TEST REPORT

Part 15 Subpart C 15.225

Equipment under test HiTRONIC Blaster

Model name HEBS-B-2A

FCC ID 2ATCL-HEBS-B-2A

Applicant HANWHA CORPORATION

Manufacturer HANWHA CORPORATION

Date of test(s) 2019.05.16 ~ 2019.05.21

Date of issue 2019.05.22

Issued to
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Revision history

Revision	Date of issue	Test report No.	Description
-	2019.05.22	KES-RF-19T0062	Initial

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1. General information

Applicant:	HANWHA CORPORATION
Applicant address:	04541 86, Cheonggyecheon-ro, Jung-gu, Seoul, Republic of Korea
Test site:	KES Co., Ltd.
Test site address:	3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Test Facility	FCC Accreditation Designation No.: KR0100, Registration No.: 444148
FCC rule part(s):	15.225
FCC ID:	2ATCL-HEBS-B-2A
Test device serial No.:	☐ Production ☒ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	HiTRONIC Blaster
Frequency range	13.56 ㎒ (NFC) 903 ㎒ ~ 927 ㎒ (Telecommand) 2 402 ㎒ ~ 2 480 ㎒ (EDR)
Model:	HEBS-B-2A
Modulation technique	ASK, FSK, π/4-DQPSK, 8DPSK
Number of channels	13.56 ㎒ (NFC) : 1ch 903 ㎒ ~ 927 ㎒ (Telecommand) : 121ch 2 402 ㎒ ~ 2 480 ㎒ (EDR) : 79ch
Antenna specification	Telecommand Antenna Peck Gain : 1.2 ㏈i EDR Antenna Peck Gain : 1 ㏈i NFC Flexible Antenna : N/A
Power source	DC 10.8 V

1.2. Test configuration

The **HANWHA CORPORATION // HEBS-B-2A // FCC ID: 2ATCL-HEBS-B-2A** was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15
FCC Part 2
ANSI C63.10-2013

1.3. Accessory information

N/A

1.4. Software and Firmware description

The software and firmware installed in the EUT is UC_01305

1.5. Measurement results explanation example

For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 0.84 + 10 = 10.70 (dB)

1.6 Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.62 dB
Uncertainty for Radiation emission test (include Fundamental emission)	9kHz - 30MHz	4.54 dB
	30MHz - 1GHz	4.36 dB
	Above 1GHz – 25GHz	5.00 dB
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		

1.7. Test frequency/Channel operation

Ch.	Frequency (MHz)
01	13.560

2. Summary of tests

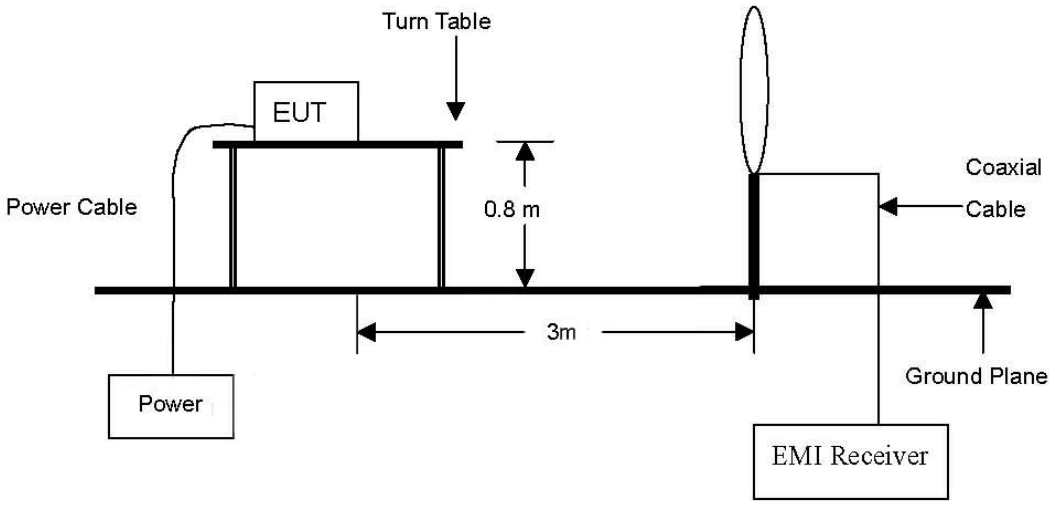
Section in FCC Part 15 & 2	Parameter	Test results
15.225(a)	The field strength of fundamental	Pass
15.225(b)(c)	The field strength of spurious emission(In-band)	Pass
15.225(d) 15.209	The field strength of spurious emission(Out-band)	Pass
2.1049	20 dB bandwidth	Pass
15.225(e)	Frequency stability	Pass
15.207(a)	AC conducted emissions	Pass

3. Test results

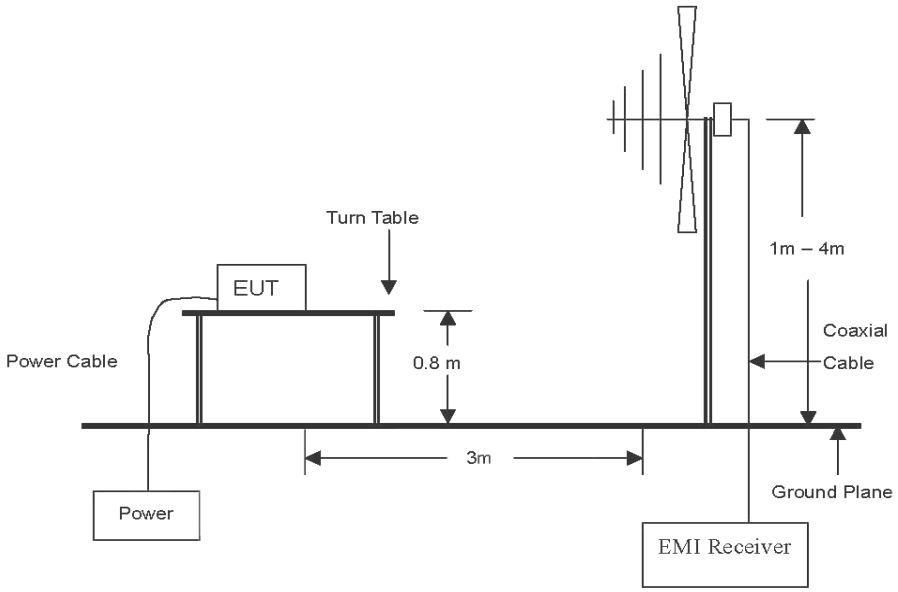
3.1. Radiated spurious emissions

Test setup

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



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



Test procedure

[9 ㎑ to 30 ㎒]

The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 ㎑ for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.

[30 ㎒ to 1 ㎓]

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.
The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.

Note.

According to exploratory test no any obvious emission except for fundamental 13.56㎒ were detected from 9 ㎑ to 30 ㎒. Although these test were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

Limit

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 (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2400/F(㎑)
0.490 ~ 1.705	30	24000/F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 ㎒, 76 ~ 88 ㎒, 174 ~ 216 ㎒ or 470 ~ 806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

In the section 15.225:

(a) The field strength of any emissions within the band 13.553 ~ 13.567 ㎒ shall not exceed 15,848 microvolts/meter (= 84 ㏈㎶/m) at 30 meters.

(b) Within the bands 13.410 ~ 13.553 ㎒ and 13.567 ~ 13.710 ㎒, the field strength of any emissions shall not exceed 334 microvolts/meter (=50.5 ㏈㎶/m) at 30 meters.

(c) Within the bands 13.110 ~ 13.410 ㎒ and 13.710 ~ 14.010 ㎒ the field strength of any emissions shall not exceed 106 microvolts/meter (=40.5 ㏈㎶/m) at 30 meters.

(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.

Test results for fundamental

Operating frequency: 13.560 ㎒

Distance of measurement: 3 meter

Radiated emissions		Ant.	Total factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Pol.	Correction factor (dB/m)	Distance factor (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
13.561	34.40	H	20.30	40.00	14.70	84.00	69.30
13.561	31.50	V	20.30	40.00	11.80	84.00	72.20

Test results for in-band & out-band(9 ㎑ to 30 ㎒)

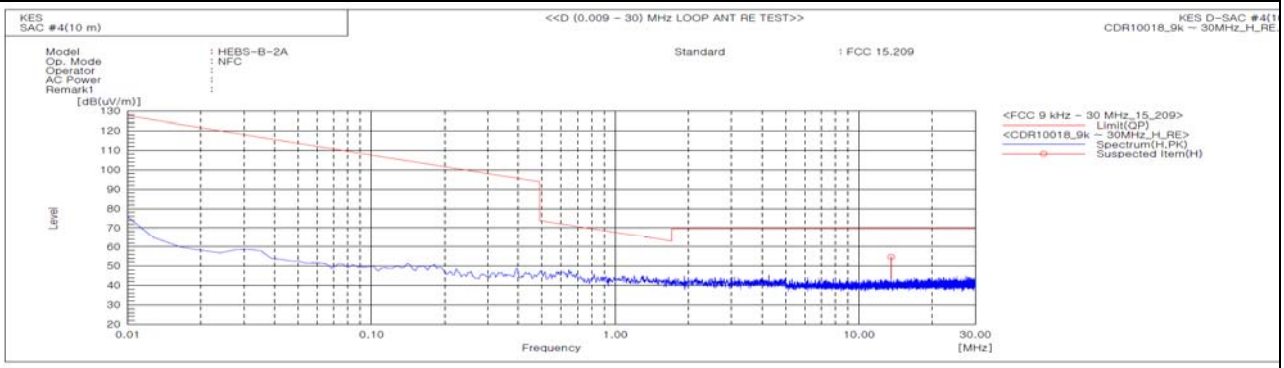
Radiated emissions		Ant.	Total factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Pol.	Correction factor (dB/m)	Distance factor (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
12.278	11.38	H	20.54	40	-9.29	29.54	38.83
13.415	12.58	H	20.63	40	-8.75	50.50	59.25
13.551	25.55	H	20.62	40	-9.42	50.50	59.92
13.567	25.44	H	20.62	40	5.47	50.50	45.03
13.983	15.07	H	20.60	40	4.37	40.50	36.13
14.978	10.72	H	20.62	40	-8.84	29.54	38.38
12.757	10.75	V	20.62	40	-9.37	29.54	38.91
13.36	10.76	V	20.63	40	-9.80	40.50	50.3
13.551	22.55	V	20.62	40	-9.34	50.50	59.84
13.567	22.73	V	20.62	40	-8.75	50.50	59.25
13.846	10.80	V	20.60	40	-9.42	40.50	49.92
14.946	10.76	V	20.62	40	5.47	29.54	24.07

Note.

1. All measurements were performed using a loop antenna. The antenna was investigated with three polarizations, and horizontal and vertical polarizations were reported as the worst case.
2. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
3. Measurements were performed at 3m and the data was extrapolated to the specified measurement distance of 30m using the square of an inverse linear distance extrapolation factor (40 ㏈/decade) as specified in §15.31(f)(2). Extrapolation Factor = 20 log10(30/3)^2 = 40 ㏈.
4. The spectrum was investigated from 9 ㎑ up to 30 ㎒ using the loop antenna. Only the emissions shown in the table above were found to be significant.
5. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector.
6. Actual = Reading + Correction factors(Ant. factor + Cable loss) - Distance factor
7. Margin [dB] = Limit [㏈㎶//m] - Field Strength Level [㏈㎶//m]
8. All modes (e.g. with and without a tag) were investigated. Only the radiated emissions of the configuration (with a tag) that produced the worst case emissions are reported in this section.

Test results (9 ㎑ to 30 ㎒)

Horizontal

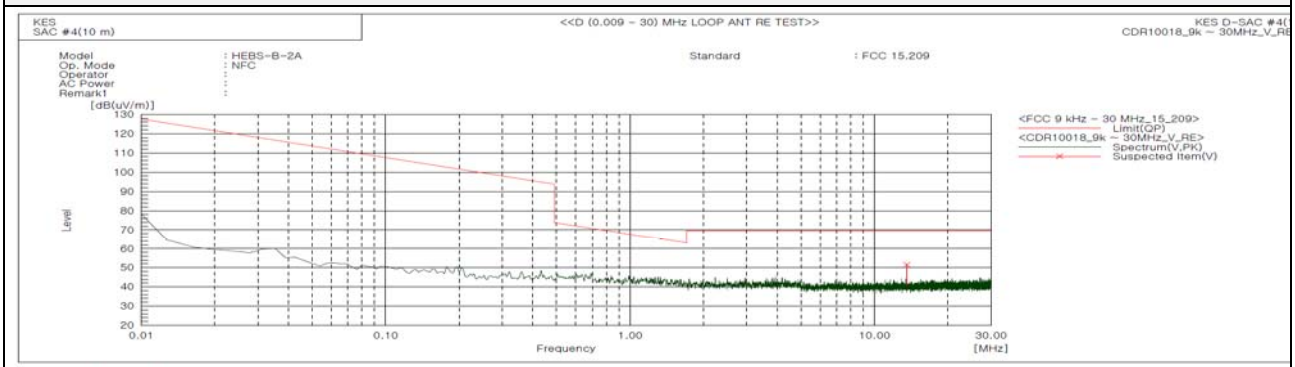


Spectrum Selection

--- Horizontal Polarization ---

No.	Frequency [MHz]	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	13.561	34.4	20.3	54.7	69.5	14.8	100.0	89.0	

Vertical

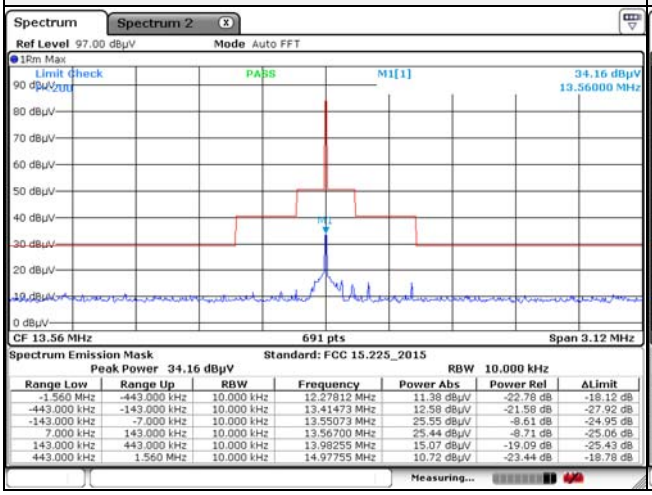


Spectrum Selection

--- Vertical Polarization ---

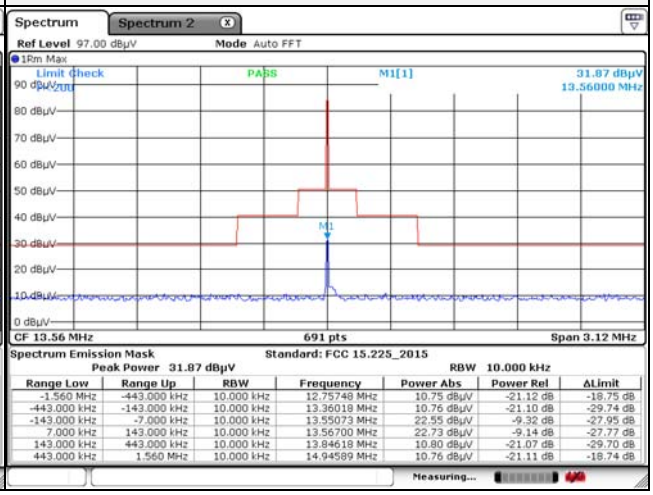
No.	Frequency [MHz]	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	13.561	31.5	20.3	51.8	69.5	17.7	100.0	58.0	

Horizontal // in-band & out-band



Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-1.560 MHz	-443.000 kHz	10.000 kHz	12.27812 MHz	11.38 dBµV	-22.78 dB	-18.12 dB
-443.000 kHz	-143.000 kHz	10.000 kHz	13.41473 MHz	12.58 dBµV	-21.58 dB	-27.92 dB
-143.000 kHz	-7.000 kHz	10.000 kHz	13.55073 MHz	25.55 dBµV	-8.61 dB	-24.95 dB
7.000 kHz	143.000 kHz	10.000 kHz	13.56700 MHz	25.44 dBµV	-8.71 dB	-25.06 dB
143.000 kHz	443.000 kHz	10.000 kHz	13.98255 MHz	15.07 dBµV	-19.09 dB	-25.43 dB
443.000 kHz	1.560 MHz	10.000 kHz	14.97755 MHz	10.72 dBµV	-23.44 dB	-18.78 dB

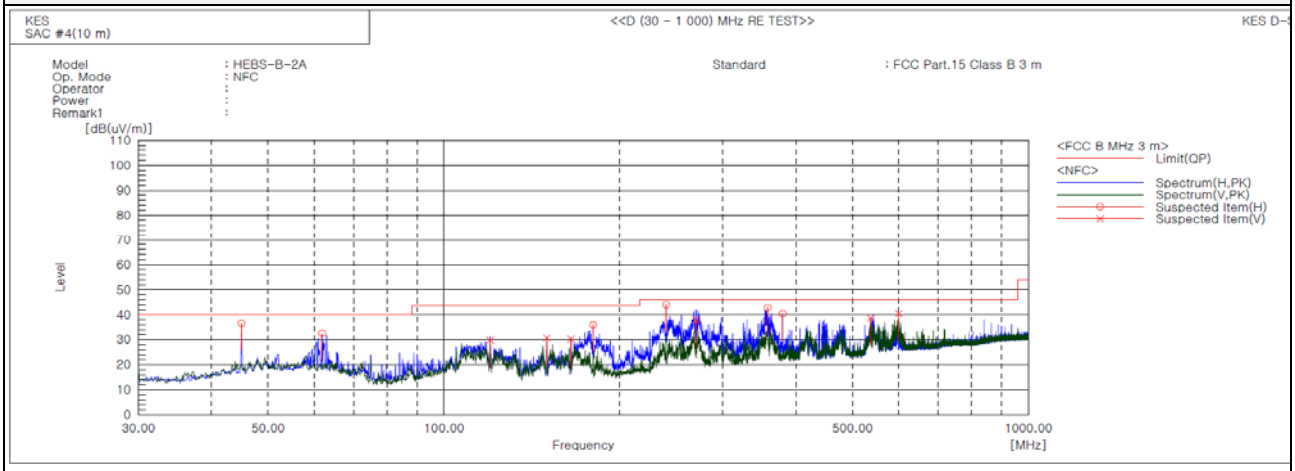
Vertical // in-band & out-band



Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-1.560 MHz	-443.000 kHz	10.000 kHz	12.75748 MHz	10.75 dBµV	-21.12 dB	-18.75 dB
-443.000 kHz	-143.000 kHz	10.000 kHz	13.36018 MHz	10.76 dBµV	-21.10 dB	-29.74 dB
-143.000 kHz	-7.000 kHz	10.000 kHz	13.55073 MHz	22.55 dBµV	-9.32 dB	-27.95 dB
7.000 kHz	143.000 kHz	10.000 kHz	13.56700 MHz	22.73 dBµV	-9.14 dB	-27.77 dB
143.000 kHz	443.000 kHz	10.000 kHz	13.84618 MHz	10.80 dBµV	-21.07 dB	-29.70 dB
443.000 kHz	1.560 MHz	10.000 kHz	14.94589 MHz	10.76 dBµV	-21.11 dB	-18.74 dB

Test results (Below 1 000 ㎒)

Horizontal // Vertical



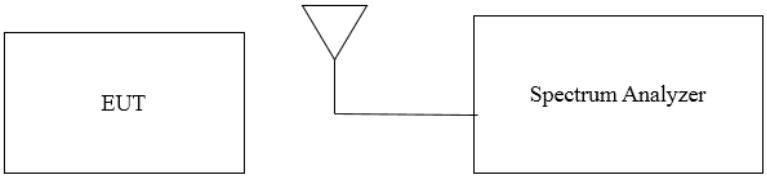
No.	Frequency	(P)	Reading	c.f	Result PK	Limit QP	Margin QP	Height	Angle	Remark
	[MHz]		[dB(uV)]	[dB(1/m)]	[dB(uV/m)]	[dB(uV/m)]	[dB]	[cm]	[deg]	
1	45.035	H	59.0	-22.4	36.6	40.0	3.4	100.0	290.0	
2	61.889	H	56.1	-23.5	32.6	40.0	7.4	100.0	290.0	
3	179.986	H	60.7	-24.8	35.9	43.5	7.6	200.0	90.0	
4	240.005	H	65.2	-21.2	44.0	46.0	2.0	100.0	132.0	
5	357.981	H	60.2	-17.4	42.8	46.0	3.2	100.0	132.0	
6	379.685	H	57.3	-17.0	40.3	46.0	5.7	100.0	183.0	
7	119.968	V	54.6	-24.8	29.8	43.5	13.7	100.0	265.0	
8	150.038	V	57.5	-26.8	30.7	43.5	12.8	100.0	325.0	
9	164.951	V	55.9	-25.6	30.3	43.5	13.2	100.0	277.0	
10	269.954	V	58.6	-20.8	37.8	46.0	8.2	150.0	207.0	
11	536.825	V	52.3	-13.7	38.6	46.0	7.4	100.0	63.0	
12	599.996	V	51.9	-11.5	40.4	46.0	5.6	100.0	15.0	

Note.

1. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector for emissions below 960 ㎒.
2. Below 30 MHz, loop Antenna was investigated with three polarizations, horizontal and vertical polarizations were reported as the worst case.
3. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
4. The spectrum is measured from 9 ㎑ to the 10th harmonic and the worst-case emissions are reported.
5. No spurious emissions levels were found to be greater than the level of the fundamental.

3.2 20 dB bandwidth

Test setup

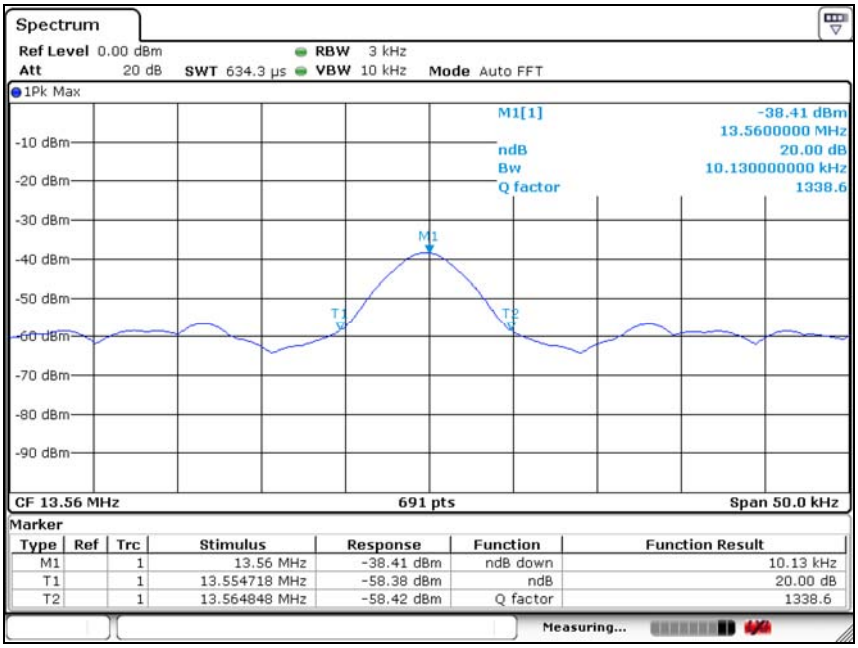


Test procedure

ANSI C63.10-2013 – Section 6.9.2

1. Spectrum analyzer frequency is set to the nominal EUT channel center frequency.
2. RBW = 1~5% OBW
3. VBW ≥ 3 x RBW
4. Reference level set to keep signal from exceeding maximum input mixer for linear operation.
5. Detector = Peak
6. Trace mode = Max hold
7. Sweep = Auto couple
8. The trace was allowed to stabilize
9. Using the marker-delta function, determine the "-20 dB down amplitude" using [(highest in band spectral density) – 20 dB]
10. Set a marker at the lowest frequency of the envelope of the spectral density, such that the marker is at or slightly below the "-20 dB down amplitude" determined in Step 9.
11. Reset Marker-delta function and move the marker to other side of the emission until the delta marker amplitude is the same level as reference amplitude. The marker delta frequency reading at this point is the specified emission bandwidth.

Test results

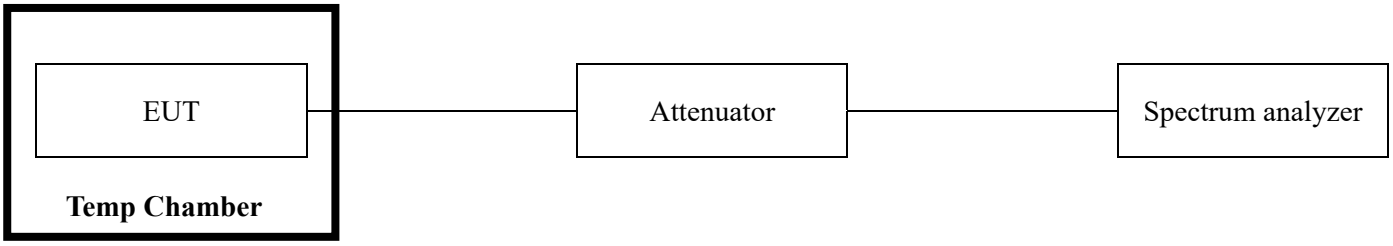


3.3. Frequency Stability

Test procedure

ANSI C63.10-2013, clause 6.8.1

Test setup



1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
2. Turn the EUT on and couple its output to a spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.
7. While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

Limit

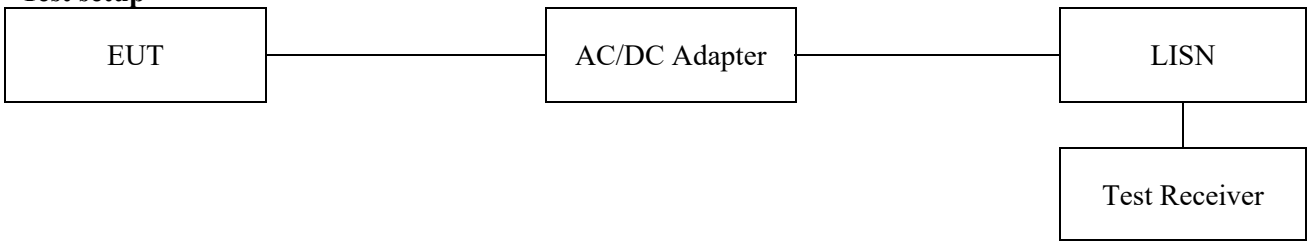
According to §15.225 (e), the frequency tolerance of the carrier signal shall be maintained within +/-0.01 % of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated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

Test results

Test voltage (%)	Test voltage (V)	Temperature (℃)	Maintaining time	Measure frequency (㎒)	Frequency deviation (㎐)	Deviation (%)
100 %	DC 10.80	-20	Startup	13.559 537	-463	-0.003 415
			2 minutes	13.559 518	-482	-0.003 555
			5 minutes	13.559 513	-487	-0.003 592
			10 minutes	13.559 514	-486	-0.003 584
		-10	Startup	13.559 557	-443	-0.003 267
			2 minutes	13.559 527	-473	-0.003 488
			5 minutes	13.559 515	-485	-0.003 577
			10 minutes	13.559 543	-457	-0.003 370
		0	Startup	13.559 590	-410	-0.003 024
			2 minutes	13.559 525	-475	-0.003 503
			5 minutes	13.559 544	-456	-0.003 363
			10 minutes	13.559 512	-488	-0.003 599
		10	Startup	13.559 603	-397	-0.002 928
			2 minutes	13.559 597	-403	-0.002 972
			5 minutes	13.559 612	-388	-0.002 861
			10 minutes	13.559 595	-405	-0.002 987
		20	Startup	13.559 615	-385	-0.002 839
			2 minutes	13.559 618	-382	-0.002 817
			5 minutes	13.559 627	-373	-0.002 751
			10 minutes	13.559 635	-365	-0.002 692
		30	Startup	13.559 620	-380	-0.002 802
			2 minutes	13.559 616	-384	-0.002 832
			5 minutes	13.559 605	-395	-0.002 913
			10 minutes	13.559 611	-389	-0.002 869
		40	Startup	13.559 630	-370	-0.002 729
			2 minutes	13.559 646	-354	-0.002 611
			5 minutes	13.559 668	-332	-0.002 448
			10 minutes	13.559 660	-340	-0.002 507
		50	Startup	13.559 698	-302	-0.002 227
			2 minutes	13.559 705	-295	-0.002 176
			5 minutes	13.559 731	-269	-0.001 984
			10 minutes	13.559 750	-250	-0.001 844
85 %	DC 9.18	23	Startup	13.559 751	-249	-0.001 836
			2 minutes	13.559 780	-220	-0.001 622
			5 minutes	13.559 800	-200	-0.001 475
			10 minutes	13.559 802	-198	-0.001 460
115 %	DC 12.42	23	Startup	13.559 623	-377	-0.002 780
			2 minutes	13.559 626	-374	-0.002 758
			5 minutes	13.559 640	-360	-0.002 655
			10 minutes	13.559 630	-370	-0.002 729

3.4. AC conducted emissions

Test setup



Limit

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 50uH/50 ohm 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.

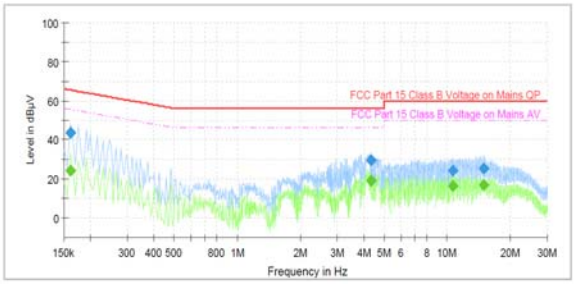
Frequency of Emission (㎒)	Conducted limit (㏈μV/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

Note:

1. All AC line conducted spurious emission are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and the appropriate frequencies. All data rates and modes were investigated for conducted spurious emission. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.
3. Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).

Test results

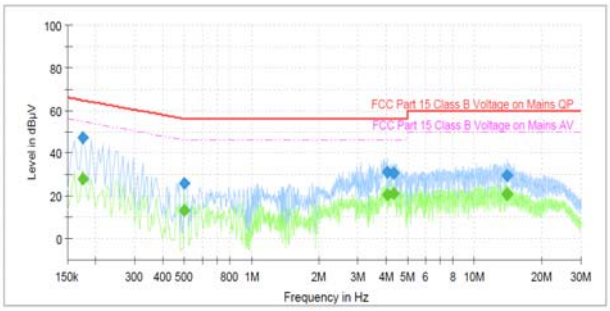
Hot Line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.160000	---	24.54	55.46	30.92	1000.0	9.000	L1	9.6
0.160000	43.46	---	65.46	22.00	1000.0	9.000	L1	9.6
4.340000	---	19.27	46.00	26.73	1000.0	9.000	L1	10.1
4.340000	29.53	---	56.00	26.47	1000.0	9.000	L1	10.1
10.685000	---	16.50	50.00	33.50	1000.0	9.000	L1	9.8
10.685000	24.50	---	60.00	35.50	1000.0	9.000	L1	9.8
14.905000	---	16.82	50.00	33.18	1000.0	9.000	L1	10.0
14.905000	25.20	---	60.00	34.80	1000.0	9.000	L1	10.0

Neutral Line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.175000	---	28.30	54.72	26.42	1000.0	9.000	N	9.6
0.175000	47.34	---	64.72	17.38	1000.0	9.000	N	9.6
0.500000	---	13.48	46.00	32.52	1000.0	9.000	N	9.8
0.500000	25.94	---	56.00	30.06	1000.0	9.000	N	9.8
4.045000	---	20.80	46.00	25.20	1000.0	9.000	N	10.1
4.045000	31.02	---	56.00	24.98	1000.0	9.000	N	10.1
4.320000	---	21.07	46.00	24.93	1000.0	9.000	N	10.1
4.320000	30.97	---	56.00	25.03	1000.0	9.000	N	10.1
14.010000	---	21.20	50.00	28.80	1000.0	9.000	N	9.9
14.010000	29.58	---	60.00	30.42	1000.0	9.000	N	9.9
14.025000	---	20.43	50.00	29.57	1000.0	9.000	N	9.9
14.025000	29.52	---	60.00	30.48	1000.0	9.000	N	9.9

Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	101389	1 year	2020.01.09
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2020.01.15
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2021.02.15
Trilog-broadband Antenna	Schwarzbeck	VULB9163	714	2 years	2020.11.26
EMI Test Receiver	R&S	ESU26	100552	1 year	2020.04.19
Attenuator	HP	8491A	32173	1 year	2020.03.11
Amplifier	AGILENT	8449B	3008A00538	1 year	2019.06.29
Temperature Chamber	TABAI	MC711P	112000492	1 year	2020.01.16
Pulse Limiter	R&S	ESH3-Z2	101915	1 year	2019.11.26
DC Power Supply	HP	6632B	MY43004130	1 year	2019.06.28

Peripheral device

Device	Manufacturer	Model No.	Serial No.
-	-	-	-