TEST REPORT

According to

CFR 47 Part 15 Subpart C-15.225

Test Report No : CSTS-A14-FCC0004

EQUIPMENT NAME	:	SMART VALIDATOR
MODEL NO.	:	SAM-CRM-14
APPLICANT	:	SAMSUNG SDS Co., Ltd.
MANUFACTURER	:	SAMSUNG SDS Co., Ltd.
TEST STANDARD	:	FCC CFR 47, Part 15. Subpart C-15.225
TEST METHOD	:	ANSI C63.10(2009) and ANSI C63.4(2009)
FCC ID	:	P4YSAM-CRM-14

This report applies only to the product named in the title of this report manufactured at the location indicated.
Test results apply only to the particular equipment and functionality described in this test report.

This is the result of test that was carried out from the submitted type-samples of a product in conformity with the specification of the respective standards.

Date : January 16, 2014

Tested by
S.J. Yang

Date : January 16, 2014

Approved by
Ik Seon, Jeong

CERTIFICATION SERVICE TECHNOLOGY INC.

181, Manhaero, Danwan-gu, Ansan-city, Kyeonggi-do, 425-839, Korea
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1. General Information

1.1 General Description of EUT

Applicant's Information	
Company Name	SAMSUNG SDS Co., Ltd.
Address	707-19, Yoksam 2-dong, Gangnam-gu, Seoul, Korea, 135-918
Name For Contact Purposes	Kim Dal-Young
E-mail	dalyoung81.kim@samsung.com
Telephone no.	+82-2-6484-0756
Fax no.	+82-2-6484-1301

Manufacturer Information	
Company Name	SAMSUNG SDS Co., Ltd.
Address	707-19, Yoksam 2-dong, Gangnam-gu, Seoul, Korea, 135-918

1.2 Basic Description of EUT

Basic Description of EUT		
Equipment Name	:	SMART VALIDATOR
Model NO.	:	SAM-CRM-14
Serial NO.	:	Proto Type
Frequency Range	:	13.56 MHz
Channel	:	1
Modulation Type	:	ASK
Emission Type	:	A1D
Oscillation Type	:	Crystal
Power Source	:	DC 24V (Car Battery)
Dimension	:	193.0 mm x 319.0 mm x 61.5 mm
FCC ID	:	P4YSAM-CRM-14

1.3 Antenna Description

Antenna Description		
Type of Antenna	:	Internal PCB ANT.
Length	:	117 x 107 mm, 4-turns

2. Summary of test results

The EUT has been tested according to the follow specification:

Description of Test	FCC Rule	Report Section	Pass/Fail	Test Result
Radiated Emissions Field Strength within the band 13.553-13.567 MHz	15.225(a)	5.1	Pass	Compliance
Field Strength within the bands 13.410-13.553 MHz and 13.567-13.710 MHz 13.110-13.410 MHz and 13.710-14.010 MHz Radiated Harmonics and Spurious Emissions Outside of the 13.110 – 14.010 MHz	15.225(b) & (c) 15.225(d) 15.209(a)	5.1	Pass	Compliance
Frequency Tolerance of Carrier Signal	15.225(e)	5.2	Pass	Compliance
20 dB bandwidth	15.215(c)	5.3	Pass	Compliance
Antenna requirement	15.203	5.4	Pass	Compliance
AC Power line Conducted emission	15.207	N/A	N/A	N/A

Compliance : The EUT complies with the essential requirements in the standard.
Not Compliance : The EUT does not comply with the essential requirements in the standard.
N/A : The test was not applicable in the standard.

- The measurement report and tested in accordance with measurement procedures specified in ANSI C63.10(2009) and ANSI C63.4(2009)

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Name	***S.J. Yang***
Position held	***Engineer / RF Team***
Date	***January 16, 2014***

Begin Test : January 13, 2014
End Test : January 15, 2014

2.1 Measurement uncertainty

Conducted Emissions

TYPE	Contribution	Probability Distribution	Uncertainty	Remark
B	LISN Impedance Voltage Division Factor	 normal(k=2) normal(k=2)	 ±1.3 ±0.12	 CAL. CAL.
	cable	normal (k=2)	±0.2	NONCAL.
	Receiver Input Impedance QP Sine-Wave Voltage Accuracy QP-Pulse Amplitude Sensibility QP-Pulse Frequency Response Random Noise	 normal(k=1.64) normal(k=2) normal(k=2) normal(k=2) normal(k=2)	 ±0.0070 ±0.20 dB ±0.40 dB ±0.57 dB ±0.35 dB	CAL.
	Mismatch AMN to Receiver	U-Shaped	+0.7/-0.8	CISPR Theory
A	System Repeatability	Std deviation	±0.0721	
Combined Standard Uncertainty		normal	± 1.1155 [dB]	
Expanded Uncertainty U		normal(k=2)	*± 2.23*	*95.45 %*

Radiated Emission

TYPE	Contribution	Probability Distribution	Uncertainty 3/10m	Remark
B	Antenna factor frequency interpolation height variation direcvalupsy difference phase center location	 normal(k=2) rectangular rectangular rectangular	 ±0.5 dB ±0.1039 dB +1.5/-2.6 dB +0/-1.0 dB ±1.0 dB	 NPL NAMAS NAMAS
	Cable loss	normal(k=2)	±0.5 dB	
	Receiver Input Impedance QP Sine-Wave Voltage Accuracy QP-Pulse Amplitude Sensibility QP-Pulse Frequency Response Random Noise	 normal(k=1.64) normal(k=2) normal(k=2) normal(k=2) normal(k=2)	 ±0.0070 ±0.20 dB ±0.40 dB ±0.57 dB ±0.35 dB	
	Mismatch : AMN – receiver $\lvert\Gamma_{antenna}\rvert$ =0.33 $\lvert\Gamma_{receiver}\rvert$ =0.33	U-Shaped	+0.9/-1.0 dB	CISPR
A	System repeatibility	Std deviation	±0.1149 dB	
Combined standard Uncertainty		normal	±1.3193 [dB]	
Expanded Uncertainty U		normal(k=2)	*± 2.63*	*95.45 %*

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of $k = 2$.

2.2 Testing Facility

We , Certification Service Technology Inc. are an independent EMC and RF consultancy that was established the whole facility in our laboratories. The test facility has been accredited by the following accreditation Bodies in compliance with ISO 17025:

Test laboratory and address	Certification Service Technology Inc. (CSTech) 1055, Singil-dong ,Danwon-gu ,Ansan-si, Gyeonggi-do, Korea 425-839
FCC registration number	289252
IC registration number	10024A
KCC registration number (Korea Communication Commission)	KR0074
Contact Person	Ik Seon Jeong Testing Manager
e-mail	isjeong@cstlab.co.kr
Tel	82-31-493-2001
Fax	82-31-493-2055

3. TEST Instruments

No	Description	Model	Manufacturer	S/N	Next Calibration
1	Receiver	ER-265	LIG Nex 1	L0804B002	2014.07.04
2	Receiver	ER-30	LIG Nex 1	861743/024	2014.08.30
3	Bi-Log	3142	EMCO	9701-1128	2014.09.12
4	Biconical ANT.	3104C	EMCO	9012-4380	2014.03.13
5	Log Periodic ANT.	3146	EMCO	9008-2863	2014.03.13
6	LOOP ANT.	HFH2-Z2	Schwarz beck	100187	2015.07.29
7	DC Power Supply	6674A	Agilent	US36372373	2015.01.03
8	Dual Directional Coupler	778D	H.P	18592	2015.01.03
9	Signal Generator	E8257D	Agilent	MY47461024	2015.01.03
10	Signal Generator	E4432B	Agilent	US38441383	2015.01.03
11	Pulse/Pattern Generator	81110A	Agilent	DE41B02781	2015.01.03
12	Universal Radio Communication Tester	CMU200	Rohde &Schwarz	110665	2014.05.16
13	Modulation Analyzer	8901B	H.P	3438A05141	2014.05.16
14	Audio Analyzer	8903B	H.P	3514A16134	2014.05.16
15	Spectrum Analyzer	R3273	Advantest	121100554	2014.05.16
16	Spectrum Analyzer	E7405A	Agilent	US41110271	2015.01.03
17	Attenuator	8498A	H.P	1801A07058	2015.01.03
18	Horn Antenna	BBHA9120D	SCHWARZBECK	0501	2014.10.19
19	Horn Antenna	BBHA9170	SCHWARZBECK	BBHA9170152	2014.10.19
20	Digital Multimeter	45	FLUKE	76669036	2014.07.04
21	Digital Power Meter	ML2495A	Anritsu	824015	2014.01.03
22	High Accuracy Sensor	MA2445D	Anritsu	738191	2014.11.26
23	Highpass Filter	WHKX3.0/18G-10SS	WAINWRIGHT	84	2014.07.04
24	Highpass Filter	WHKX1.0/15G-10SS	WAINWRIGHT	2	2014.07.04
25	Band Reject Filter	WRCG824/849-814/859-80/16SS	WAINWRIGHT	1	2014.07.04
26	Band Reject Filter	WRCG890/915-880/925-80/16SS	WAINWRIGHT	2	2014.07.04
27	Band Reject Filter	WRCG1749.9/1784.9-1730/1805-90/14SS	WAINWRIGHT	6	2014.07.04

28	Band Reject Filter	WRCG1920/1980-1900/2000-80/14SS	WAINWRIGHT	42	2014.07.04
29	Band Reject Filter	WRCJ5125/5825-4950/6000-80/16SS	WAINWRIGHT	1	2014.07.04
30	TURN TABLE	Dail EMC	D-TT 06	N/A	N/A
31	ANT. MASTER	Dail EMC	D-AM 06	N/A	N/A
32	Controller	Dail EMC	D-CTR	N/A	N/A
33	TEMP&HUMID CHAMBER	KR-3001C	GOREAENG.	20080204-01	2015.01.03
34	TEMP&HUMID CHAMBER	SE-CT-02	SukSan Tech.	CST-RF-078	2015.01.03
35	Signal Generator	Agilent	E4438C	MY45093719	2014.11.21
36	POWER DIVIDER	KRYTAR	6010265	111194	2014.07.04
37	POWER DIVIDER	KRYTAR	6010265	111195	2014.07.04
38	POWER DIVIDER	KRYTAR	6010265	111196	2014.07.04

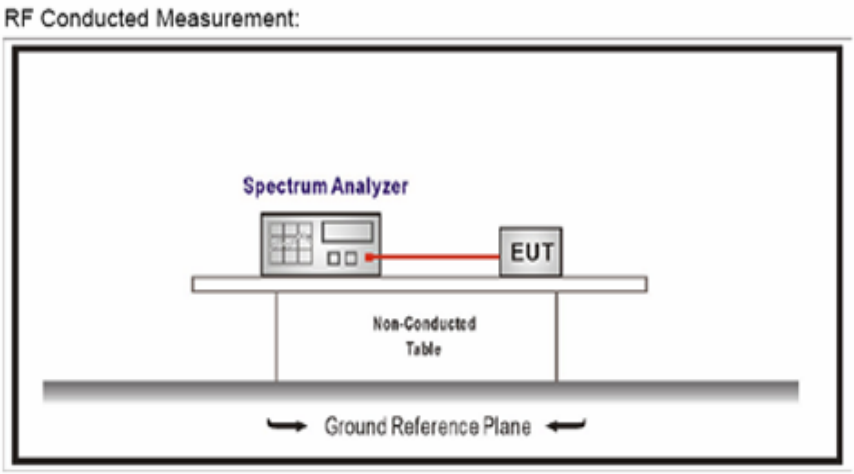
NOTE: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRA, KRISS, KTL and HCT.

2. The calibration interval of Horn ant. and Loop, Dipol ant. is 24 months

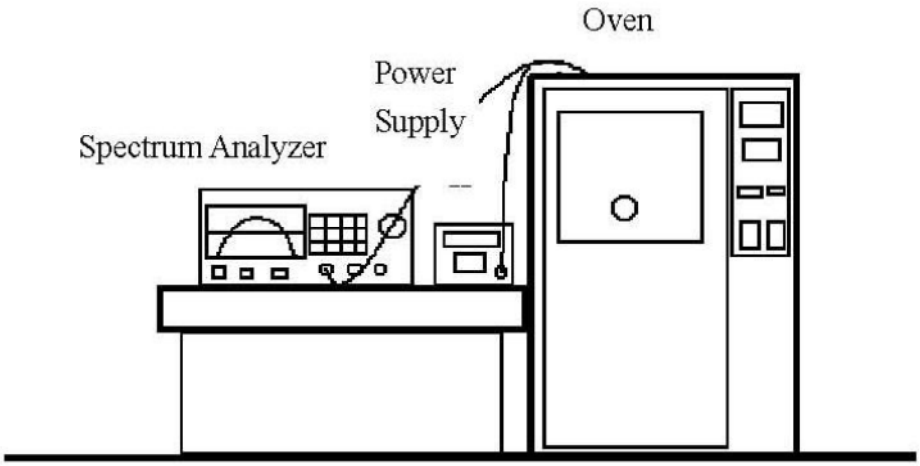
4. Configuration of system under test

4.1 Test Setup

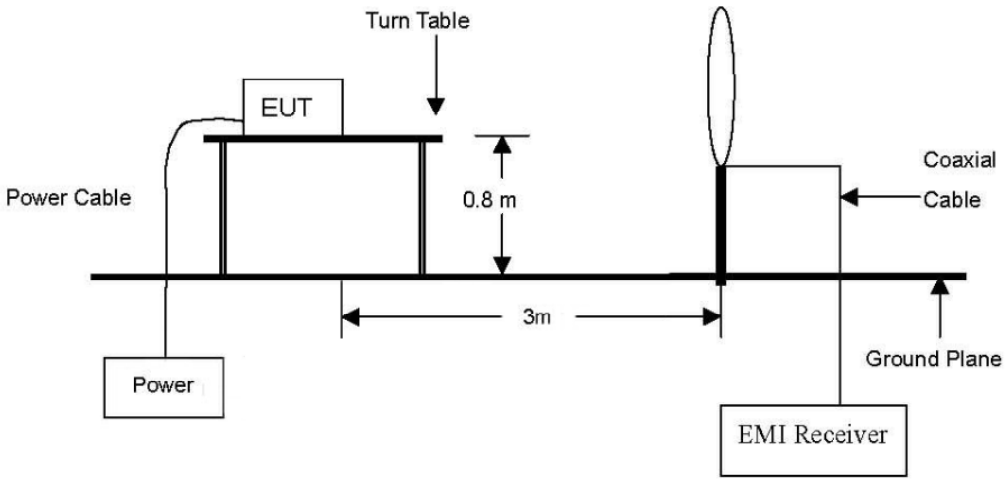
- **20dB Bandwidth**



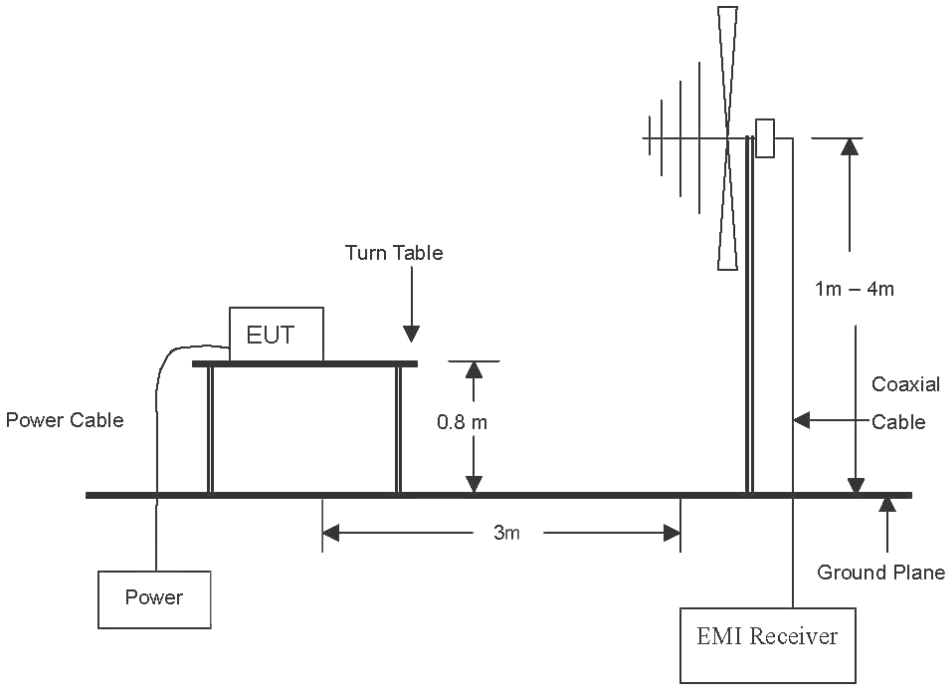
- **Frequency tolerance**



- **9 ㎑ to 30 ㎒ Emissions**



- **30 ㎒ to 1 ㎓ emissions**



4.2 Description of support units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO	PRODUCT	MODEL NO.	SERIAL NO.	Mnufacture
1	Note Book PC	PP04X	05098	DELL
2	USB Cable	E166307	-	-

4.3 Test Software Power Setting.

TEST Mode	13.56 MHz (1CH)
Target Power	05

The parameter POWER CONTROL in the test software was set to the values in the table below for 13.56MHz

5. Measurement Results

5.1 RADIATED EMISSIONS

5.1.1 Regulation

FCC 47CFR15 – 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.

(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.

(c) 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.

(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.

Frequency (MHz)	Field strength limit (μV/m) @ 30 m	Field strength limit (dBμV/m) @ 30 m	Field strength limit (dBμV/m) @ 3 m
13.110 – 13.410	106	40.5	80.5
13.410 – 13.553	334	50.5	90.5
13.553 – 13.567	15,848	84.0	124.0
13.567 – 13.710	334	50.5	90.5
13.710 – 14.010	106	40.5	80.5

FCC 47CFR15 – 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 (MHz)	Field strength limit (μV/m)	Field strength limit (dBμV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F (kHz) = 266.7 – 4.9	48.5 – 13.8	300
0.490 – 1.705	24000/F (kHz) = 49.0 – 14.1	33.8 – 23.0	30
1.705 – 30.0	30	29.5	30
30 – 88	100	40.0	3
88 – 216	150	43.5	3
216 – 960	200	46.0	3
Above 960	500	54.0	3

* The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector. For the frequency bands 9 – 90 kHz, 110 – 490 kHz and above 1000 MHz, the radiated emission limits are based on measurements employing an average detector.

* The lower limit shall apply at the transition frequencies.

5.1.2 Measurement Procedure

Radiated Emissions Test, 9 kHz to 30 MHz (Magnetic Field Test)

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions at a distance of 1 meter or 3 meters according to Section 15.31(f)(2).
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table.
3. Emissions from the EUT are maximized by adjusting the orientation of the Loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions if applicable.
4. To obtain the final measurement data, 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.

Radiated Emissions Test, above 30 MHz

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 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°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1000 MHz using the TRILOG broadband antenna
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. 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.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.

5.1.3 Calculation of the field strength limits below 30 MHz

1. No special calculation for obtaining the field strength in dBμV/m is necessary, because the EMI receiver and the active loop antenna operate as a system, where the reading gives directly the field strength result (dBμV/m). The antenna factors and cable losses are already taken into consideration.
2. For test distance other than what is specified, but fulfilling the requirements of section 15.31 (f) (2) the field strength is calculated by adding additionally an extrapolation factor of 40dB/decade (inverse linear distance for field strength measurements).
3. All following emission measurements were performed using the test receiver's average, peak, and quasi-peak detector function with specified bandwidth.
4. The basic equation is as follows;

FS= RA + DF

Where

FS = Field strength in dBμV/m

RA = Receiver Amplitude in dBμV/m

DF = Distance Extrapolation Factor in dB

Where DF = 40log(D_{TEST} / D_{SPEC}) where D_{TEST} = Test Distance and D_{SPEC} = Specified Distance

DF = 40log(3m/300m) = -80dB, for frequency band: 0.009 to 0.490MHz

DF = 40log(3m/30m) = -40dB, for frequency band: 0.490 to 30MHz

5.1.4 Test Results:

▣ Field strength below 30 MHz (In Band)

Frequency (MHz)	Reading (dBuV/m)	RBW (kHz)	Factor(dB) CL+AF	Limits (dBuV/m)	Result (dBuV/m)	V/H	Result
13.149	3.69	9	19.16	80.5	22.85	H	Pass
13.421	6.65	9	19.15	90.5	25.80	H	Pass
13.560	51.86	9	19.14	124.0	71.00	H	Pass
13.606	3.84	9	19.14	90.5	22.98	H	Pass
13.748	3.76	9	19.13	80.5	22.89	H	Pass

▣ Field strength below 30 MHz (Out Band)

Frequency (MHz)	Reading (dBuV/m)	RBW (kHz)	Factor(dB) CL+AF	Limits (dBuV/m)	Result (dBuV/m)	V/H	Result
25.663	8.98	9	19.98	69.5	28.96	H	Pass

▣ Field strength above 30 MHz

Frequency (MHz)	Reading (dBuV/m)	RBW (kHz)	Factor(dB) CL+AF	Limits (dBuV/m)	Result (dBuV/m)	V/H	Result
40.672	13.22	100	12.54	40.0	25.76	H	Pass
94.910	28.83	100	11.36	43.5	40.19	H	Pass
262.029	26.61	100	14.71	46.0	41.32	V	Pass
960.014	7.98	100	29.86	54.0	37.84	H	Pass

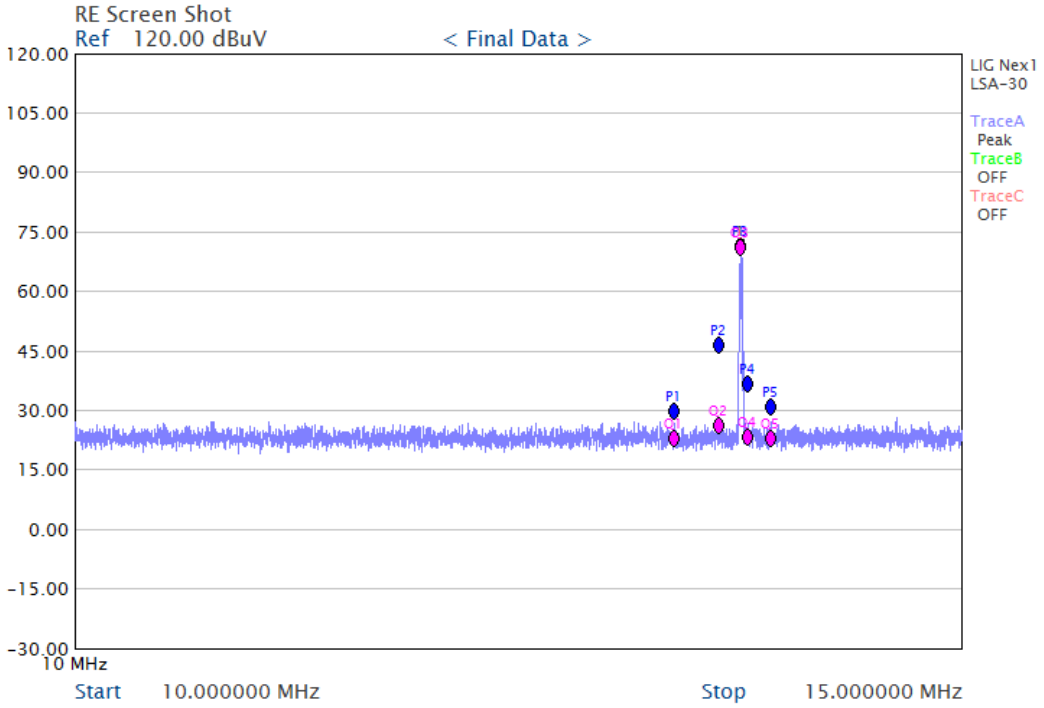
Emission Level(dBuV/m) = Reading Level + Correct Factor.

Note : Correct Factor = AF + CL

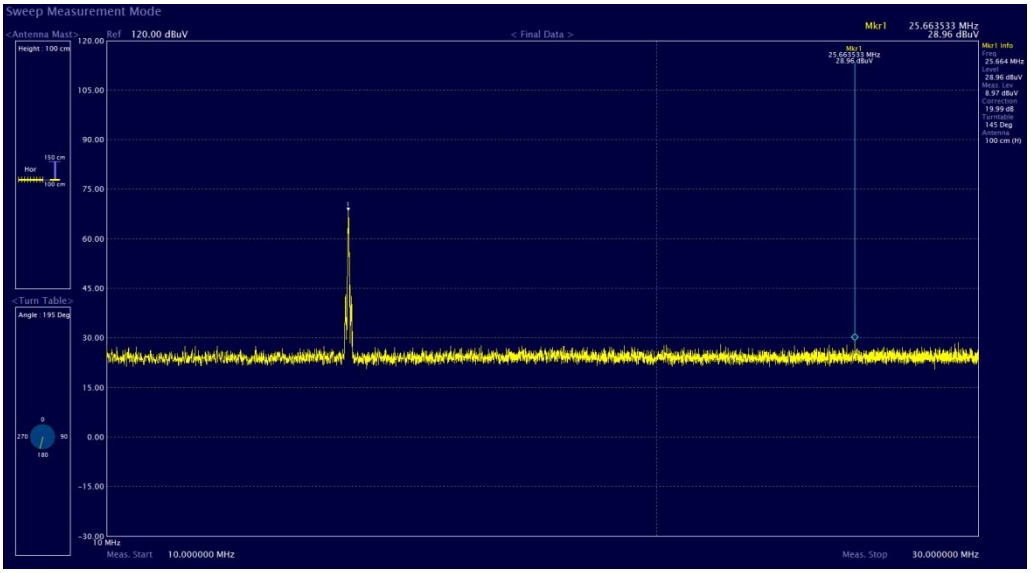
AF : Antenna Factor

CL : Cable Loss

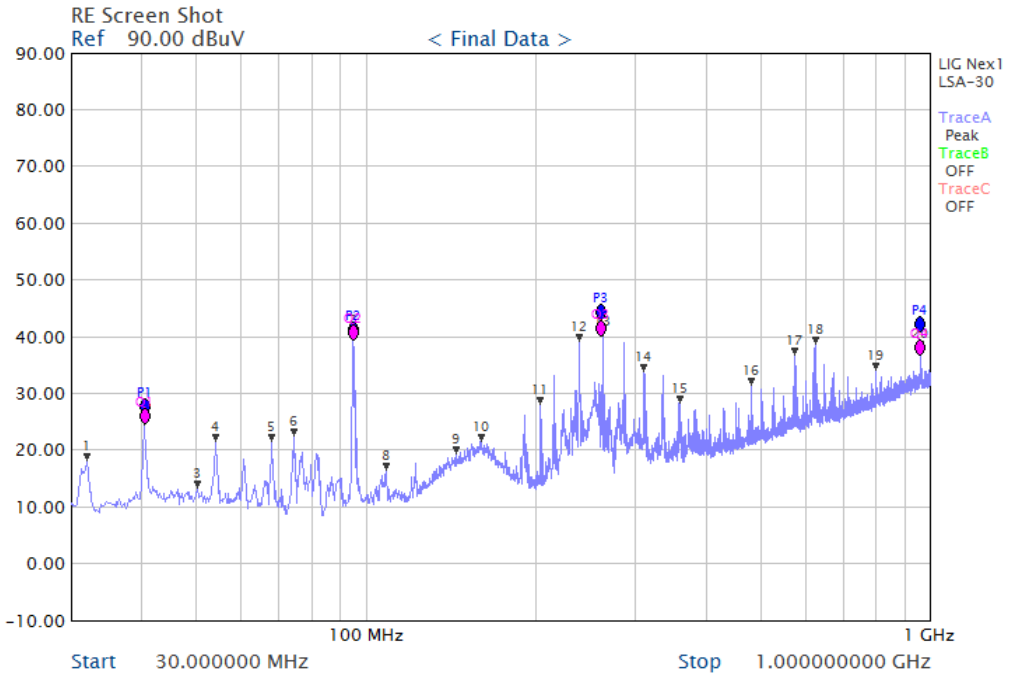
▣ Field strength below 30 MHz (In Band)



▣ Field strength below 30 MHz (Out Band)



▣ Field strength above 30 MHz



5.2 FREQUENCY TOLERANCE OF CARRIER SIGNAL

5.2.1 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 batteryoperated equipment, the equipment tests shall be performed using a new battery.

5.2.2 Measurement Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The transmission time was measured with the spectrum analyzer using RBW=1 ㎑, VBW=1 ㎑.
3. Set the temperature of chamber to -20℃. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency.
4. Repeat step 2 with a 10℃ decreased per stage until the highest temperature 50℃ is measured, record all measured frequencies on each temperature step.

Limit

According to FCC Part 15 Section 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.

5.2.3 Test Results : PASS

▣ Reference Frequency : 13.5600MHz

Test voltage (%)	Test voltage (V)	Temperature (℃)	Measure frequency (㎒)	Frequency deviation (Hz)	Limit (Hz)
100 %	DC 24	-20	13.559129	-871	within ± 1 356 Hz (within ±0.01%)
100 %		-10	13.559127	-873	
100 %		0	13.559126	-874	
100 %		10	13.559117	-883	
100 %		20	13.559109	-891	
100 %		30	13.559100	-900	
100 %		40	13.559099	-901	
100 %		50	13.559161	-839	
85 %	DC 20.4	20	13.559116	-884	
115 %	DC 27.6	20	13.559101	-899	

5.3 20dB Bandwidth

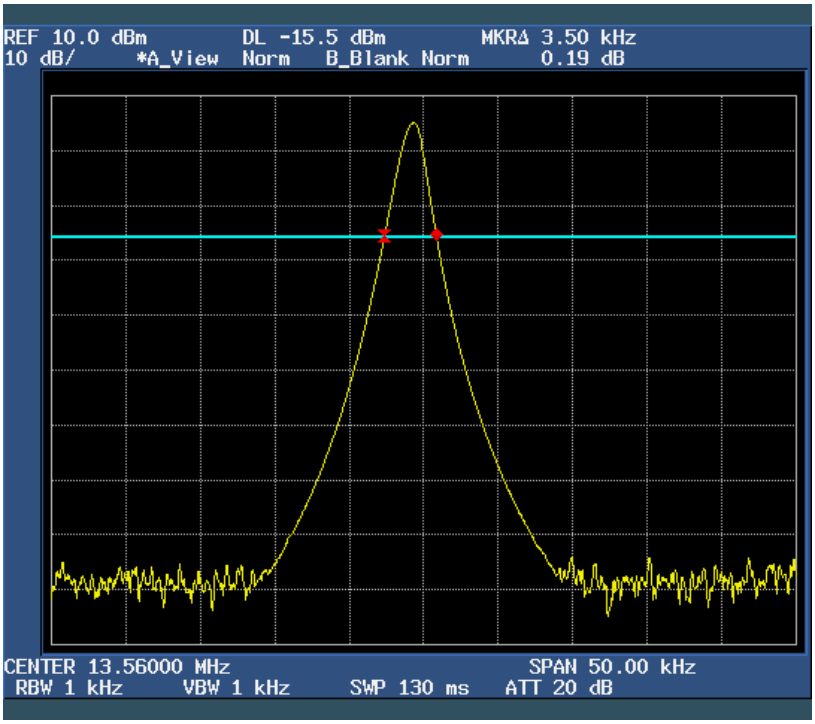
5.3.1 Regulation

FCC 47CFR15 – 15.225(e)

Test setup: The EUT was connected to a spectrum analyzer.

Test procedure: The 20 dB bandwidth was measured by using a spectrum analyzer.

5.3.2 Test Results : PASS



5.4 ANTENNA REQUIREMENT

5.4.1 Regulation

FCC 47CFR15 – 15.203

FCC 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 Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31 (d), must be measured at the installation site. However, the installer shall be responsible for nsuring that the proper antenna is employed so that the limits in this Part are not exceeded.

5.4.2 Result: PASS

The EUT has an integral PCB loop antenna, and meets the requirements of this section.