TEST REPORT

Testing laboratory:
SK Tech Co., Ltd.
88, Geulgaeul-ro, 81beon-gil,
Wabu-eup, Namyangju-si,
Gyeonggi-do, Korea
TEL: +82-31-576-2204
FAX: +82-31-576-2205

Test Report Number: SKT-RFC-230005
Date of issue: March 17, 2023

Applicant:	**AISOLUTION CO., LTD.** 28-4, Samyang-ro 29-gil, Gangbuk-gu, Seoul, 01194, South Korea
Manufacturer:	**AISOLUTION CO., LTD.** 28-4, Samyang-ro 29-gil, Gangbuk-gu, Seoul, 01194, South Korea
Product:	KDC380 Wireless Barcode Scanner
Model:	KDC380
FCC ID:	VH9-KDC380
Project number:	SKTEU22-1568
EUT received:	December 7, 2022
Applied standards:	ANSI C63.10-2020 ANSI C63.4-2014 and ANSI C63.4a-2017
Rule parts:	FCC 47 CFR Part 15 Subpart C - Intentional radiators
Equipment Class:	**DXX – Part 15 Low Power Communication Device Transmitter**
Remarks to the standards:	None

The above equipment has been tested by SK Tech Co., Ltd., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product or system, which was tested.

Changwon Yang / **Testing Engineer**

Jongsoo Yoon / **Technical Manager**

Revision History of Test Report

Rev.	Revisions	Effect page	Approved by	Date
-	Initial issue	All	Jongsoo Yoon	Mar. 17, 2023

TABLE OF CONTENTS

1 Summary of test results

Requirement	CFR 47 Section	Result
Antenna Requirement	15.203	Meets the requirements
Radiated Emissions Field Strength within the band 13.553-13.567 MHz	15.225(a)	Meets the requirements
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	15.225(b) & (c)	Meets the requirements
Radiated Harmonics and Spurious Emissions Outside of the 13.110 – 14.010 MHz	15.225(d) 15.209(a)	Meets the requirements
Frequency Tolerance of Carrier Signal	15.225(e)	Meets the requirements
AC power line Conducted emissions	15.207(a)	Meets the requirements

2 Description of equipment under test (EUT)

Product:	KDC380 Wireless Barcode Scanner
Model:	KDC380
Serial number:	None (prototype)
Hardware version:	prototype
Software version:	prototype

Model differences:

Model name	Difference	Tested (checked)
KDC380	fully tested model that was provided by the applicant	☒

Technical data:

Transmit frequency	WiFi: 2412 MHz to 2462 MHz (NOTE 1) Bluetooth Low Energy: 2402 MHz to 2480 MHz (NOTE 2) NFC: 13.56 MHz
Technologies	WiFi (802.11b/g/n(HT20)), Bluetooth Low Energy (1Mbps, 2Mbps), NFC
Antenna type	WiFi: Omni-directional antenna (3.02 dBi) Bluetooth Low Energy: Integral Chip antenna (3.14 dBi) NFC: Internal loop antenna
Power source	DC 3.7 V (Battery)
Operation temperature range	-20 °C to +50 °C

Note: *1. This test report did not contain the tests for the WiFi links, which is subject to FCC Part 15.*
2. This test report did not contain the tests for the Bluetooth links, which is subject to FCC Part 15.

I/O port	Type	Q'ty	Remark
USB	USB (Type C)	1	

Modification of EUT during the compliance testing: none

3 Test and measurement conditions

3.1. Operating modes

Operating modes of the sample:

No.	Description
-	Normal operating mode: NFC

Operating modes used for the Test:

No.	Operating mode
1	Normal operating mode: (a) The EUT was operated in the normal test mode, continuously transmitting the modulated RF signals. (b) The tests were performed while transmitting at 13.56 MHz.

3.2. Description of support units (accessory equipment)

The following support units or accessories were used to form a representative test configuration during the tests.

#	Equipment	Manufacturer	Model No.	Serial No.
1	NFC tag	N/A	N/A	N/A
2	PC(Laptop)	Lenovo	ThinkPad X13 Gen 2	PF-2J6LQR
3	AC Adapter (Laptop)	Lite-On Techonology (CHANG ZHOU) Co., Ltd	ADLX65YLC3D	N/A
4	PC(Desktop)	HP	HP 280 G3 MT Business PC	4CE7233RL1

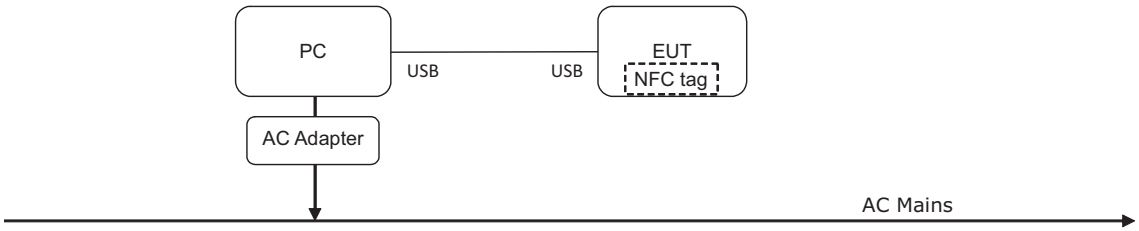
3.3. Interconnection and I/O cables

The following support units or accessories were used to form a representative test configuration during the tests.

#	Start		End		Cable	
	Name	I/O port	Name	I/O port	length (m)	shielded (Y/N)
1	EUT	USB	Notebook	USB	1.0	Y
2	PC	DC Input	AC Adapter	DC Output	1.7	N
3	AC Adapter	AC Input	AC Mains	AC Mains	1.8	N
4	NFC tag	-	-	-	-	-

Note: *All the operating conditions including the cable connection were selected by the applicant.*

3.4. Test configuration (arrangement of EUT)



3.5. Test date

Date Tested	February 4, 2023 - February 24, 2023

4 Facilities and accreditations

4.1. Facilities

All of the measurements described in this report were performed at SK Tech Co., Ltd.

Site I: 88, Geulgaeul-ro, 81beon-gil, Wabu-eup, Namyangju-si, Gyeonggi-do, Korea
Site II: 124-8, Geulgaeul-ro, Wabu-eup, Namyangju-si, Gyeonggi-do, Korea

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-4. The sites comply with the Normalized Site Attenuation requirements given in ANSI C63.4, and site VSWR requirements specified in CISPR 16-1-4. The FAR used for the radiated spurious emissions fulfills the NSA requirements specified in ETSI TS 102 321 V1.1.1 (2004-05) and ETSI TR 102 273-2 V1.2.1 (2001-12). The measuring apparatus and ancillary equipment conform to CISPR 16-1 series.

4.2. Accreditations

The laboratory has been also notified to FCC and ISED by RRA as a Conformity Assessment Body, and designated to perform compliance testing on equipment subject to Certification under Parts 15, 18, 22, 24, 25, 27, 74, 90, 95, 97 and 101 of the FCC Rules, and RSS-GEN, RSS-170, RSS-210, RSS-247, RSS-248, and RSS-102 (RF Exp.)[MEAS].

Designation No.	KR0007
Company Number (IC)	5429A

4.3. List of test and measurement instruments

4.3.1 Instruments for the conducted measurements

No	Description	Model	Manufacturer	Serial No.	Cal. due	Use
1	Spectrum Analyzer	E4440A	Agilent	MY46186322	2023.05.09	☐
2	Spectrum Analyzer	FSW67	Rohde&Schwarz	101371	2023.05.17	☒
3	Power Meter	E4417A	Agilent	MY450042B	2023.05.11	☐
4	Power Sensor	8485A	HP	3318A1396	2023.05.11	☐
5	Vector Signal Generator	SMBV100B	Rohde&Schwarz	101179	2023.05.10	☐
6	Signal Generator	SMB100A	Rohde&Schwarz	180704	2024.01.17	☐
7	EMI Test Receiver	PMM9010F	Narda	020WW40105	2024.01.03	☒
8	Pulse limiter	ESH3-Z2	Rohde&Schwarz	100604	2024.01.03	☒
9	AMN (LISN)	ENV 216	Rohde&Schwarz	102047	2024.01.03	☒
10	AMN (LISN)	FCC-LISN-50-32-2-01-480V	FCC	141455	2023.05.09	☐
11	Attenuator (10 dB)	8491B	HP	38067	2023.05.11	☐
12	Attenuator (6 dB, 5 W)	18N5W-06	API Technologies	1	2023.05.11	☐
13	Attenuator (6 dB, 5 W)	18N5W-06	API Technologies	2	2023.05.11	☐
14	Temperature Chamber	DJ-THC1000	DAE JIN ENG	22-002	2024.01.17	☒
15	Multimeter	17B+	FLUKE	32700017WS	2024.01.16	☒
16	Digital Thermo-Hygrometer	608-H1	Testo	41383411	2023.05.20	☒

AC power line Conducted emissions measurement software: PMM Emission Suite Version: 2.31

4.3.2 Instruments for the radiated measurements

No	Description	Model	Manufacturer	Serial No.	Cal. due	Use
1	EMI Test Receiver	ESR26	Rohde&Schwarz	101441	2023.12.19	☐
2	EMI Test Receiver	ESIB40	Rohde&Schwarz	100277	2023.08.25	☒
3	Spectrum Analyzer	FSW67	Rohde&Schwarz	101371	2023.05.17	☐
4	Vector Signal Generator	SMBV100B	Rohde&Schwarz	101179	2023.05.10	☐
5	Signal Generator	SMB100A	Rohde&Schwarz	180704	2024.01.17	☐
6	Loop Antenna (9 kHz - 30 MHz)	HFH2-Z2E	Rohde&Schwarz	100883	2023.12.16	☒
7	BiLog broadband Antenna (30 MHz - 1 GHz)	VULB9168	Schwarzbeck	9168-230	2023.06.08	☒
8	Horn Antenna (1 GHz - 18 GHz)	3117	ETS Lindgren	00205960	2024.06.07	☐
9	Horn Antenna (1 GHz - 18 GHz)	BBHA 9120D	Schwarzbeck	9120D-816	2024.04.26	☐
10	Horn Antenna (6.5 GHz - 18 GHz)	LB-65180-20-C-SF	A-INFO	2110054000021	2024.01.22	☐
11	Horn Antenna (18 GHz - 26.5 GHz)	20240-20	Flann microwave	273364	2023.12.08	☐
12	Horn Antenna (18 GHz - 26.5 GHz)	20240-20	Flann microwave	273363	2023.12.08	☐
13	Horn Antenna (26.5 GHz - 40 GHz)	22240-20	Flann microwave	274186	2023.12.10	☐
14	Horn Antenna (26.5 GHz - 40 GHz)	22240-20	Flann microwave	274185	2023.12.10	☐
15	Pre-amplifier (30 MHz - 1 GHz)	MLA-10K01-B01-27	TSJ	2005350	2023.05.11	☒
16	Pre-amplifier (1 GHz - 18 GHz)	MLA-0118-J01-40	TSJ	14879	2023.05.09	☐
17	Pre-amplifier (18 GHz - 40 GHz)	MLA-1840-A01-50	TSJ	2610050	2023.05.17	☐
18	Attenuator (10 dB)	50HFAR-010-2.9mm	JFW	-	2023.07.21	☐
19	High pass filter (3 GHz)	WHKX 3.0/18G-12SS	Wainwright	8	2023.05.11	☐
20	Multimeter	17B+	FLUKE	32700017WS	2024.01.16	☒
21	Digital Thermo-Hygrometer	608-H1	Testo	41383411	2023.05.20	☒

Radiated emission measurement software (9 kHz to 1 GHz): TEPTO-DV/RE_Version: 3.1.0044

5 Test and measurements

5.1. Antenna requirement

5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 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 ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

5.1.2 Result: PASS

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

5.2. Radiated emissions

5.2.1 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.

5.2.2 Test 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 broadband antenna.
4. 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)

5.2.3 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) = -80 dB, for frequency band: 0.009 to 0.490 MHz

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

5.2.3 Result: **PASS**

Table 1: Field strength below 30 MHz

(On NFC tag)

Frequency [MHz]	RBW [kHz]	Reading [dBμV]	AF [dB/m]	Cable Loss [dB]	Actual [dBμV/m]	Limit (at 3m) [dBμV/m]	Margin [dB]	Axis
13.560	9	19.0	21.5	0.5	41.0	124.0	83.0	X-axis
13.560	9	33.6	21.5	0.5	55.5	124.0	68.4	Y-axis
13.560	9	32.5	21.5	0.5	54.5	124.0	69.5	Z-axis

Table 2: Field strength below 30 MHz

(No NFC tag)

Frequency [MHz]	RBW [kHz]	Reading [dBμV]	AF [dB/m]	Cable Loss [dB]	Actual [dBμV/m]	Limit (at 3m) [dBμV/m]	Margin [dB]	Axis
13.560	9	24.3	21.5	0.5	46.3	124.0	77.7	X-axis
13.560	9	37.5	21.5	0.5	59.5	124.0	64.5	Y-axis
13.560	9	37.5	21.5	0.5	59.5	124.0	64.5	Z-axis

Actual (dBμV/m) = Reading + AF + Cable Loss

Margin (dB) = Limit – Actual

NOTE: 1. All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

2. These test results measured at the 3 m distance.

Table 3: Field strength above 30 MHz

(On NFC tag)

Frequency [MHz]	RBW [kHz]	POL [V/H]	ANT [m]	Reading [dBμV]	AMP [dB]	AF [dB/m]	CL [dB]	Actual [dBμV/m]	Limit [dBμV/m]	Margin [dB]
On NFC tag – Y-axis										
40.716	120	V	1.00	37.2	30.6	18.8	1.1	26.5	40.0	13.5
67.789	120	H	3.99	30.5	30.4	17.8	1.4	19.3	40.0	20.7
67.799	120	V	1.00	33.6	30.4	17.8	1.4	22.4	40.0	17.6
149.166	120	V	1.01	30.4	29.6	18.5	2.0	21.3	43.5	22.2
149.206	120	H	3.99	28.0	29.6	18.5	2.0	18.9	43.5	24.6

Table 4: Field strength above 30 MHz

(No NFC tag)

Frequency [MHz]	RBW [kHz]	POL [V/H]	ANT [m]	Reading [dBμV]	AMP [dB]	AF [dB/m]	CL [dB]	Actual [dBμV/m]	Limit [dBμV/m]	Margin [dB]
No NFC tag – Z-axis										
88.844	120	V	1.25	29.6	30.2	13.7	1.6	14.7	43.5	28.8
298.845	120	V	1.00	28.3	29.9	19.4	2.8	20.6	46.0	25.4
299.426	120	H	3.20	28.7	29.9	19.4	2.8	21.0	46.0	25.0

Margin (dB) = Limit – Actual

[Actual = Reading + AF + CL]

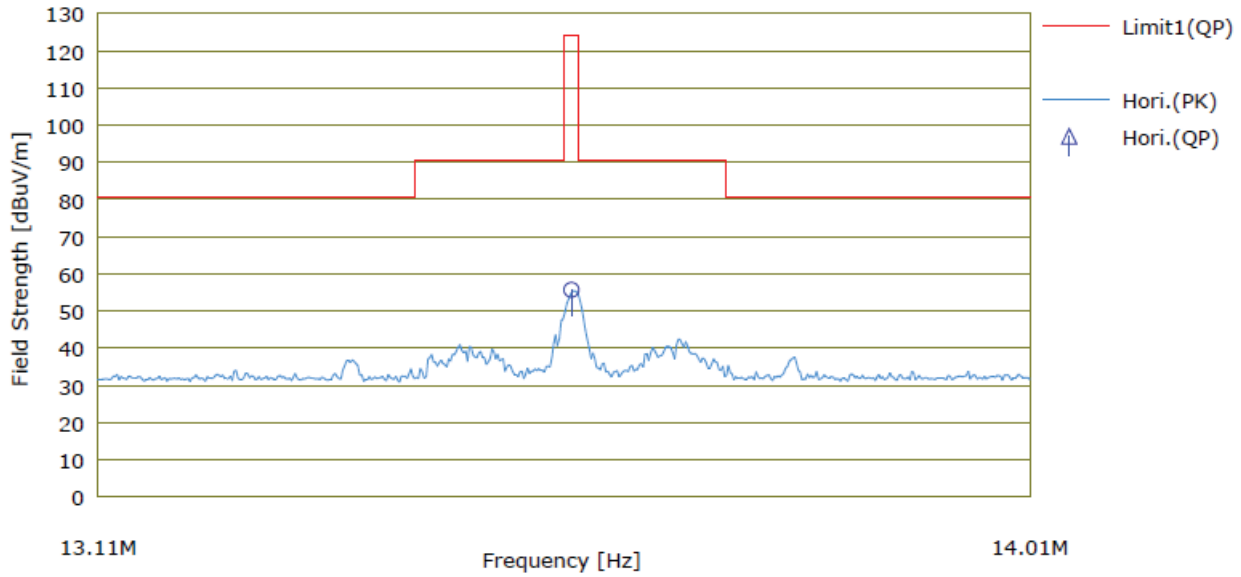
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss

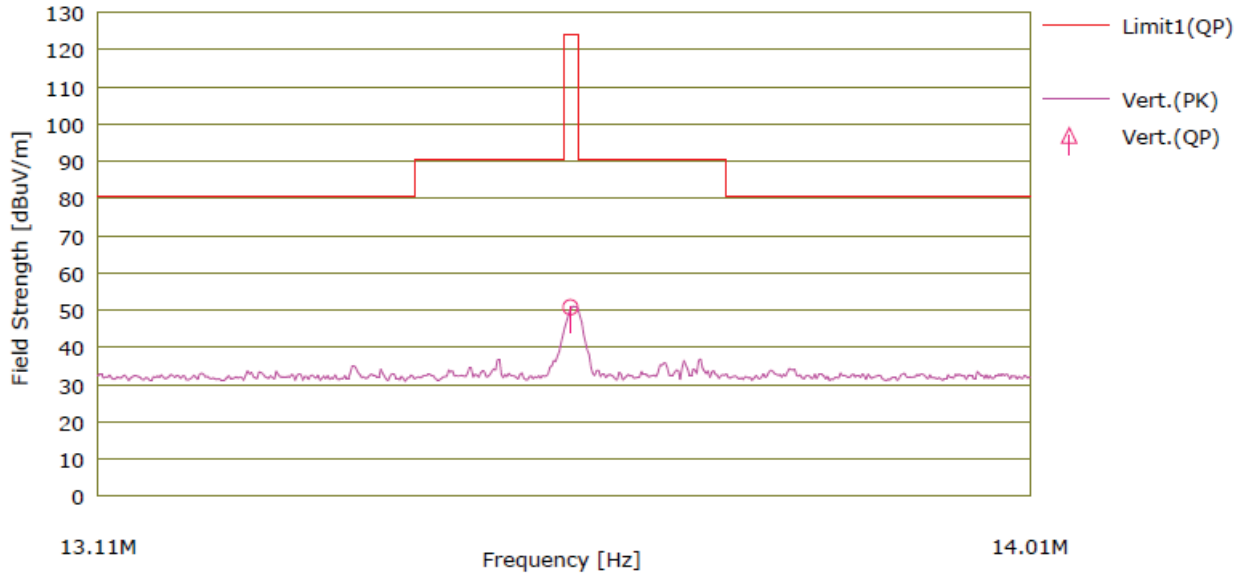
NOTE: 1. All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

2. These test results measured at the 3 m distance.

Figure 1. Plot of Band edge (Preliminary measurement in the anechoic chamber at 3 m distance to find out the frequencies, at which the spurious emissions occur, with the peak detector function)

(On NFC tag)





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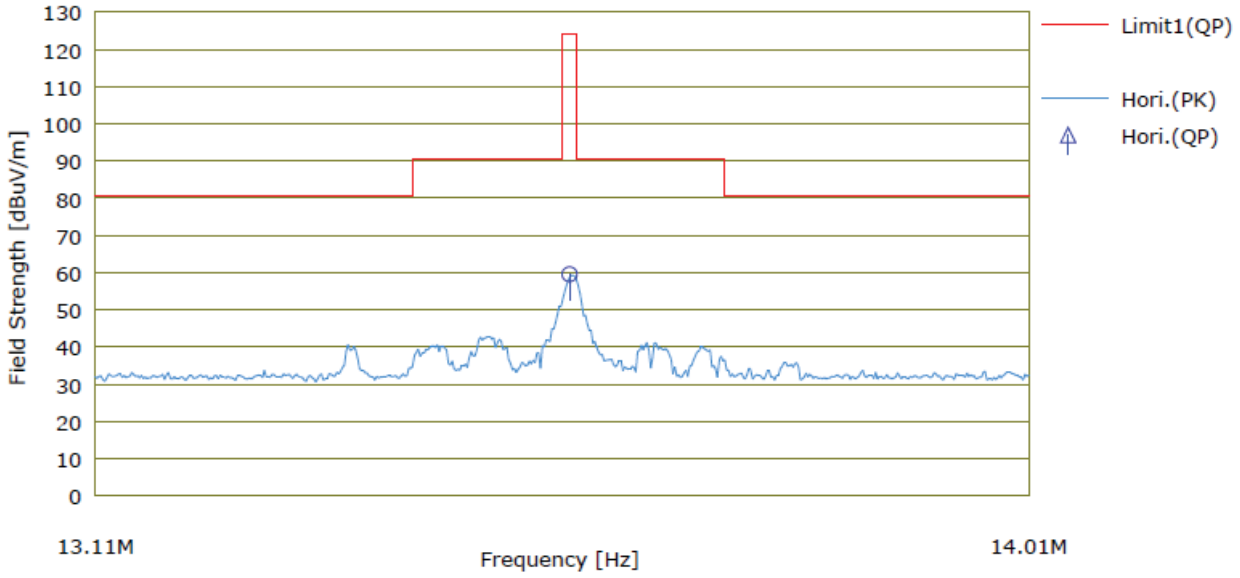
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100
90
80
70
60
50
40
30
20
10
0
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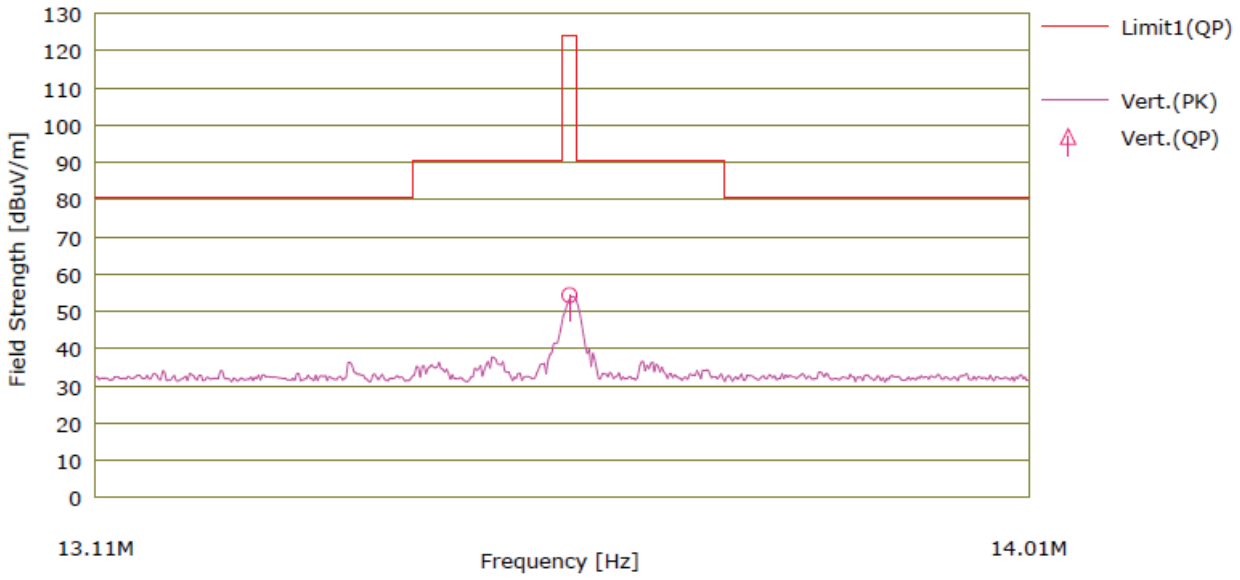
Limit1(QP)
Hori.(PK)
Hori.(QP)
13.11M
Frequency [Hz]
14.01M


130
120
110
100
90
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70
60
50
40
30
20
10
0
Field Strength [dBuV/m]
Limit1(QP)
Vert.(PK)
Vert.(QP)
13.11M
Frequency [Hz]
14.01M

Figure 2. Plot of 20 dB Bandwidth

(On NFC tag)

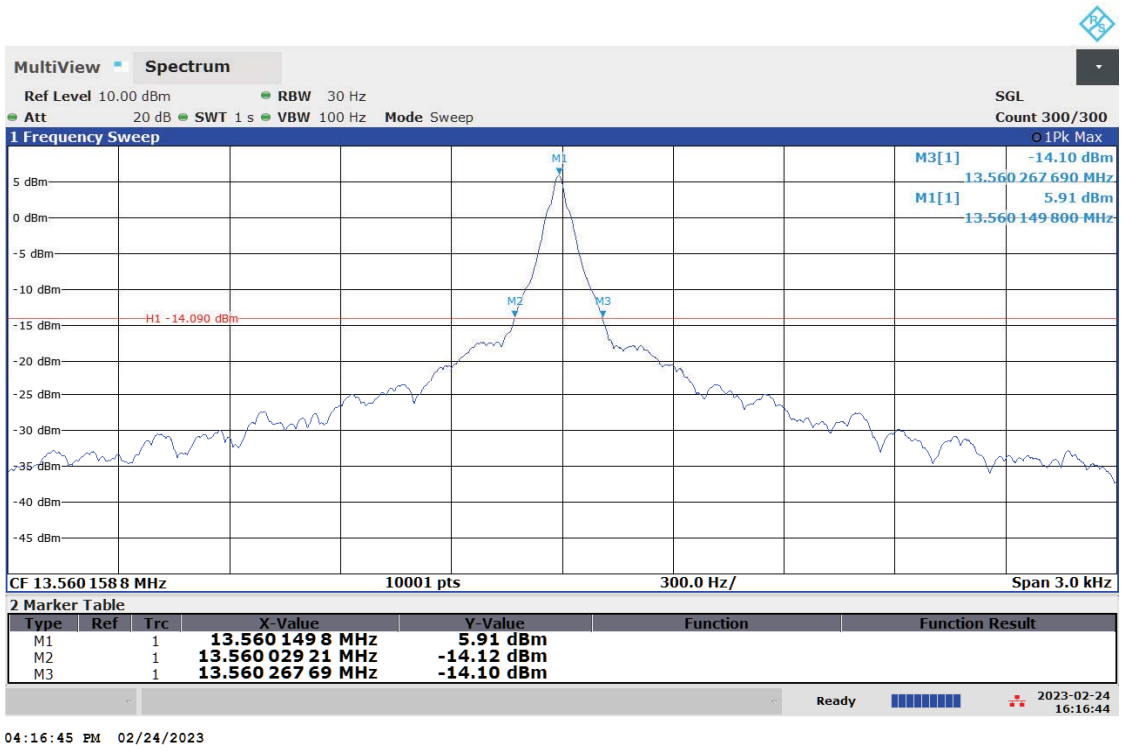
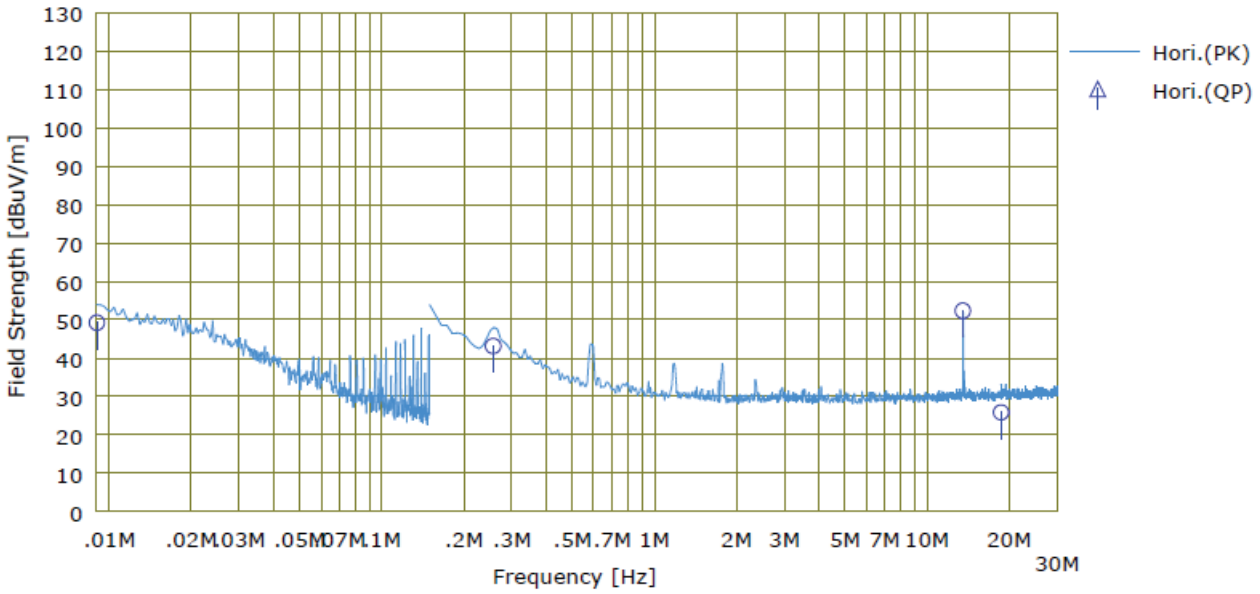
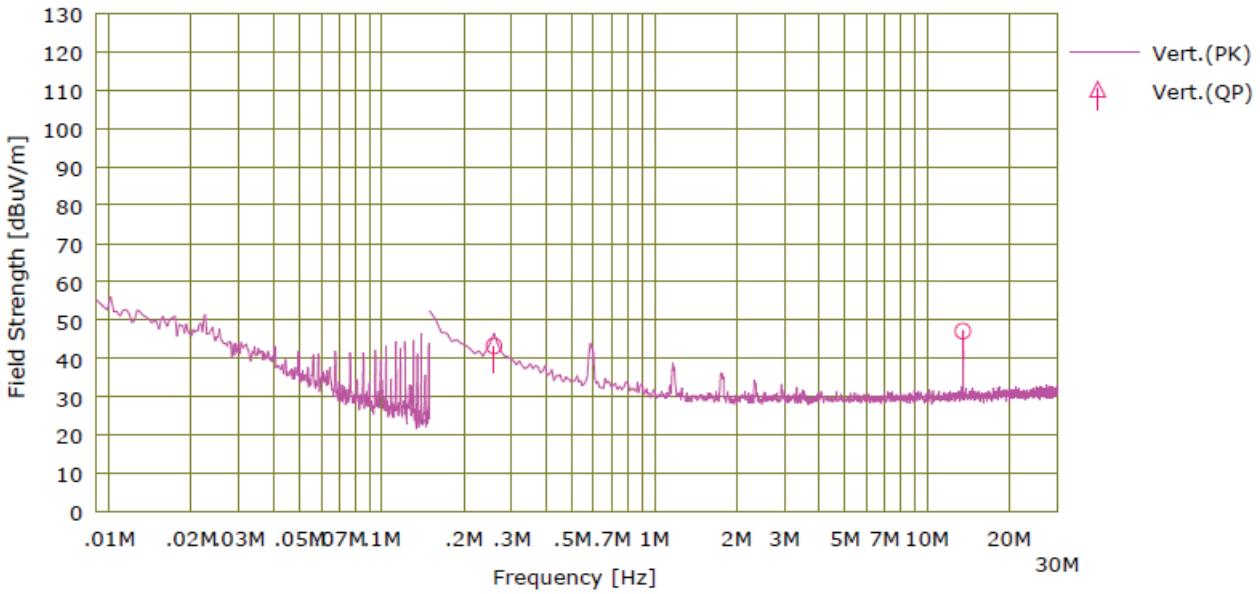


Figure 3. Plot of radiated spurious emissions (from 9 kHz to 30 MHz)

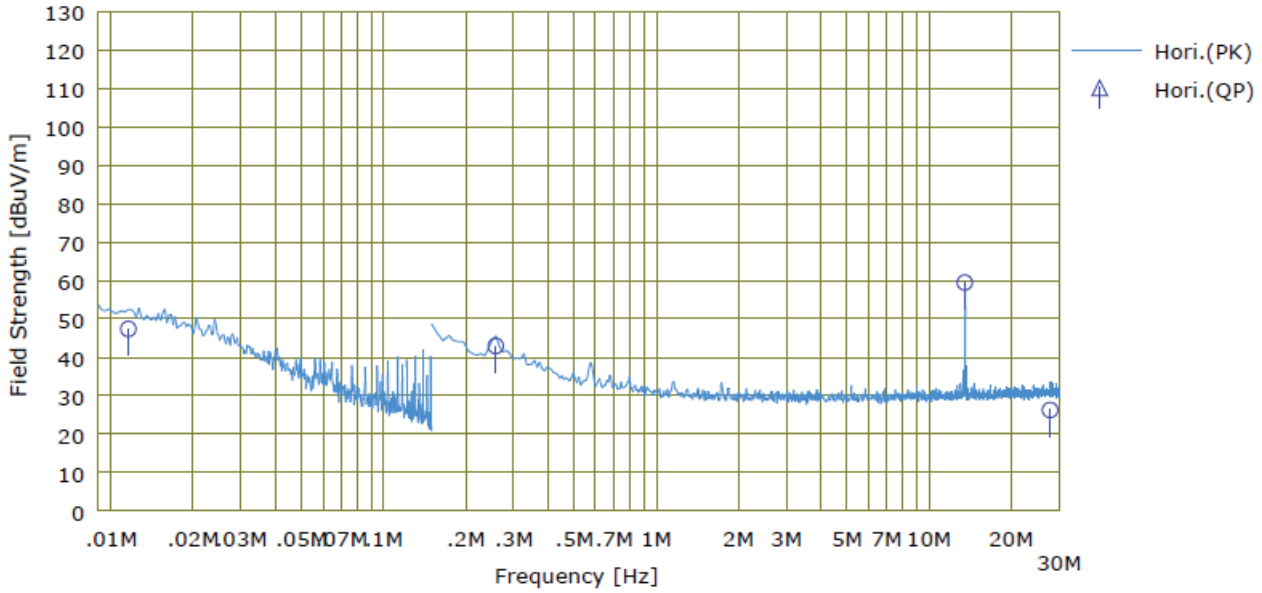
(On NFC tag)

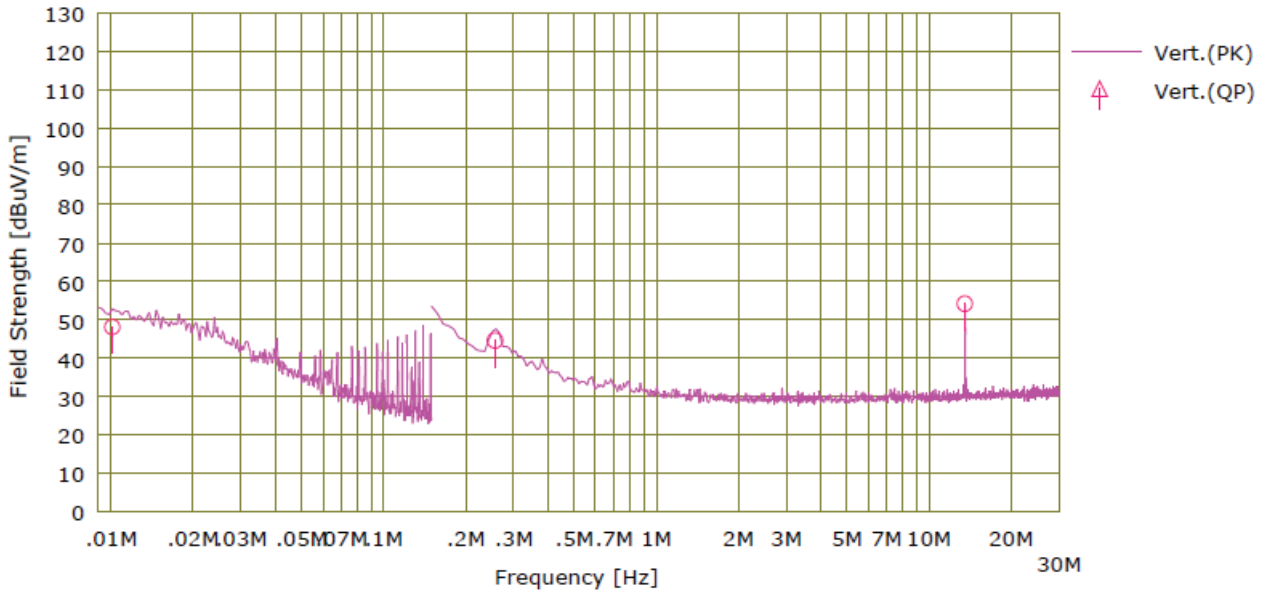




Remark: The tests were performed for three axes X, Y, and Z from the preliminary measurements. The plot(s) were obtained at Y-axis of the maximum emission levels.

(No NFC tag)

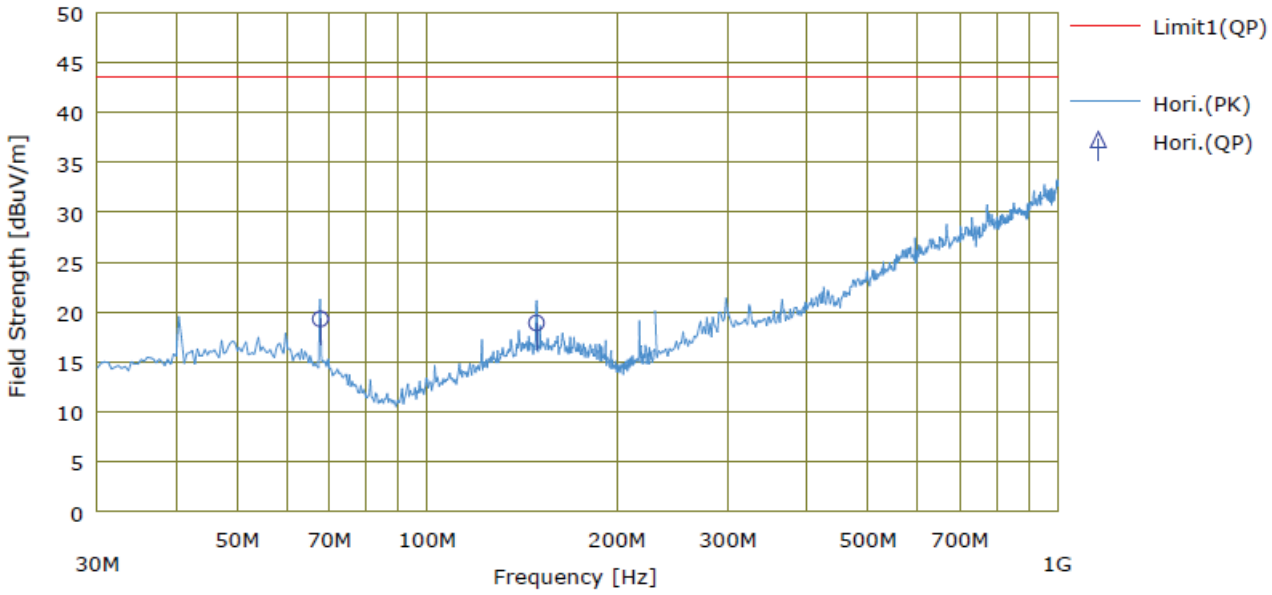


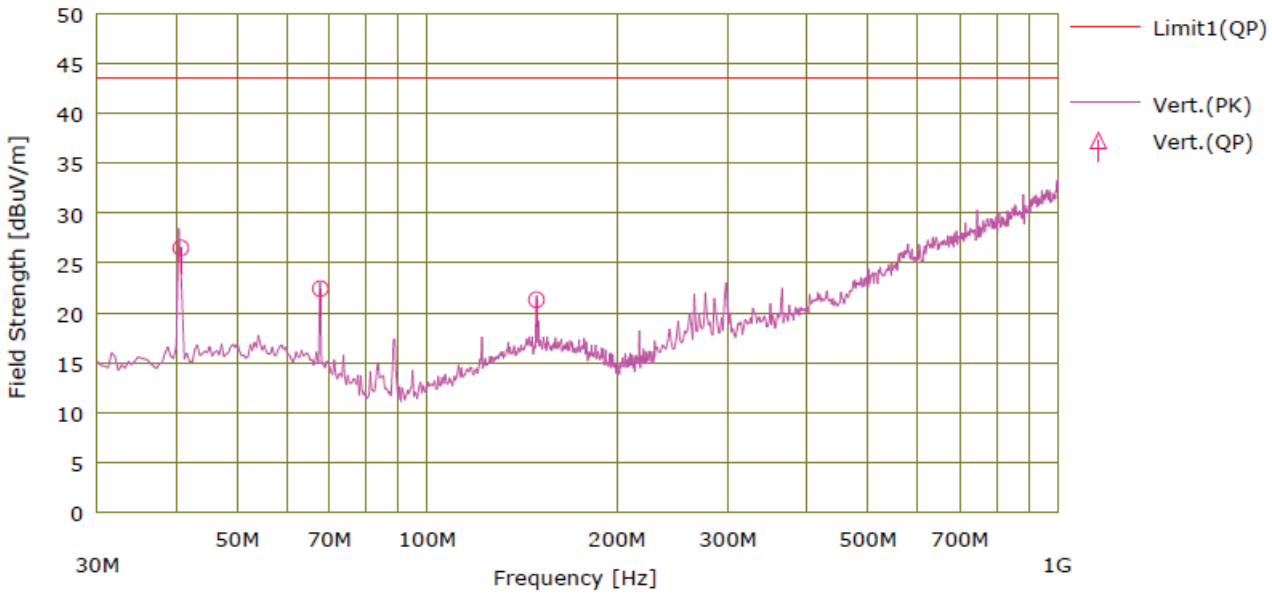


Remark: The tests were performed for three axes X, Y, and Z from the preliminary measurements. The plot(s) were obtained at Z-axis of the maximum emission levels.

Figure 4. Plot of radiated spurious emissions (from 30 MHz to 1 GHz)

(On NFC tag)





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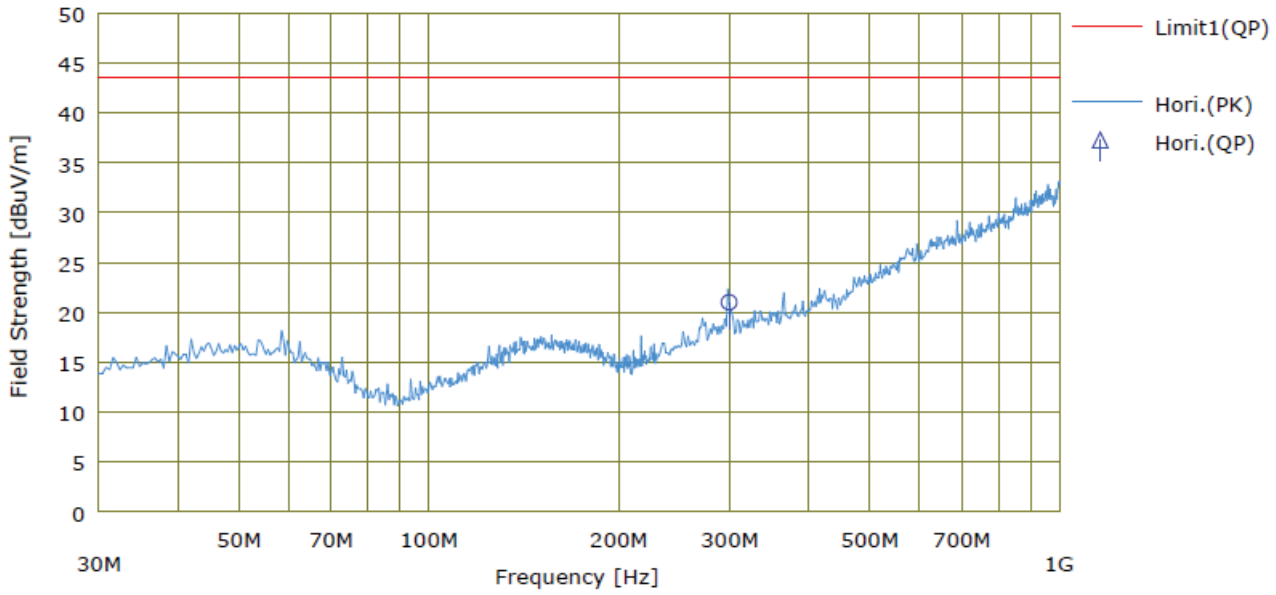
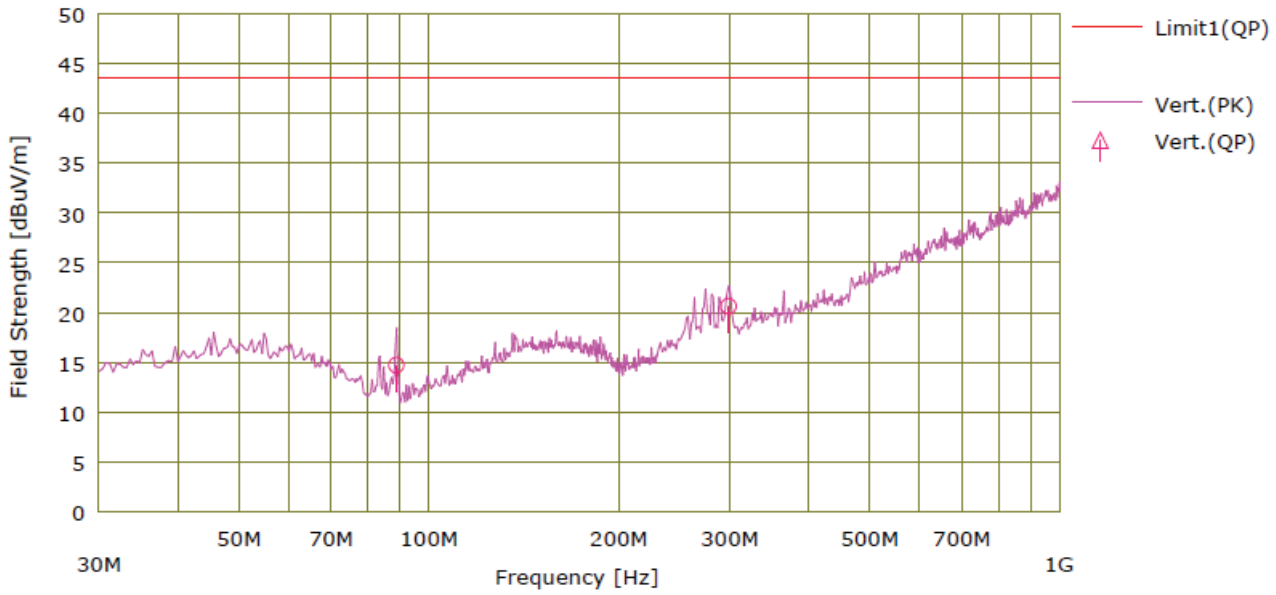

Limit1(QP)
Hori.(PK)
Hori.(QP)
Field Strength [dBuV/m]
50
45
40
35
30
25
20
15
10
5
0
30M
50M
70M
100M
200M
300M
500M
700M
1G
Frequency [Hz]


Limit1(QP)
Vert.(PK)
Vert.(QP)
Field Strength [dBuV/m]
50
45
40
35
30
25
20
15
10
5
0
30M
50M
70M
100M
200M
300M
500M
700M
1G
Frequency [Hz]

5.3. Frequency tolerance of carrier signal

5.3.1 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.

5.3.2 Test Procedure

Frequency stability versus environmental temperature

1. Supply the EUT with nominal DC 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 room temperature (20 ± 5) °C supply the EUT with nominal DC 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 DC voltage and repeat the above procedure.
5. Supply it with 115 % of the nominal DC voltage and repeat the above procedure.

Note: This EUT uses a rechargeable battery. The minimum operating voltage is DC 3.50 V.

5.3.3 Result: **PASS**

Table 5: Frequency Tolerance

(No NFC tag)

Reference Frequency: 13.56 MHz, LIMIT: within ± 1 356 Hz									
Environment Temperature	Power Supplied	Carrier Frequency Measured with Time Elapsed							
		STARUP		2 minutes		5 minutes		10 minutes	
[°C]	[V_{DC}]	[MHZ]	Err [Hz]	[MHZ]	Err [Hz]	[MHZ]	Err [Hz]	[MHZ]	Err [Hz]
+50	3.7 V	13.560 053	53	13.560 037	37	13.560 030	30	13.560 025	25
+40	3.7 V	13.560 066	66	13.560 066	66	13.560 064	64	13.560 054	54
+30	3.7 V	13.560 097	97	13.560 091	91	13.560 095	95	13.560 090	90
+20	3.7 V	13.560 130	130	13.560 120	120	13.560 120	120	13.560 115	115
+10	3.7 V	13.560 176	176	13.560 173	173	13.560 160	160	13.560 157	157
0	3.7 V	13.560 186	186	13.560 180	180	13.560 184	184	13.560 183	183
-10	3.7 V	13.560 170	170	13.560 173	173	13.560 181	181	13.560 183	183
-20	3.7 V	13.560 168	168	13.560 167	167	13.560 168	168	13.560 167	167

Reference Frequency: 13.56 MHz, LIMIT: within ± 1 356 Hz								
Power Supplied	Carrier Frequency Measured with Time Elapsed							
	STARUP		2 minutes		5 minutes		10 minutes	
[V_{DC}]	[MHZ]	Err [Hz]	[MHZ]	Err [Hz]	[MHZ]	Err [Hz]	[MHZ]	Err [Hz]
3.50 V	13.560 090	90	13.560 093	93	13.560 087	87	13.560 087	87
3.70 V	13.560 130	130	13.560 120	120	13.560 120	120	13.560 115	115
4.26 V	13.560 099	99	13.560 094	94	13.560 101	101	13.560 098	98

Err [Hz] = Measured carrier frequency (MHz) - Reference Frequency (13.56 MHz)

5.4. AC power line Conducted emissions

5.4.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

5.4.2 Test Procedure

1. The EUT and supporting equipment including all I/O cables were set up as per the test configuration to simulate typical usage. If the EUT is a table top system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane. If the EUT is a floor standing equipment, it is placed on the ground plane, which has about 10 mm non-conductive covering to insulate the EUT from the ground plane.
2. Each current-carrying conductor of the EUT power cord(s), except the ground (safety) conductor(s) was individually connected through a 50 Ω/50 μH line impedance stabilization network (LISN) to the input power mains. Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.
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 mode, quasi-peak mode and average mode within a bandwidth of 9 kHz.

5.4.3 Result: **PASS**

Table 6: Conducted Emissions

(On NFC tag)

Frequency (MHz)	Line (L/N)	CF (dB)	CL (dB)	Actual (dBμV)		Limit (dBμV)		Margin (dB)	
				QP	AV	QP	AV	QP	AV
0.434 3	L	9.58	9.93	32.50	29.48	57.17	47.17	24.67	17.69
0.462 9	L	9.58	9.93	33.08	30.10	56.64	46.64	23.56	16.54
0.491 5	L	9.58	9.93	32.89	28.01	56.14	46.14	23.25	18.13
2.687 8	N	9.59	10.01	31.99	27.58	56.00	46.00	24.01	18.42
16.878 1	N	9.66	10.26	41.63	29.76	60.00	50.00	18.37	20.24
17.066 2	L	9.68	10.27	42.02	30.46	60.00	50.00	17.98	19.54

Table 7: Conducted Emissions

(No NFC tag)

Frequency (MHz)	Line (L/N)	CF (dB)	CL (dB)	Actual (dBμV)		Limit (dBμV)		Margin (dB)	
				QP	AV	QP	AV	QP	AV
0.426 1	N	9.57	9.93	34.76	32.32	57.33	47.33	22.57	15.01
0.456 8	N	9.57	9.93	34.57	31.71	56.75	46.75	22.18	15.04
0.487 4	N	9.57	9.93	34.13	30.22	56.21	46.21	22.08	15.99
0.520 1	N	9.57	9.93	34.19	29.82	56.00	46.00	21.81	16.18
17.127 6	L	9.68	10.27	41.68	30.40	60.00	50.00	18.32	19.60
17.205 3	N	9.66	10.27	42.30	30.38	60.00	50.00	17.70	19.62

Note: *1) L/N: Line / Neutral*

2) CF and CL: correction factor (LISN) and cable loss including the insertion loss of Pulse Limiter

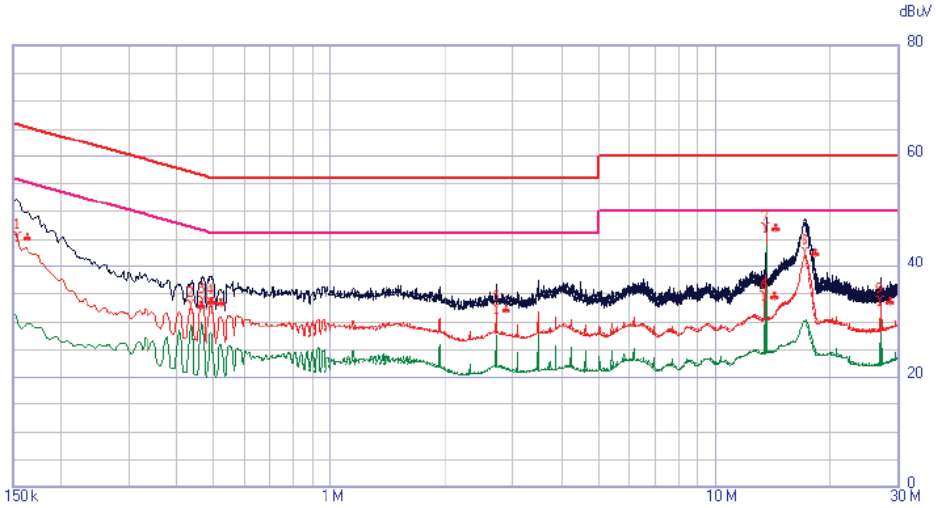
3) Actual = Final measured values after containing CF and CL

4) Margin = Limit - Actual

Figure 5. Plot of Conducted Emissions

(On NFC tag)

Line – PE



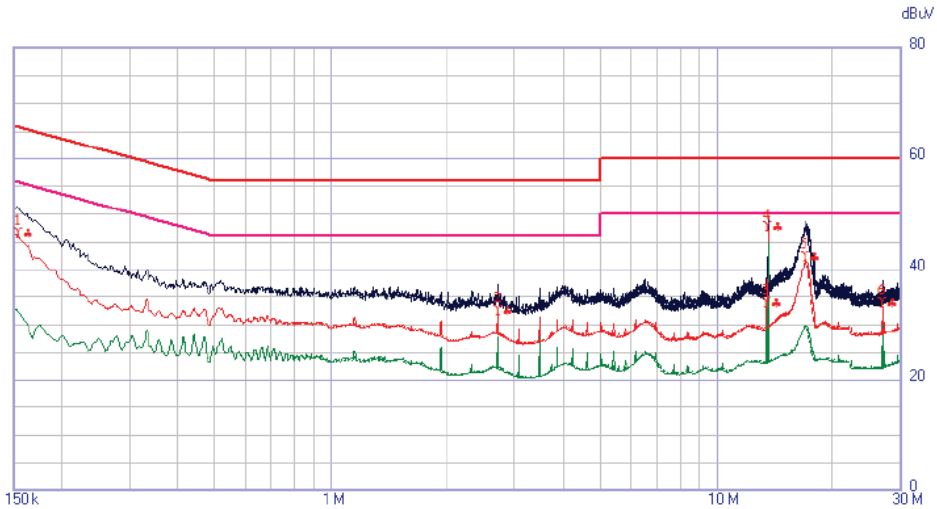
	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary
1	0.15	30	AUTO (2.045 kHz)	P Q C 32_QP_B 32_CAV_B	1500 ms	9 kHz	10	OFF	ON	...	...

Ancillary = General
Nr. of Worst = 3
Limits:
32_QP_B
32_CAV_B

Factors:
ENV 216_L_2023.01.03
CL_Pule Limiter_2023.01.03

Peak
QPeak
CAvg

Neutral – PE



	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary
1	0.15	30	AUTO (2.045 kHz)	P Q C 32_QP_B 32_CAV_B	1500 ms	9 kHz	10	OFF	ON	...	...

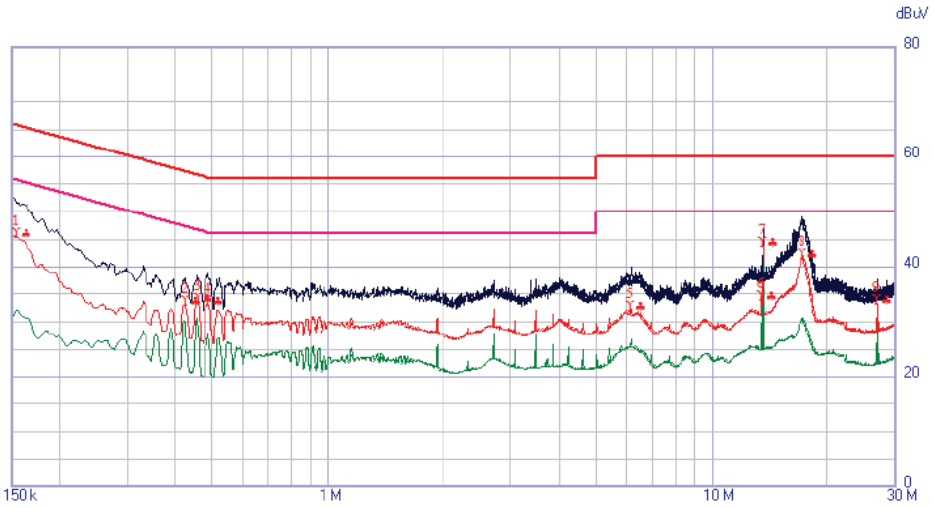
Ancillary = General
Nr. of Worst = 3
Limits:
32_QP_B
32_CAV_B

Factors:
ENV 216_N_2023.01.03
CL_Pule Limiter_2023.01.03

Peak
QPeak
CAvg

(No NFC tag)

Line – PE



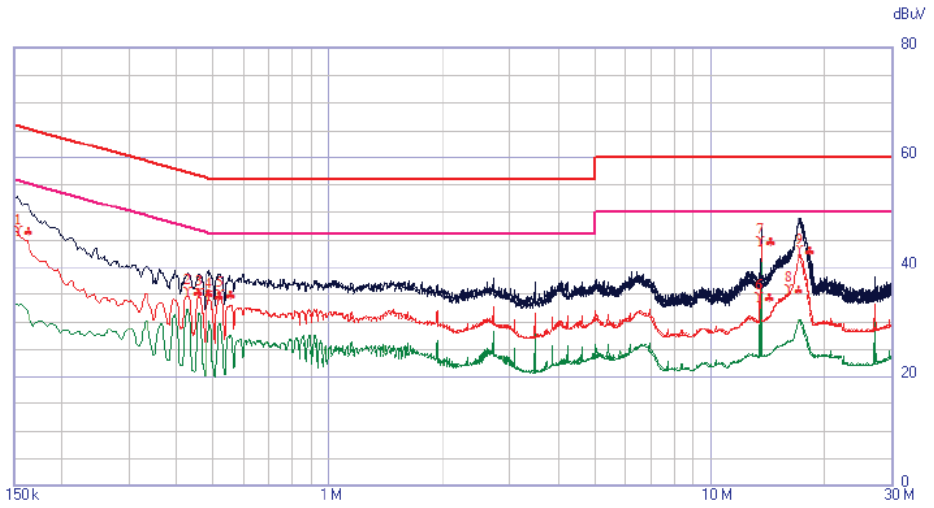
	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary
1	0.15	30	AUTO (2.045 kHz)	P Q C 32_QP_B 32_CAV_B	1500 ms	9 kHz	10	OFF	ON	...	...

Ancillary = General
Nr. of Worst = 3
Limits:
32_QP_B
32_CAV_B

Factors:
ENV 216_L_2023.01.03
CL_Pule Limiter_2023.01.03

Peak
QPeak
CAvg

Neutral – PE



	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary
1	0.15	30	AUTO (2.045 kHz)	P Q C 32_QP_B 32_CAV_B	1500 ms	9 kHz	10	OFF	ON	...	...

Ancillary = General
Nr. of Worst = 3
Limits:
32_QP_B
32_CAV_B

Factors:
ENV 216_N_2023.01.03
CL_Pule Limiter_2023.01.03

Peak
QPeak
CAvg