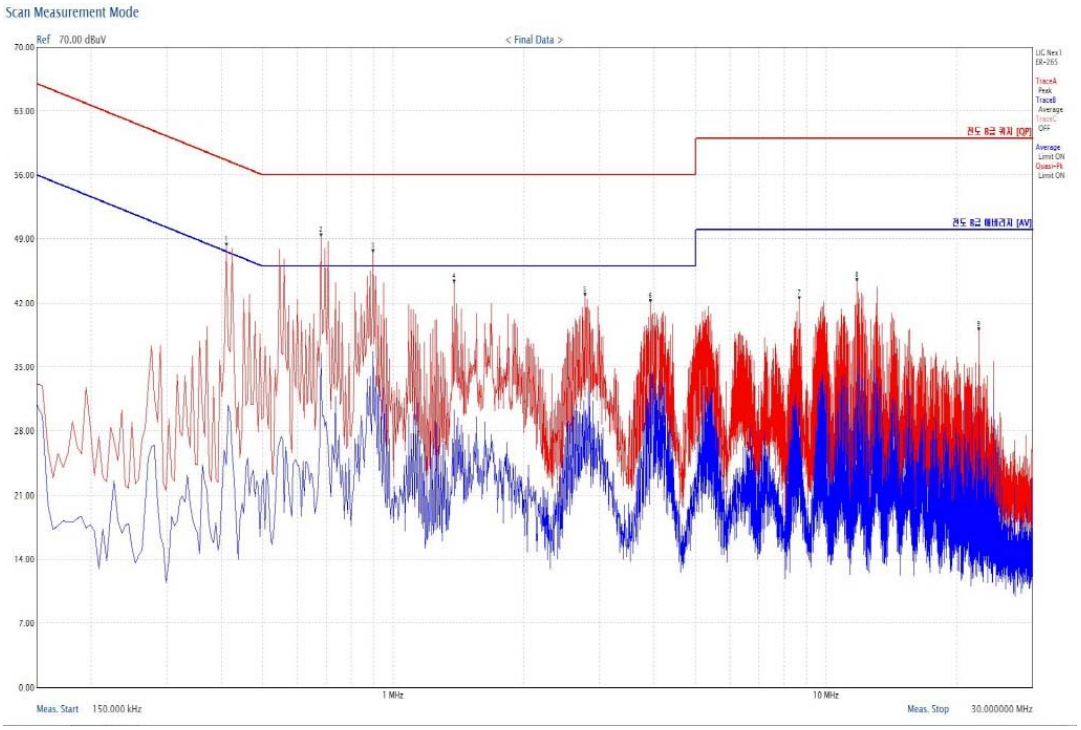
Line Conducted Emission Tabulated Data

Remark : "H": Hot Line, "N": Neutral Line.

See next page for an overview sweep performed with peak and average detector.



HOT LINE



NEUTRAL LINE

5.2 Emission Test

5.2.1 Radiated Emissions

5.2.1.1 Regulation

the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:
15.225(a): The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.i.e. 124.0dBμV/m @ 3 m.
15.225(b): Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters. i.e. 90.5dBμV/m @ 3 m.
15.225l: Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters. i.e. 80.5dBμV/m @ 3 m.
15.225(d) :The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209

Out of band emissions shall not exceed:

Frequency (MHz)	Quasi-peak limits (dBμV/m)
1.705 - 30.0	69.5
30 - 88	40
88 - 216	43.5
216 - 960	46
Above 960	54
At transitional frequencies the lower limit applies.	

5.2.1.2 Measurement Procedure

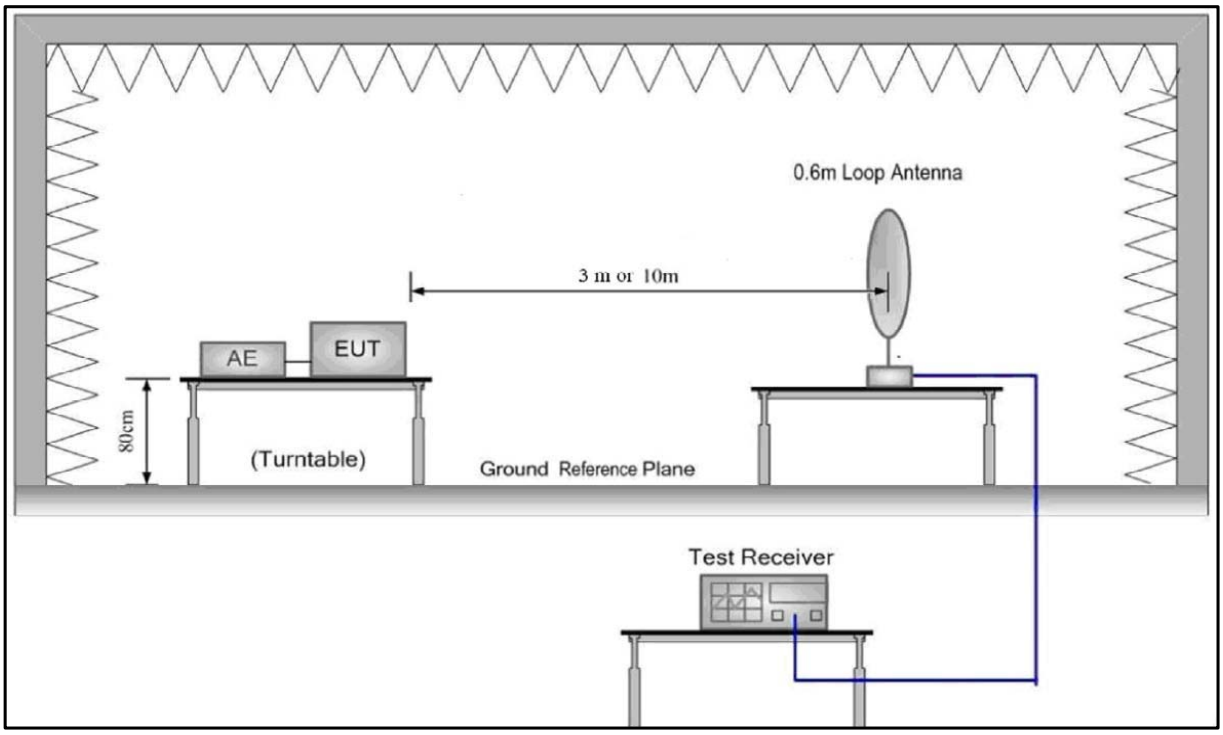
1) 9 kHz to 30 MHz emissions:
For testing performed with the loop antenna. The center of the loop was positioned 1 m above the ground and positioned with its plane vertical at the specied distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.
2) 30 MHz to 1 GHz emissions:
For testing perfomed with the bi-log type antenna. The measurement is performed with the EUT rotated 360º, the antenna height scaned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

Detector Peak for pre-scan

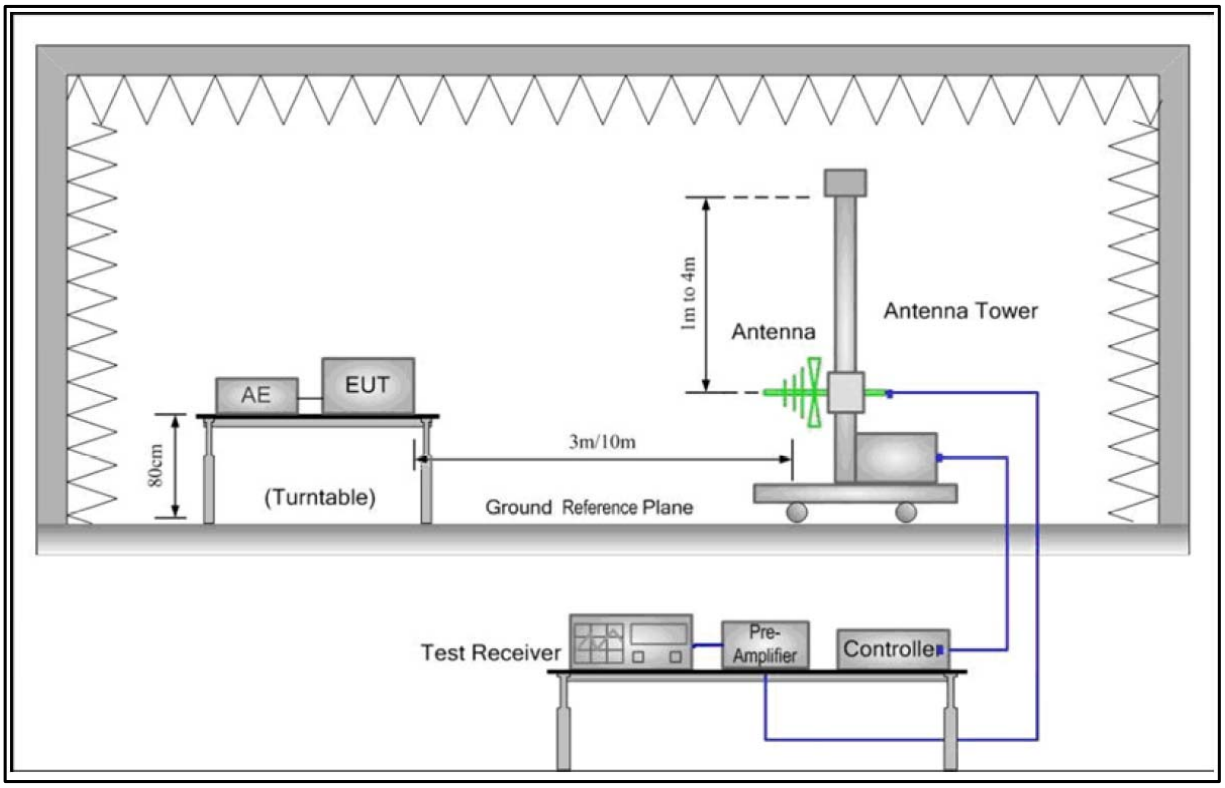
Test Receiver test setup	Detector		
	9 kHz-150 kHz	150 kHz-30 MHz	30 MHz-1000 MHz
RBW	200 Hz	9 kHz	120 kHz
VBW	³ RBW	³ RBW	³ RBW
Sweep	auto	auto	auto
Detector function	QP	QP	AV
Trace	max hold	max hold	max hold

5.2.1.3 Test Configuration

1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



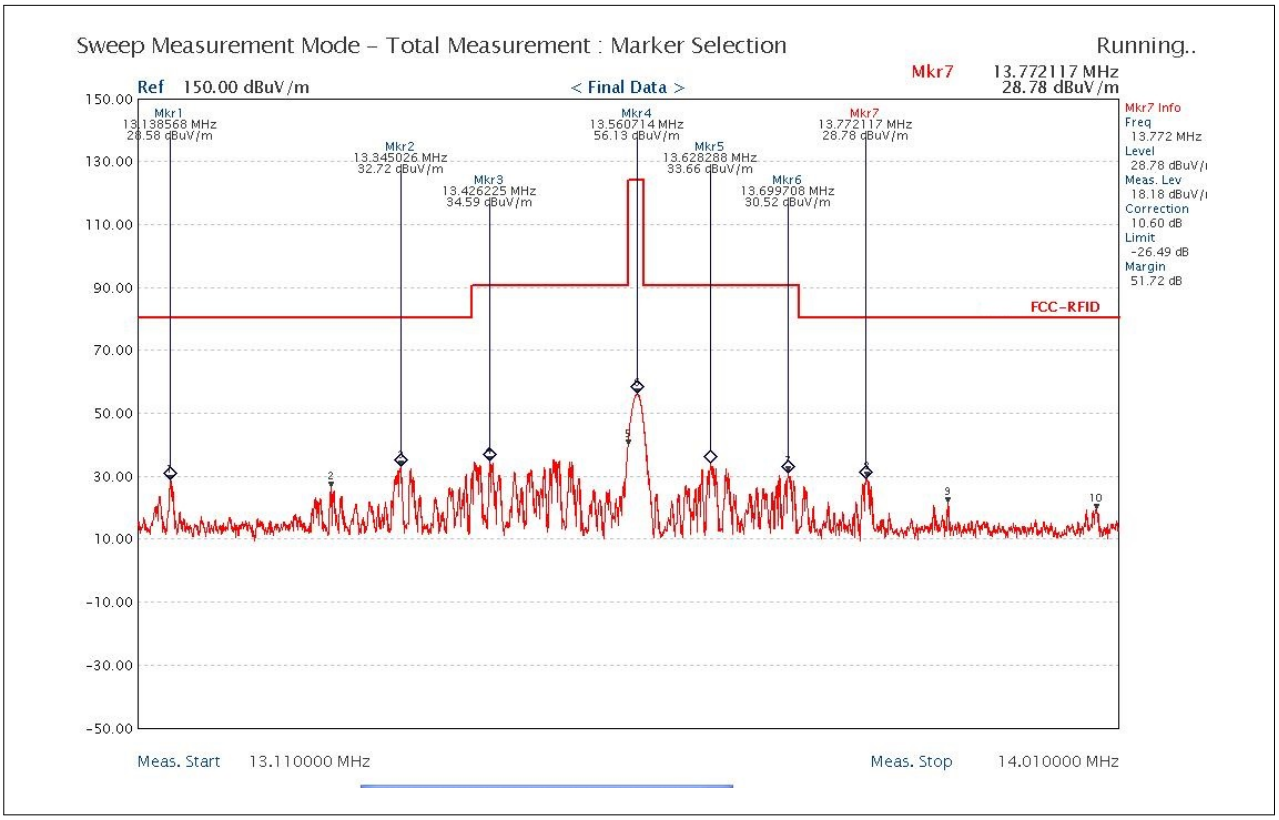
5.2.1.4 Test Configuration

1) Intentional Emission and Spectrum Mask

Test Frequency (MHz)	Quasi-Peak (dBμV/m)	Limits (dBμV/m)	Margin (dB)
13.1385	28.58	80.5	51.92
13.345	32.72	80.5	47.78
13.4262	34.59	90.5	55.91
13.5607	56.13	124	67.87
13.628	33.66	90.5	56.84
13.699	30.52	90.5	59.98
13.772	28.78	80.5	51.72

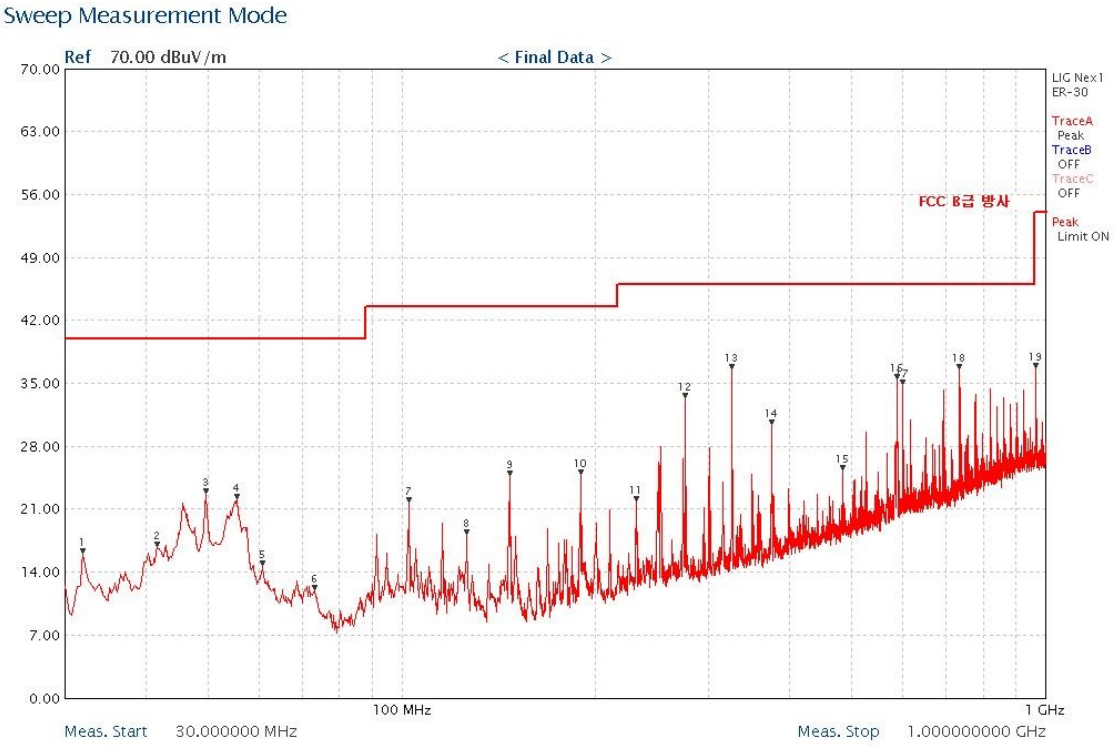
2) Spurious Emission: below 30 MHz

Test Frequency (MHz)	Detect Mode	Quasi-Peak (dBμV/m)	Limits (dBμV/m)	Margin (dB)
1.463	H	50.49	69.5	19.01
1.457	V	51.31	69.5	18.19
2.214	H	46.23	69.5	23.27
2.237	V	42.74	69.5	26.76
9.746	H	52.16	69.5	17.34
10.593	V	50.44	69.5	19.06
27.527	H	49.58	69.5	19.92
27.622	V	50.74	69.5	18.76



[Intentional Emission and Spectrum Mask]

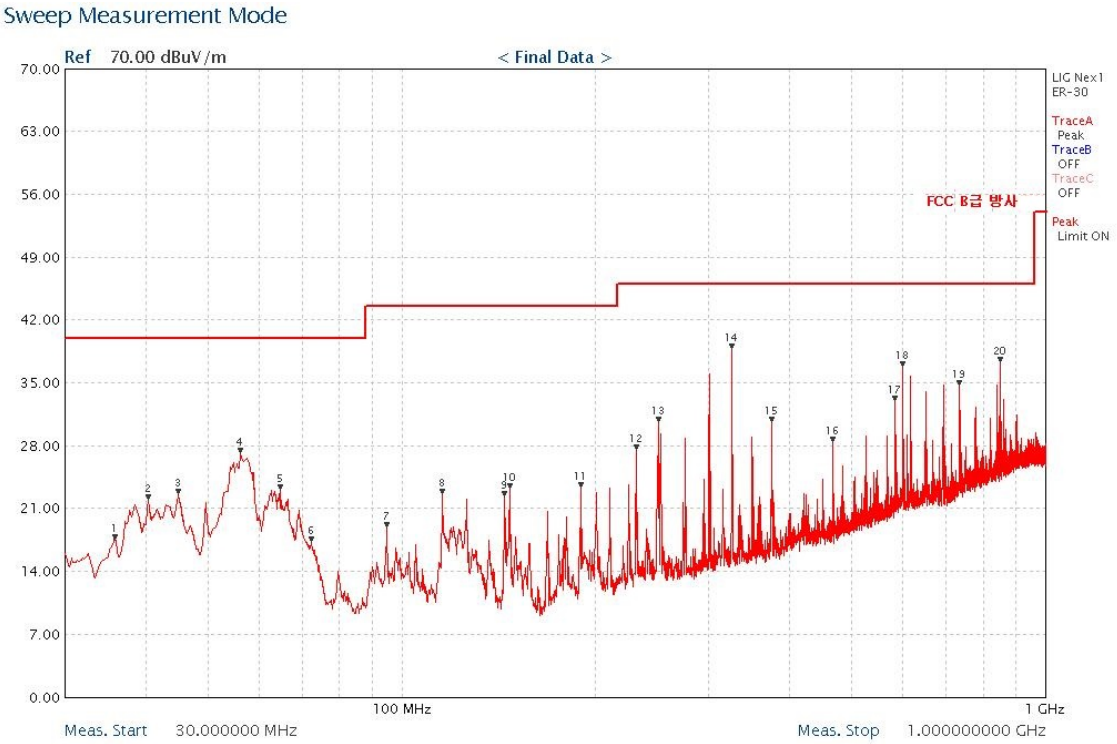
3) Spurious Emssion: above 30 MHz
The following test results were performed on the EUT.
Horizontal:
Peak scan
Level (dBμV/m)



REDUCTION TABLE

Freq (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reference
49.65	22.65	40.0	17.35	QK
147.00	24.62	43.5	18.88	QK
275.37	33.32	46.0	12.68	QK
325.58	36.52	46.0	9.48	QK
375.55	30.27	46.0	15.73	QK
587.88	35.42	46.0	10.58	QK
733.78	36.43	46.0	9.57	QK
966.13	36.62	54.0	17.38	QK

Vertical:
Peak scan
Level (dBμV/m)



REDUCTION TABLE

Freq (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reference
56.17	27.08	40.0	12.92	QK
250.62	30.60	46.0	15.40	QK
287.56	36.41	46.0	15.40	QK
325.58	38.68	46.0	7.32	QK
600.20	36.79	46.0	9.21	QK
848.41	37.25	46.0	8.75	QK

5.3 Occupied bandwidth

5.3.1 Regulation

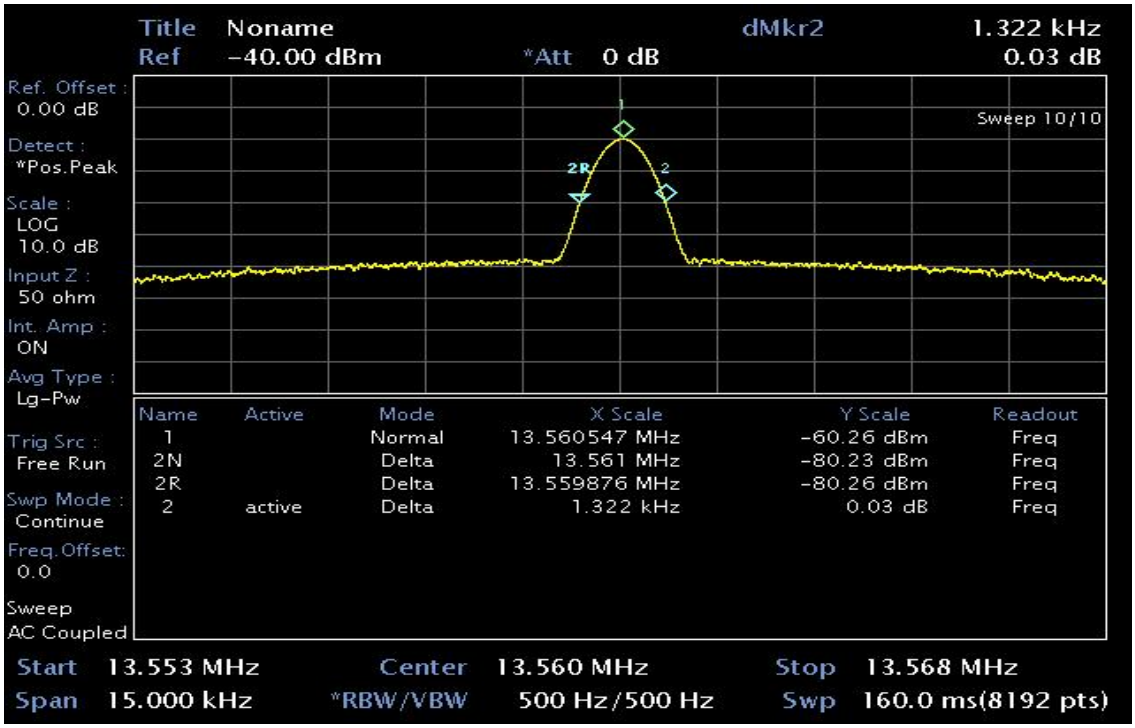
FCC 47CFR15 - 15.225

15.215(c), Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the 20 dB bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

5.3.2 Measurement Procedure

The useful radiated emission from the EUT was detected by the spectrum analyzer with peak detector. Record the 20 dB bandwidth of the carrier.
The useful radiated emission from the EUT was detected by the spectrum analyser with peak detector. The vertical Scale is set to 10dB per division. The horizontal scale is set to 20 kHz per division. Read the down 20dB bandwidth of the carrier.
Set the spectrum analyzer: Span = 15 kHz
Set the spectrum analyzer: RBW = 500 Hz, VBW = 500 Hz
Sweep = auto; Detector Function = Peak. Trace = Max Hold.
Mark the peak frequency and -20dB points bandwidth.

5.3.3 Test Results



5.4 Frequency Stability

5.4.1 Regulation

FCC 47CFR15 - 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.

5.4.2 Measurement Procedure

Frequency stability versus environmental temperature

1. Supply the EUT with nominal AC voltage.

2. Turn the EUT off, and place it inside an environmental temperature chamber. For devices that are normally operated continuously, the EUT may be energized while inside the test chamber. For devices that have oscillator heaters, energize only the heater circuit while the EUT is inside the chamber.

3. RF output was connected to a frequency counter or other frequency-measuring instrument via feed through attenuators.

4. Set the temperature control on the chamber to the highest specified EUT operating temperature, and allow the temperature inside the chamber to stabilize at the set temperature before starting frequency measurements.

5. While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup and two, five, and ten minutes after the EUT is energized.

6. After all measurements have been made at the highest specified temperature turn the EUT off.

7. Repeat the above measurement process for the EUT with the test chamber set at the appropriate temperature.

Frequency Stability versus Input Voltage

1. At temperature (20 ± 5°C), supply the EUT with nominal AC voltage

2. Couple RF output to a frequency counter or other frequency-measuring instrument.

3. Turn the EUT on, and measure the EUT operating frequency at startup and two, five, and ten minutes after startup

4. Supply it with 85% of the nominal AC voltage and repeat above procedure.

5. Supply it with 115% of the nominal AC voltage and repeat above procedure.

5.4.3 Test Results: PASS

TEST MODE : TX on

Table 6: Test Data, Frequency Tolerance of carrier signal									
Operating Frequency : 13.5607 MHz, LIMIT : within 1.35607 KHz (+/- 0.01% of the operating frequency)									
Environment Temperature [C]	Power Supplied [AC]	Carrier Frequency Measured with Time Elapsed							
		STARTUP		2 minutes		5 minutes		10minutes	
		[MHz]	Err[KHz]	[MHz]	Err[KHz]	[MHz]	Err[KHz]	[MHz]	Err[KHz]
+50	120	13.5602	-0.0005	13.5602	-0.0005	13.5606	-0.0001	13.5606	-0.0001
+40	120	13.5603	-0.0004	13.5603	-0.0004	13.5606	-0.0001	13.5606	-0.0001
+30	120	13.5605	-0.0002	13.5606	-0.0001	13.5605	-0.0002	13.5606	-0.0001
+20	120	13.5605	-0.0002	13.5606	-0.0001	13.5608	+0.0001	13.5608	+0.0001
+10	120	13.5605	-0.0002	13.5609	-0.0002	13.5609	+0.0002	13.5609	+0.0002
0	120	13.5611	+0.0004	13.5611	+0.0004	13.5611	+0.0004	13.5611	+0.0004
-10	120	13.5613	+0.0006	13.5613	+0.0006	13.5612	+0.0005	13.5612	+0.0005
-20	120	13.5614	+0.0007	13.5614	+0.0007	13.5614	+0.0007	13.5613	+0.0006

Operating Frequency : 13.5607 MHz, LIMIT : within 1.35607 KHz (+/- 0.01% of the operating frequency)								
Power Supplied [AC]	Carrier Frequency Measured with Time Elapsed							
	STARTUP		2 minutes		5 minutes		10 minutes	
	[MHz]	Err[KHz]	[MHz]	Err[Hz]	[MHz]	Err[Hz]	[MHz]	Err[Hz]
85 %	13.5611	+0.0004	13.5611	+0.0004	13.5611	+0.0004	13.5611	+0.0004
100 %	13.5613	+0.0006	13.5613	+0.0006	13.5613	+0.0006	13.5613	+0.0006
115 %	13.5614	+0.0007	13.5614	+0.0007	13.5614	+0.0007	13.5614	+0.0007

Err[Hz] = Measured carrier frequency (MHz) – Reference Frequency (13.5607MHz)

6. LIST OF TEST EQUIPMENT

No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Data	Used equipment
1	EMI Test Receiver	LIG	LSA-265	L07098033	03/08/2016	03/08/2017	■
2	EMI Test Receiver	Rhode & Schwarz	ESIB7	3311	02/11/2016	02/11/2017	□
3	Bi-log Antenna	Schwarzbeck	VULB9163	164	09/15/2014	09/15/2016	■
4	Loop Antenna	EMCO	6502	9206-2769	01/28/2016	01/28/2018	■
5	Spectrum Analyzer	Agilent	E4440A	US45303130	01/26/2016	01/26/2017	■
6	Frequency Counter	HP	5347A	3009A02742	01/26/2016	01/26/2017	■
7	Attenuator	Agilent	8495B	3308A22485	01/26/2016	01/26/2017	□
8	Power Meter	Agilent	E4418B	MY405111655	01/26/2016	01/26/2017	□
9	Power Sensor	HP	8485A	2347A02746	01/26/2016	01/26/2017	□
10	RF Cable	Gigalane	SMS102-MF141-SMS102-1.0M	PB1252301285	N/A	N/A	■
11	Signal Generator	HP	83630A	3420A00728	01/26/2016	01/26/2017	□
12	Oscilloscope	HP	54815A	US38380122	01/26/2016	01/26/2017	□
13	Pre Amplifier	Agilent	8449B	3008A02105	01/26/2016	01/26/2017	■
14	Signal Generator	Rhode & Schwarz	SML03	102330	01/26/2016	01/26/2017	□
15	POWER DIVIDER	Agilent	11636B	50309	01/26/2016	01/26/2017	□
16	Power Sensor	Seoksan Tech	SE-CT-02	S7400JD5340618	01/26/2016	01/26/2017	□
17	Temp & Humidity Chamber	HP	6032A	US35420383	01/26/2016	01/26/2017	■
18	Slidacs	Sunchang Electrics	5KV	N/A	01/26/2016	01/26/2017	■
19	Bandreject Filter	K&L Microwave	50140	555	01/26/2016	01/26/2017	□
20	Horn Antenna	Schwarzbeck	BBHA9120A	346	02/05/2016	02/05/2018	□
21	Horn Antenna	A.H. SYSTEMS	SAS-572	269	09/03/2015	09/03/2017	□
22	DC Power Supply	Provice	PWS-5005D	205050	01/26/2016	01/26/2017	■
23	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100137	11/13/2015	11/13/2016	■
24	LISN	Rhode & Schwarz	ESH3-Z5	100204	11/13/2015	11/13/2016	■

APPENDIX

1. EUT photo