




TEST REPORT

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR23-SRF0035 Page (1) of (29)	 KCTL
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1. Client

- Name : SUPREMA INC
- Address : 17F-5, Parkview officetower,, 248, Jeongjail-ro, Bundang-gu,
Seongnam-si, Gyeonggi-do 13554 Korea (Republic Of)
- Date of Receipt : 2022-11-03

2. Use of Report : FCC Class II permissive change

3. Name of Product / Model : FaceStation F2 / FSF2-AB

4. Manufacturer / Country of Origin : SUPREMA INC / Korea

5. FCC ID : TKWFSF2-AB

6. IC Certificate No. : 23080-FSF2AB

7. Date of Test : 2022-11-26 to 2022-11-30

8. Location of Test : Permanent Testing Lab On Site Testing
 (Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)
 FCC Part 15 Subpart C, 15.225

9. Test method used : RSS-210 Issue 10 April 2020
 RSS-Gen Issue 5 February 2021

10. Test Result : Refer to the test result in the test report

Affirmation	Tested by Name : Minki Kim (Signature)	Technical Manager Name : Heesu Ahn (Signature)
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2023-01-17

Eurofins KCTL Co.,Ltd.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by Eurofins KCTL Co.,Ltd.

REPORT REVISION HISTORY

Date	Revision	Page No
2023-01-17	Originally issued	-

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General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

Statement not required by the standard or client used for type testing

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1. General information

Client : SUPREMA INC
Address : 17F-5, Parkview officetower,, 248, Jeongjail-ro, Bundang-gu, Seongnam-si, Gyeonggi-do 13554 Korea (Republic Of)
Manufacturer : SUPREMA INC
Address : 17F-5, Parkview officetower,, 248, Jeongjail-ro, Bundang-gu, Seongnam-si, Gyeonggi-do 13554 Korea (Republic Of)
Laboratory : Eurofins KCTL Co.,Ltd.
Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132
VCCI Registration No. : R-20080, G-20078, C-20059, T-20056
CAB Identifier: KR0040, ISED Number: 8035A
KOLAS No.: KT231

2. Device information

Equipment under test : FaceStation F2
Model : FSF2-AB
Derivative Model : FSF2-DB, FSF2-ABT10, FSF2-DBT10
Frequency range : 13.56 MHz (NFC)
125 kHz (RFID)
2 402 MHz ~ 2 480 MHz (Bluetooth Low Energy)
Modulation technique : ASK (NFC,RFID), GFSK (Bluetooth Low Energy)
Number of channels : 40 ch (Bluetooth Low Energy), 1 ch (NFC, RFID)
Power source : DC 12 V, DC 24 V
Antenna specification : PCB Loop antenna (NFC)
Coil antenna (RFID)
PCB Pattern antenna (Bluetooth Low Energy)
Antenna gain : 3.03 dBi (Bluetooth Low Energy)
Software version : V2.1.1
Hardware version : V2.0.0
Operation temperature : -20 °C ~ 50 °C

2.1. Information about derivative model

The difference between basic model and derivative models is:

- 1)PCB are added to the basic model (FSF2-AB). All other internal components are the same as in the previous model. The added part does not affect the wireless part of the product.
- 2)Radio Hardware such as circuits and electrical components and Software are the same.

Component	Basic model	Variant model
LED board	FSF2_WHITE-LED_PS1	FSF2_WHITE-LED_V02
IR LED board	FSF2_IR_LED_PS1	FSF2_IR_LED_V01
Main board	FSF2_MAIN_PS1	FSF2_MAIN_V04
RF board	FSF2_RFBD_DB_PS1	FSF2_RFBD_DB_V02
USB board	FSF2_AB_DB-USB_PS1	FSF2_AB_DB-USB_V01
Camera 1 module	SV-SUE1-ET020S	SV-SUE1-ET020S
Camera 2 module	SV-SUE1L-ET020S	SV-SUE1L-ET020S



2.2. Frequency/channel operations

This device contains the following capabilities:

NFC

Frequency (MHz)
13.56

Table 2.2.1. NFC mode

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3. Antenna requirement

Requirement of FCC part 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 this section.

Requirement of RSS-Gen Section 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

-The transmitter has permanently attached PCB Loop antenna (internal antenna) on board.

4. Summary of tests

FCC Part section(s)	IC Rule reference	Parameter	Test Condition	Test results
15.225(a)	RSS-210 B.6 (I)	In-band Fundamental Emission	Radiated	Pass
15.225(b), (c)	RSS-210 B.6 (II), (III)	In-band Spurious Emission		Pass
15.225(d) 15.209	RSS-210 B.6 (IV) RSS-Gen Issue 9 (8.9)	Out-of-band Spurious Emission		Pass
15.225(e)	RSS-210 B.6 (b)	Frequency Stability Tolerance	Conducted	Pass
15.215(c)	-	20dB Bandwidth		Pass
-	RSS-Gen Issue 5 (6.7)	Occupied Bandwidth		Pass
15.207(a)	RSS-Gen Issue 5 (8.8)	AC Conducted emissions		Pass

Notes: (N/T: Not Tested, N/A: Not Applicable)

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. These tests were performed other than open field 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.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y, Z It was determined that Y orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y orientation
4. The test procedure(s) in this report were performed in accordance as following.
 - ◆ ANSI C63.10-2013
5. The radiated test was performed with and without passive tag. The test results shown in the following sections represent the worst case emissions.
 - ◆ Worst Case : Without passive tag

5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicated a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

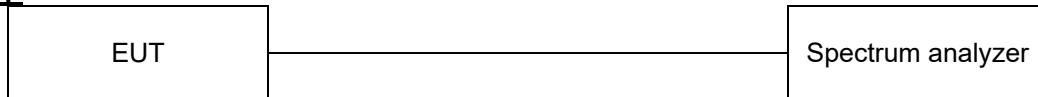
Parameter	Expanded uncertainty (\pm)	
Radiated spurious emissions	9 kHz ~ 30 MHz	2.4 dB
	30 MHz ~ 1 000 MHz	2.3 dB
	1 000 MHz ~ 18 000 MHz	5.6 dB
	Above 18 000 MHz	5.7 dB
Conducted Emissions	9 kHz ~ 150 kHz	1.6 dB
	150 kHz ~ 30 MHz	1.7 dB



6. Test results

6.1. 20dB Bandwidth & 99% Bandwidth

Test setup



Limit

According to §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, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

According to RSS-Gen Issue 5 (6.7) 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.

Test procedure

ANSI C63.10-2013 - Section 6.9.2

Test settings

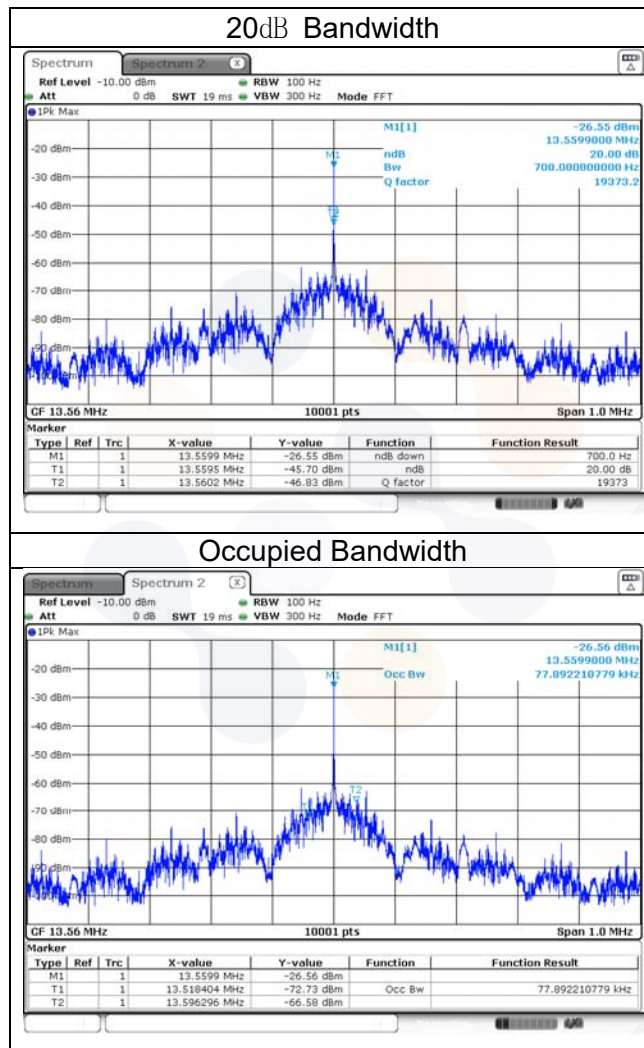
The occupied bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of dB down from the reference value). Typical ratios, expressed in dB, are -6 dB, -20 dB, and -26 dB, corresponding to 6 dB BW, 20 dB BW, and 26 dB BW, respectively. In this subclause, the ratio is designated by “-xx dB.” The reference value is either the level of the unmodulated carrier or the highest level of the spectral envelope of the modulated signal, as stated by the applicable requirement. Some requirements might specify a specific maximum or minimum value for the “-xx dB” bandwidth; other requirements might specify that the “-xx dB” bandwidth be entirely contained within the authorized or designated frequency band.

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency.
- b) Span: Two times and five times the OBW.
- c) RBW = 1 % to 5 % of the OBW and VBW \geq 3 x RBW
- d) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation.
- e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- f) Detector: peak
- g) Trace mode: max hold.
- h) Allow the trace to stabilize.
- i) Determine the “-xx dB down amplitude” using ((reference value) - xx). Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- j) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j)
- k) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

Test results

[DC 12 V]

Frequency [MHz]	20 dB Bandwidth [MHz]		Limit [MHz]	20 dB Bandwidth [kHz]	Occupied Bandwidth (99 % BW) [kHz]
13.56	Lowest Frequency	13.559 5	13.110 0	0.70	77.89
	Highest Frequency	13.560 2	14.010 0		

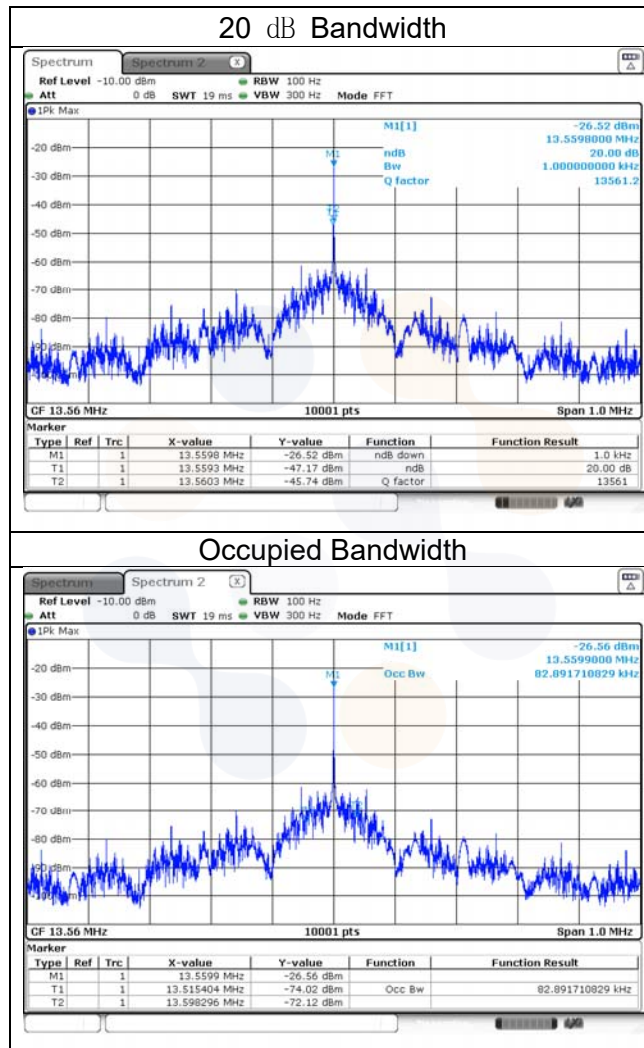


Note:

Because the measured signal is CW/CW-like, adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW

[DC 24 V]

Frequency [MHz]	20 dB Bandwidth [MHz]	Limit [MHz]	20 dB Bandwidth [kHz]	Occupied Bandwidth (99 % BW) [kHz]
13.56	Lowest Frequency	13.559 3	1.00	82.89
	Highest Frequency	13.560 3		

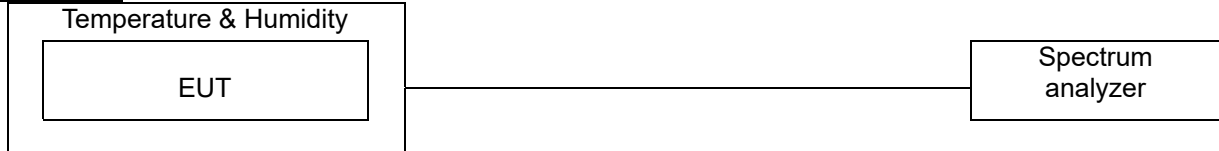


Note:

Because the measured signal is CW/CW-like, adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW

6.2. Frequency tolerance

Test setup



Limit

According to §15.225 (e), RSS-210 B.6.(b) 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 procedure

ANSI C63.10-2013 - Section 6.8.1



Test results

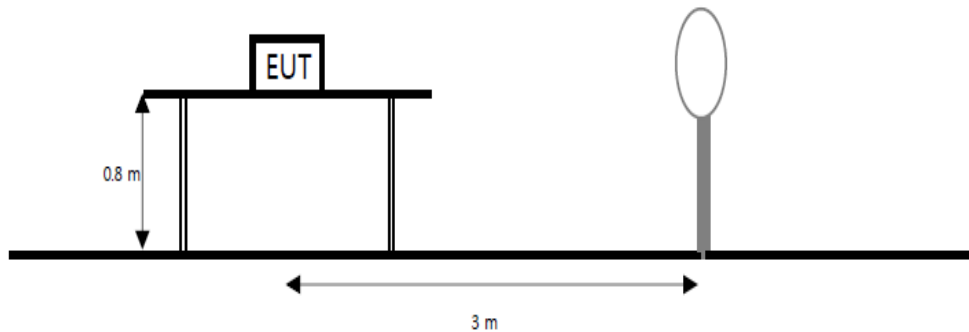
Voltage		TEMP	Maintaining time	Measure frequency	Frequency deviation	Deviation		
[%]	[V]	[°C]		[Hz]	[Hz]	[%]		
100	12.00	20	Startup	13 559 615	385.4	-0.002 84		
			2 minutes	13 559 598	402.5	-0.002 97		
			5 minutes	13 559 601	398.6	-0.002 94		
			10 minutes	13 559 626	374.5	-0.002 76		
		-20	Startup	13 559 793	207.5	-0.001 53		
			2 minutes	13 559 801	198.6	-0.001 47		
			5 minutes	13 559 821	179.5	-0.001 32		
			10 minutes	13 559 804	195.7	-0.001 44		
		-10	Startup	13 559 795	205.1	-0.001 51		
			2 minutes	13 559 805	195.2	-0.001 44		
			5 minutes	13 559 807	193.2	-0.001 43		
			10 minutes	13 559 812	188.5	-0.001 39		
		0	Startup	13 559 822	178.4	-0.001 32		
			2 minutes	13 559 806	194.2	-0.001 43		
			5 minutes	13 559 806	194.4	-0.001 43		
			10 minutes	13 559 809	191.5	-0.001 41		
		10	Startup	13 559 725	274.8	-0.002 03		
			2 minutes	13 559 720	279.9	-0.002 06		
			5 minutes	13 559 723	277.2	-0.002 04		
			10 minutes	13 559 725	274.6	-0.002 03		
		20	Startup	13 559 732	268.5	-0.001 98		
			2 minutes	13 559 731	269.5	-0.001 99		
			5 minutes	13 559 722	278.4	-0.002 05		
			10 minutes	13 559 738	261.7	-0.001 93		
		30	Startup	13 559 729	270.6	-0.002 00		
			2 minutes	13 559 726	274.5	-0.002 02		
			5 minutes	13 559 749	251.4	-0.001 85		
			10 minutes	13 559 728	271.8	-0.002 00		
		40	Startup	13 559 722	277.7	-0.002 05		
			2 minutes	13 559 728	272.5	-0.002 01		
			5 minutes	13 559 728	271.9	-0.002 01		
			10 minutes	13 559 705	295.5	-0.002 18		
		50	Startup	13 559 393	607.4	-0.004 48		
			2 minutes	13 559 426	574.5	-0.004 24		
			5 minutes	13 559 406	593.6	-0.004 38		
			10 minutes	13 559 469	531.1	-0.003 92		
		85	10.20	20	Startup	13 559 625	375.2	-0.002 77
					2 minutes	13 559 605	395.2	-0.002 92
					5 minutes	13 559 597	403.3	-0.002 97
					10 minutes	13 559 622	378.5	-0.002 79
115	13.80	20	Startup	13 559 604	396.4	-0.002 92		
			2 minutes	13 559 605	395.5	-0.002 92		
			5 minutes	13 559 593	407.4	-0.003 01		
			10 minutes	13 559 596	404.5	-0.002 98		

Voltage		TEMP [°C]	Maintaining time	Measure frequency	Frequency deviation	Deviation		
[%]	[V]			[Hz]	[Hz]	[%]		
100	24.00	20	Startup	13 559 617	382.6	-0.002 82		
			2 minutes	13 559 601	399.5	-0.002 95		
			5 minutes	13 559 605	395.4	-0.002 92		
			10 minutes	13 559 629	371.5	-0.002 74		
		-20	Startup	13 559 796	204.5	-0.001 51		
			2 minutes	13 559 805	195.4	-0.001 44		
			5 minutes	13 559 824	176.5	-0.001 30		
			10 minutes	13 559 808	192.3	-0.001 42		
		-10	Startup	13 559 797	202.9	-0.001 50		
			2 minutes	13 559 807	192.8	-0.001 42		
			5 minutes	13 559 809	190.8	-0.001 41		
			10 minutes	13 559 815	185.5	-0.001 37		
		0	Startup	13 559 824	175.6	-0.001 30		
			2 minutes	13 559 808	191.8	-0.001 41		
			5 minutes	13 559 808	191.6	-0.001 41		
			10 minutes	13 559 812	188.5	-0.001 39		
		10	Startup	13 559 729	271.2	-0.002 00		
			2 minutes	13 559 724	276.1	-0.002 04		
			5 minutes	13 559 725	274.8	-0.002 03		
			10 minutes	13 559 729	271.4	-0.002 00		
		20	Startup	13 559 735	265.5	-0.001 96		
			2 minutes	13 559 734	266.5	-0.001 97		
			5 minutes	13 559 724	275.6	-0.002 03		
			10 minutes	13 559 742	258.3	-0.001 91		
		30	Startup	13 559 733	267.4	-0.001 97		
			2 minutes	13 559 729	271.5	-0.002 00		
			5 minutes	13 559 751	248.6	-0.001 83		
			10 minutes	13 559 732	268.2	-0.001 98		
		40	Startup	13 559 726	274.3	-0.002 02		
			2 minutes	13 559 731	269.5	-0.001 99		
			5 minutes	13 559 732	268.1	-0.001 98		
			10 minutes	13 559 708	292.5	-0.002 16		
		50	Startup	13 559 395	604.6	-0.004 46		
			2 minutes	13 559 429	571.5	-0.004 22		
			5 minutes	13 559 410	590.4	-0.004 35		
			10 minutes	13 559 471	528.9	-0.003 90		
		85	20.40	20	Startup	13 559 627	372.8	-0.002 75
					2 minutes	13 559 607	392.8	-0.002 90
					5 minutes	13 559 599	400.7	-0.002 96
					10 minutes	13 559 625	375.5	-0.002 77
115	27.60	20	Startup	13 559 606	393.6	-0.002 90		
			2 minutes	13 559 608	392.5	-0.002 90		
			5 minutes	13 559 595	404.6	-0.002 98		
			10 minutes	13 559 599	401.5	-0.002 96		

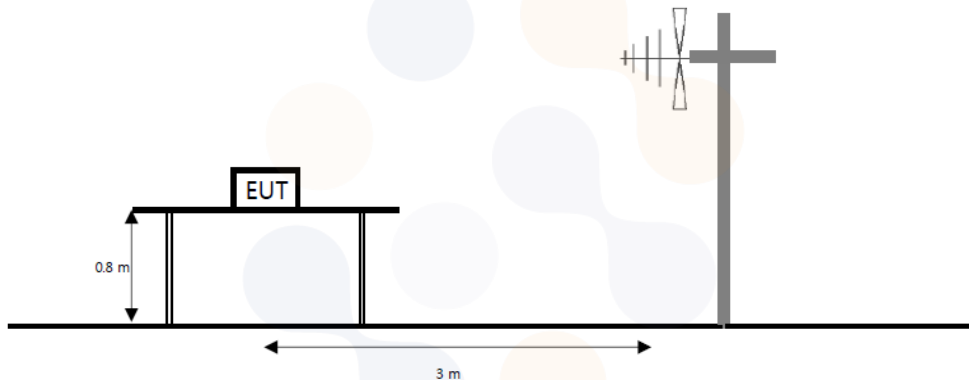
6.3. Radiated spurious emissions

Test setup

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



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



Limit

15.225 (a), RSS-210 B.6.(a).(i) The field strength of any emission within the band 13.553-13.567 MHz shall not exceed 15, 848 microvolts/meter at 30 meters.

15.225 (b), RSS-210 B.6.(a).(ii) 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.

15.225 (c), RSS-210 B.6 (a).(iii) 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.

15.225 (d), RSS-210 B.6.(a).(iv) RSS-Gen Issue 9 (8.9) 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 ($\mu V/m$)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30(29.54 dB $\mu V/m$)	30
30.0-88.0	100(40 dB $\mu V/m$)	3
88-216	150(43.5 dB $\mu V/m$)	3
216-960	200 (46 dB $\mu V/m$)	3
Above 960	500 (53.98 dB $\mu V/m$)	3

Test procedure

ANSI C63.10-2013 - Section 6.4, 6.5

Test settings

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in table
3. VBW $\geq 3 \times$ RBW
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Table. RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1 000 MHz	100 kHz to 120 kHz
> 1 000 MHz	1 MHz

Notes:

1. $f < 30$ MHz, extrapolation factor of 40 dB/decade of distance. $F_d = 40 \log(D_m/D_s)$
 $f \geq 30$ MHz, extrapolation factor of 20 dB/decade of distance. $F_d = 20 \log(D_m/D_s)$
 Where:
 F_d = Distance factor in dB
 D_m = Measurement distance in meters
 D_s = Specification distance in meters
2. 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 dB/decade) as specified in § 15.31(f)(2). Extrapolation Factor = $40 \log_{10}(30/3) = 40$ dB.
3. (dB) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) - or F_d (dB)
4. Result = Reading + Cable loss + Amp gain + Ant. factor - Distance factor
5. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
6. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector.
7. Below 30 MHz frequency range, all orientations about parallel, perpendicular, and ground-parallel were investigated then reported and the worse orientations of Face-on and Face-off were set for final test.
8. Face-on = Parallel, Face-off = Perpendicular

[DC 12V]
Test results for fundamental
15.225 (a) 13.553-13.567 MHz

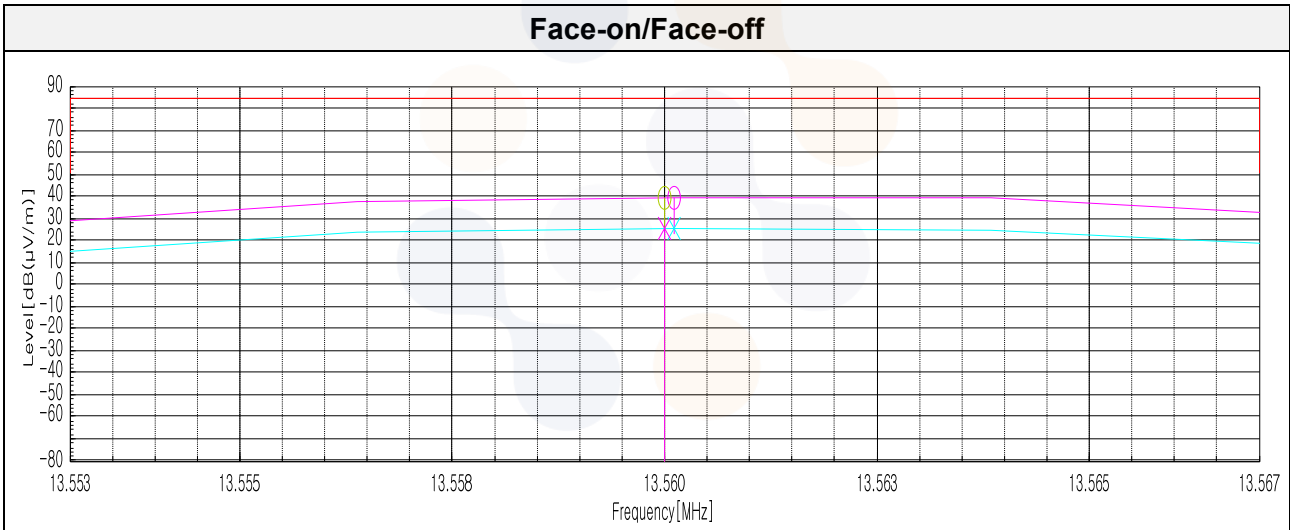
[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	90.00	20.31	-31.13	40.00	39.18	84.00	44.82

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	75.90	20.31	-31.13	40.00	25.08	84.00	58.92

Face-on/Face-off



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

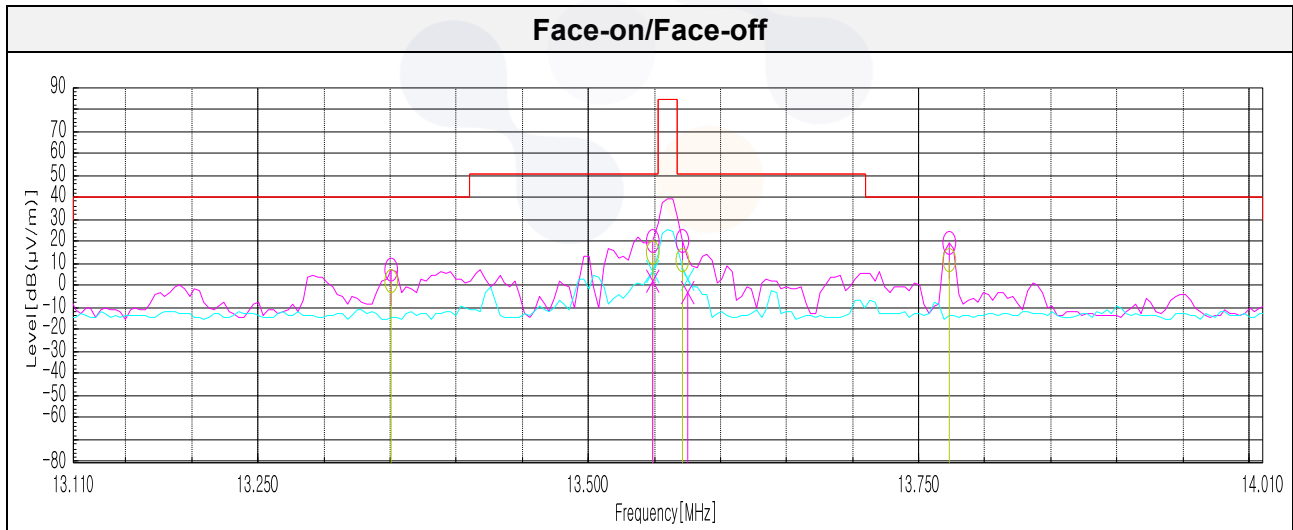
15.225 (b,c) 13.110-14.010 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.35	52.70	20.30	-31.14	40.00	1.86	40.50	38.64
13.55	65.40	20.31	-31.13	40.00	14.58	50.50	35.92
13.57	61.70	20.31	-31.13	40.00	10.88	50.50	39.62
13.77	61.90	20.33	-31.14	40.00	11.09	40.50	29.41

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.55	52.80	20.31	-31.13	40.00	1.98	50.50	48.52
13.58	47.40	20.31	-31.13	40.00	-3.42	50.50	53.92



Note. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBμV/m, which is equivalent to Y-51.5 = Z dBμA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.

Test results (9 kHz to 30 MHz)

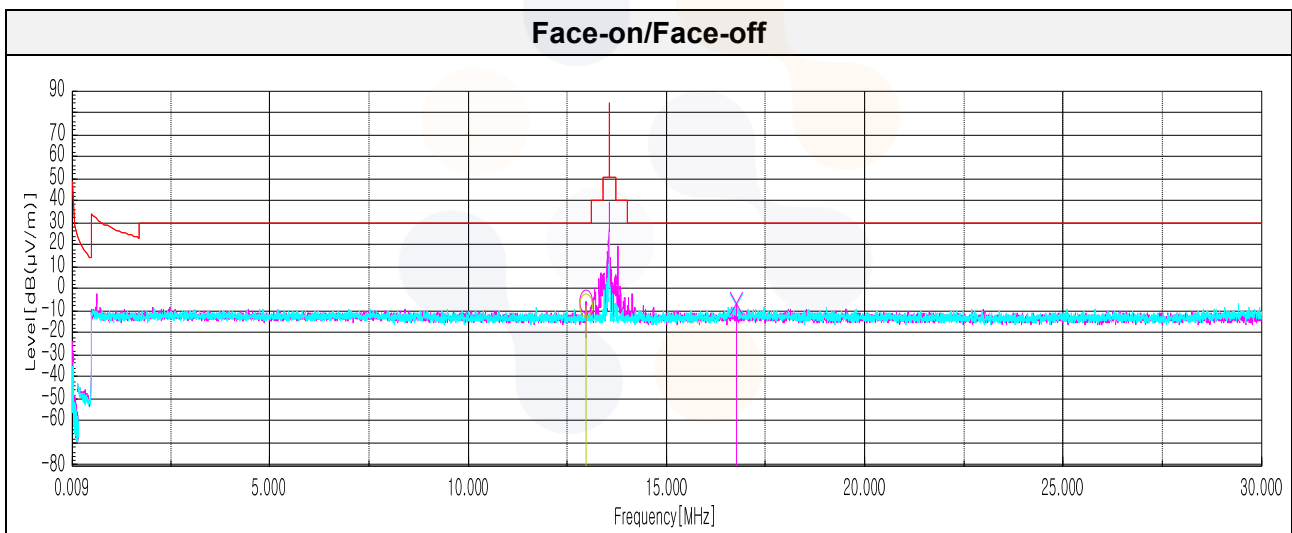
15.225 (d) 0.009-30 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
12.98	42.80	20.28	-31.17	40.00	-8.09	29.54	37.63

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
16.77	37.50	20.51	-30.98	40.00	-12.97	29.54	42.51

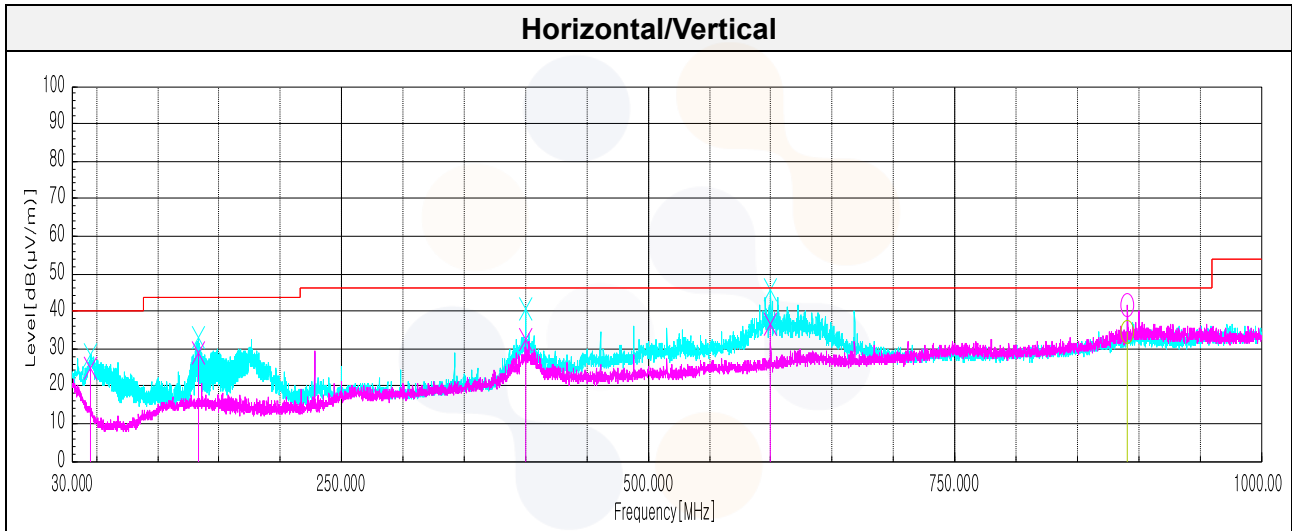


Note. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBμV/m, which is equivalent to Y-51.5 = Z dBμA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.

Test results (Below 1 000 MHz)

15.225 (d) 30-1 000 MHz

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data								
45.40	V	37.80	16.20	-29.30	-	24.70	40.00	15.30
133.18 ¹⁾	V	38.20	17.80	-27.36		28.64	43.50	14.86
400.06 ¹⁾	V	34.50	21.60	-23.84	-	32.26	46.00	13.74
599.88	V	34.00	24.50	-21.86	-	36.64	46.00	9.36
891.12	H	26.50	26.52	-18.79	-	34.23	46.00	11.77



[DC 24V]
Test results for fundamental
15.225 (a) 13.553-13.567 MHz

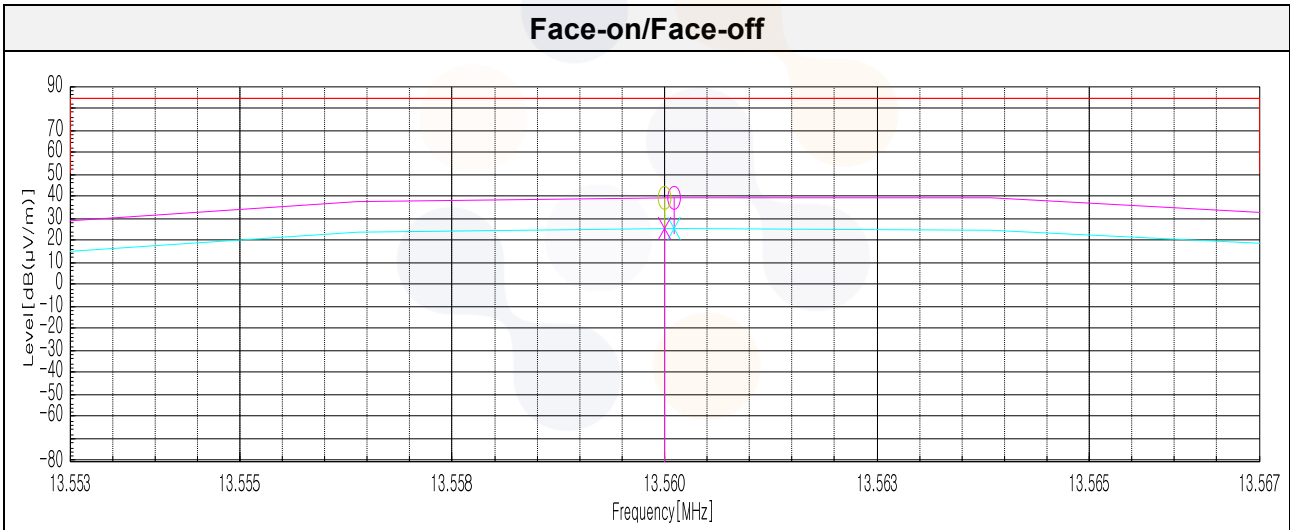
[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	90.10	20.31	-31.13	40.00	39.28	84.00	44.72

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	74.90	20.31	-31.13	40.00	24.08	84.00	59.92

Face-on/Face-off



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

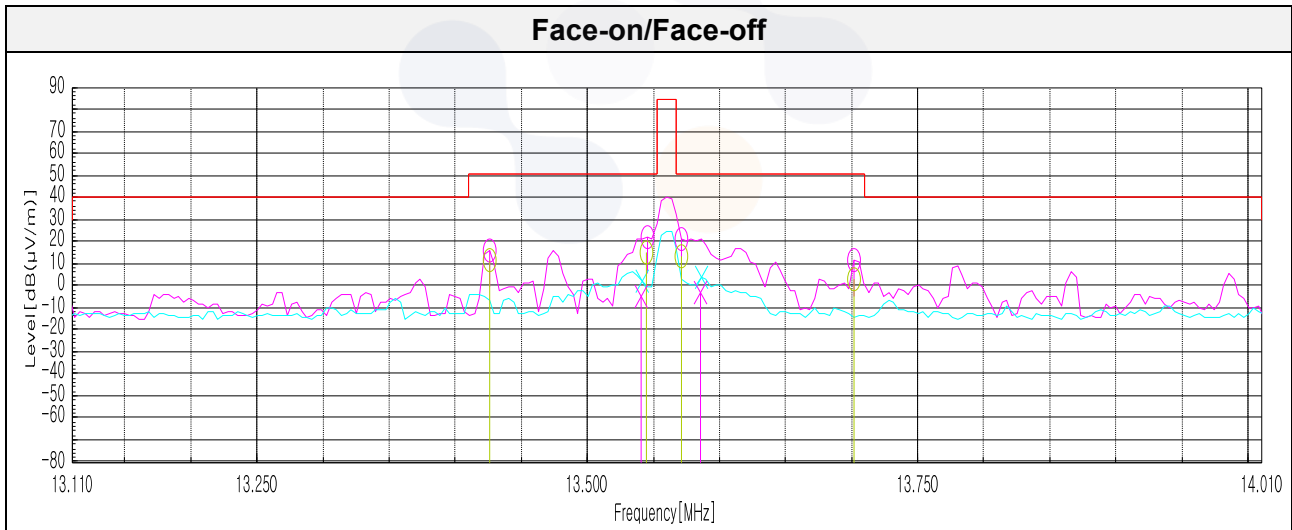
15.225 (b,c) 13.110-14.010 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.43	62.50	20.31	-31.14	40.00	11.67	50.50	38.83
13.55	65.90	20.31	-31.13	40.00	15.08	50.50	35.42
13.57	64.20	20.31	-31.13	40.00	13.38	50.50	37.12
13.70	53.80	20.32	-31.13	40.00	2.99	50.50	47.51

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.54	45.20	20.31	-31.13	40.00	-5.62	50.50	56.12
13.59	47.70	20.32	-31.13	40.00	-3.11	50.50	53.61



Note. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBμV/m, which is equivalent to Y-51.5 = Z dBμA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.

Test results (9 kHz to 30 MHz)

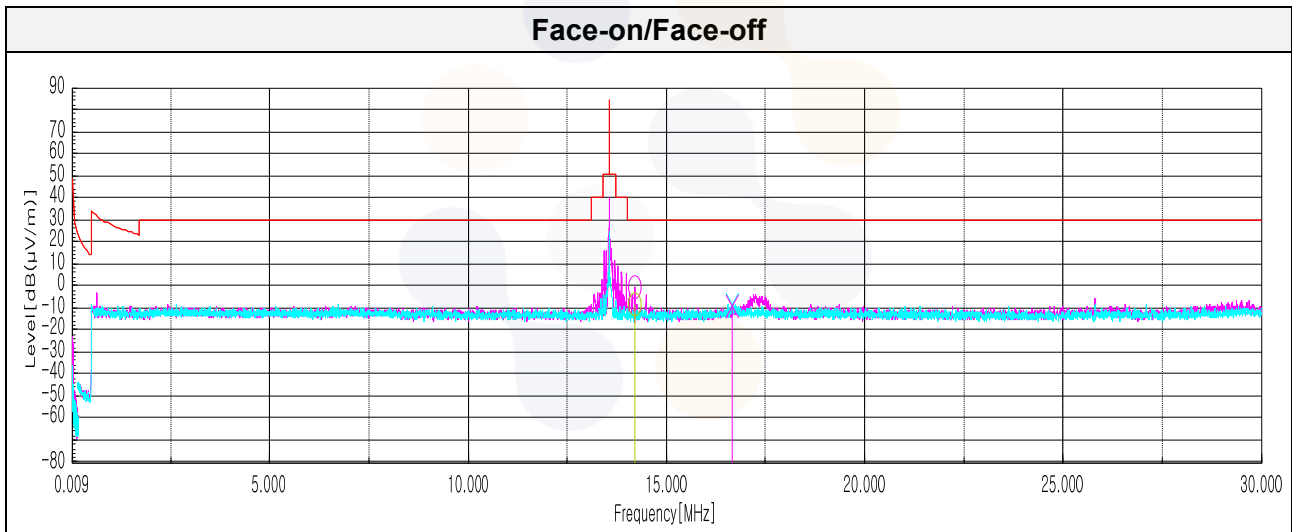
15.225 (d) 0.009-30 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
14.20	42.10	20.35	-31.12	40.00	-8.67	29.54	38.21

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
16.67	40.90	20.50	-30.98	40.00	-9.58	29.54	39.12

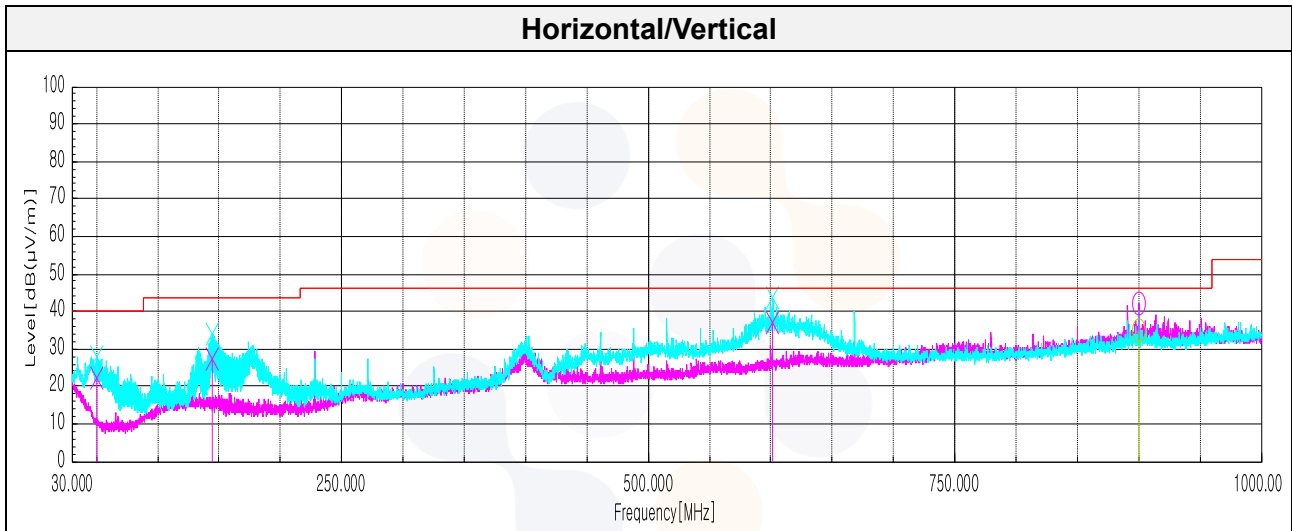


Note. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBμV/m, which is equivalent to Y-51.5 = Z dBμA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.

Test results (Below 1 000 MHz)

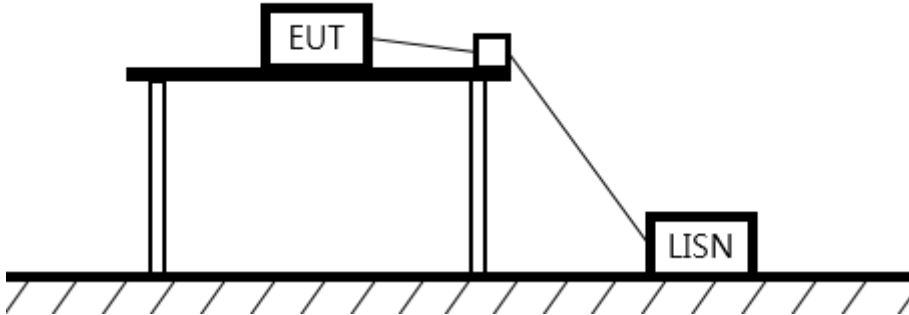
15.225 (d) 30-1 000 MHz

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data								
50.37	V	37.50	13.78	-29.12	-	22.16	40.00	17.84
144.34	V	37.40	17.17	-27.17	-	27.40	43.50	16.10
601.69	V	34.10	24.50	-21.85	-	36.75	46.00	9.25
900.09	H	27.00	26.50	-18.63	-	34.87	46.00	11.13



6.4. AC Conducted emission

Test setup



Limit

According to 15.207(a) and RSS-Gen(8.8), 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 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall be 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.

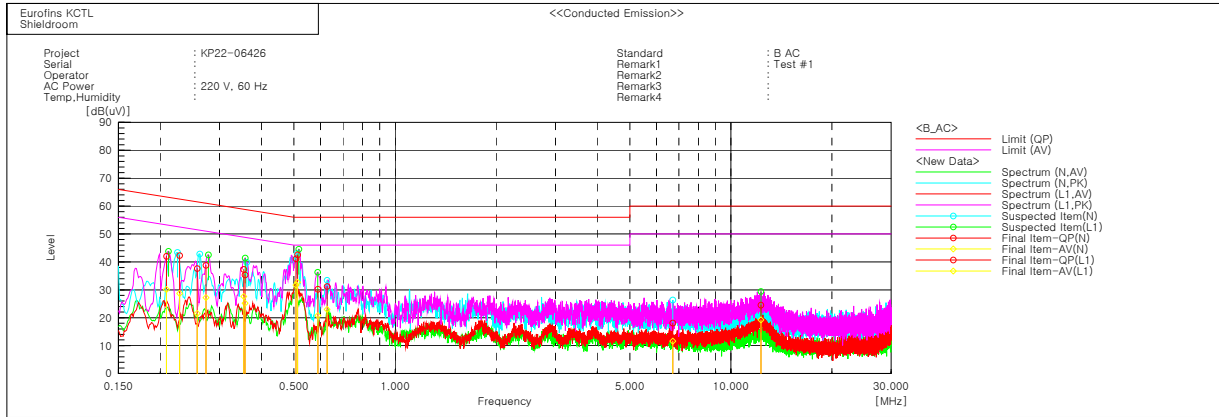
Frequency of Emission (MHz)	Conducted limit (dB μ V/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

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 50 Ω /50 μ H 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 in 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.

Test results

[DC 12V]



Final Result

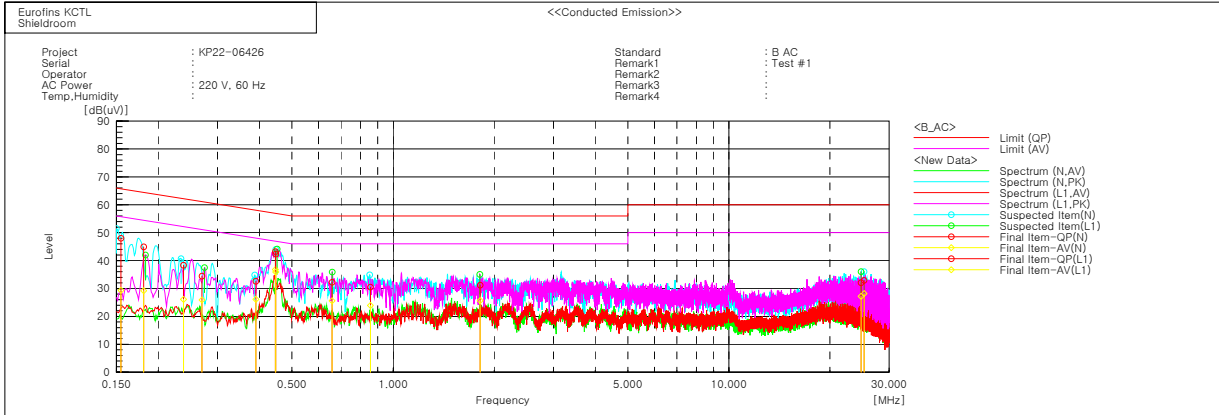
--- N Phase ---

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	0.22826	32.6	19.0	9.7	42.3	28.7	62.5	52.5	20.2	23.8
2	0.25764	28.0	11.9	9.6	37.6	21.5	61.5	51.5	23.9	30.0
3	0.35755	25.5	15.4	9.8	35.3	25.2	58.8	48.8	23.5	23.6
4	0.50729	31.3	21.9	9.8	41.1	31.7	56.0	46.0	14.9	14.3
5	0.62726	21.4	13.2	9.8	31.2	23.0	56.0	46.0	24.8	23.0
6	6.71562	8.4	1.9	9.7	18.1	11.6	60.0	50.0	41.9	38.4

--- 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	0.20874	32.2	20.3	9.8	42.0	30.1	63.3	53.3	21.3	23.2
2	0.27344	29.2	17.6	9.6	38.8	27.2	61.0	51.0	22.2	23.8
3	0.35449	27.5	17.8	9.8	37.3	27.6	58.9	48.9	21.6	21.3
4	0.51246	32.7	22.9	9.8	42.5	32.7	56.0	46.0	13.5	13.3
5	0.58916	20.4	10.9	9.8	30.2	20.7	56.0	46.0	25.8	25.3
6	12.2847	14.6	9.3	9.9	24.5	19.2	60.0	50.0	35.5	30.8

[DC 24V]



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	0.15477	38.2	19.5	9.8	48.0	29.3	65.7	55.7	17.7	26.4
2	0.23757	28.7	16.5	9.6	38.3	26.1	62.2	52.2	23.9	26.1
3	0.39009	22.8	16.3	9.8	32.6	26.1	58.1	48.1	25.5	22.0
4	0.44635	33.4	27.0	9.8	43.2	36.8	56.9	46.9	13.7	10.1
5	0.85598	20.8	14.3	9.7	30.5	24.0	56.0	46.0	25.5	22.0
6	25.25418	23.0	18.3	9.9	32.9	28.2	60.0	50.0	27.1	21.8

--- 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	0.18085	34.9	19.2	10.0	44.9	29.2	64.4	54.4	19.5	25.2
2	0.26995	24.9	16.3	9.6	34.5	25.9	61.1	51.1	26.6	25.2
3	0.44745	32.5	26.1	9.8	42.3	35.9	56.9	46.9	14.6	11.0
4	0.65835	22.4	15.8	9.8	32.2	25.6	56.0	46.0	23.8	20.4
5	1.81806	21.5	15.9	9.7	31.2	25.6	56.0	46.0	24.8	20.4
6	24.75958	22.1	17.2	10.0	32.1	27.2	60.0	50.0	27.9	22.8

7. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV30	100808	23.07.11
DC Power Supply	AGILENT	E3632A	MY40004791	23.09.14
Temp & Humid Chamber	ESPEC CORP.	SH-642	93016978	23.03.02
EMI TEST RECEIVER	R&S	ESCI7	100732	23.03.04
Bilog Antenna	TESEQ	CBL6112D	62438	24.08.24
AMPLIFIER	SONOMA	310N	284608	23.08.18
ATTENUATOR	KEYSIGHT	8491B-6dB	MY39271082	24.08.24
ISOLATION TRANSFORMER	ONETECH CO., LTD	OT-IT500VA	OTR1-16026	23.03.28
Loop Antenna	R&S	HFH2-Z2	100355	24.08.10
Vector Signal Generator	R&S	SMBV100A	257566	23.07.04
Signal Generator	R&S	SMB100A	176206	23.01.19
TWO-LINE V - NETWORK	R&S	ENV216	101358	23.09.29
EMI TEST RECEIVER	R&S	ESCI3	100001	23.08.18
Antenna Mast	Innco Systems	MA4000-EP	303	-
Turn Table	Innco Systems	CO3000	1175/45850319/P	-

End of test report