

RF Test Report

Project Number: 4602458**Proposal Number: 10607****Report Number: 4602458EMC02****Revision Level: 1****Client: HavenLock Inc.****Equipment Under Test: Electrically Operated Security Door Lock****Product Marketing Name: Haven Connect Z****HVIN HL1-CNT-001-Z****FCC ID: 2ARFQHL1CNT001Z****IC: 24389-HL1CNT001Z****Applicable Standards: FCC Part 15 Subpart C, § 15.249****RSS-210, Issue 10, December 2019 (Annex F)****RSS-GEN, Issue 5, March 2019 Amendment 1****ANSI C63.10: 2013****Report issued on: 6 May 2020****Test Result: Compliant**

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Remarks: This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 Summary of Test Results

Test Description	Test Specification	Test Result
Field Strength of Fundamental	15.249(a), RSS-210 F.1(a)	Compliant
Field Strength of Spurious Radiation	15.249(a)(d) and 15.209 RSS-210 F.1(a)(b)(e)	Compliant
Fixed, Point-to-Point	15.249(b)	Not Applicable
20 dB Bandwidth	15.215(c)	Reported
99% Occupied Bandwidth	RSS-GEN 6.7	Reported
AC Powerline Conducted Emissions	15.107, 15.207, RSS-GEN 8.8	Compliant

1.1 *Modifications Required for Compliance*

None

2 General Information

2.1 Client Information

Name: HavenLock Inc.
Address: 188 Front Street Suite 116-112
City, State, Zip, Country: Franklin, TN 37064

2.2 Test Laboratory

Name: SGS North America, Inc.
Address: 620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country: Suwanee, GA 30024, USA

Accrediting Body: A2LA
Type of lab: Testing Laboratory
Certificate Number: 3212.01

2.3 General Information of EUT

Equipment Under Test: Electrically Operated Security Door Lock
Model Name: Haven Connect Z
Firmware Version: 0.52
Model Number: HL1-CNT-001-Z
Serial Number: 5244
Modulation: GFSK

FCC ID: 2ARFQHL1CNT001Z
IC: 24389-HL1CNT001Z

Tx Frequency Range: 908.4 MHz
Antenna Type: Integral PCB

Rated Voltage: 100-240Vac, 50/60Hz
Test Voltage: 120Vac, 60Hz

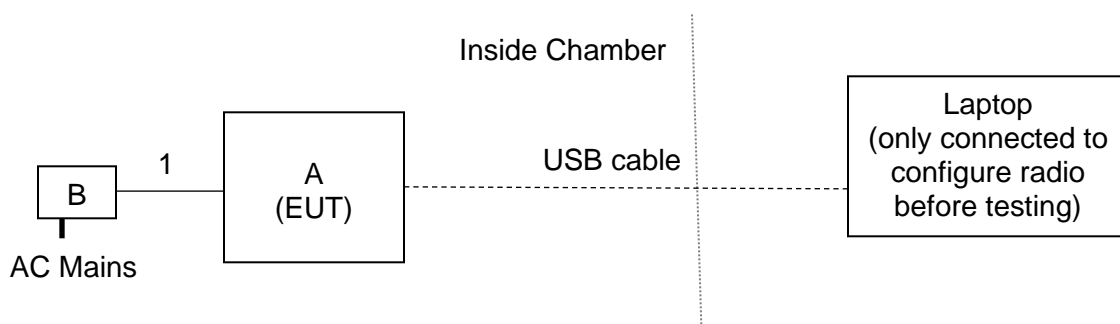
Sample Received Date: 18 March 2020
Dates of testing: 1 – 14 April 2020

2.4 Operating Modes and Conditions

The EUT had an internal battery pack installed and was connected to the AC Mains using the supplied AC/DC wall adapter. The EUT was running test mode software which allowed it to be commanded to turn on a continuous transmit signal at maximum power at 908.4 MHz using a Terminal program and CLI (Command Line Interface).

The software used to exercise the transmitter was Silicon Labs RailTest version 2.7.1

2.5 EUT Connection Block Diagram



2.6 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	HavenLock Inc.	Electrically Operated Security Door Lock	HL1-CNT-001-Z	5244
B	Not Labeled	Switching Power Supply	PSAA05A-050QL6	NSN

2.7 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
1	DC Input	Power adapter	EUT	1.8	No	No

3 Field Strength of Fundamental

3.1 Test Result

Test Description	Test Specification	Test Result
Field Strength of Fundamental	15.249(a) RSS-210 F.1(a)	Compliant

3.2 Test Method

The test data was measured using a Quasi-Peak detector below 1GHz and a Peak detector above 1GHz. The receiver's resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHz and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Used	Fundamental Frequency	QP / Average Limits			Peak Limits dBuV/m
		Millivolts/meter	Microvolts/m	dBuV/m	
Yes	902 - 928 MHz	50	50000	94 ⁽¹⁾	--
No	2400 - 2483.5 MHz	50	50000	94 ⁽²⁾	114
No	5725 - 5875 MHz	50	50000	94 ⁽²⁾	114
No	24 - 24.25 GHz	250	250000	108 ⁽²⁾	128

(1) Quasi-peak limit

(2) Average limit

3.3 Test Site

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 22.2 °C

Relative Humidity: 51.5 %

Atmospheric Pressure: 97.05 kPa

3.4 Test Equipment

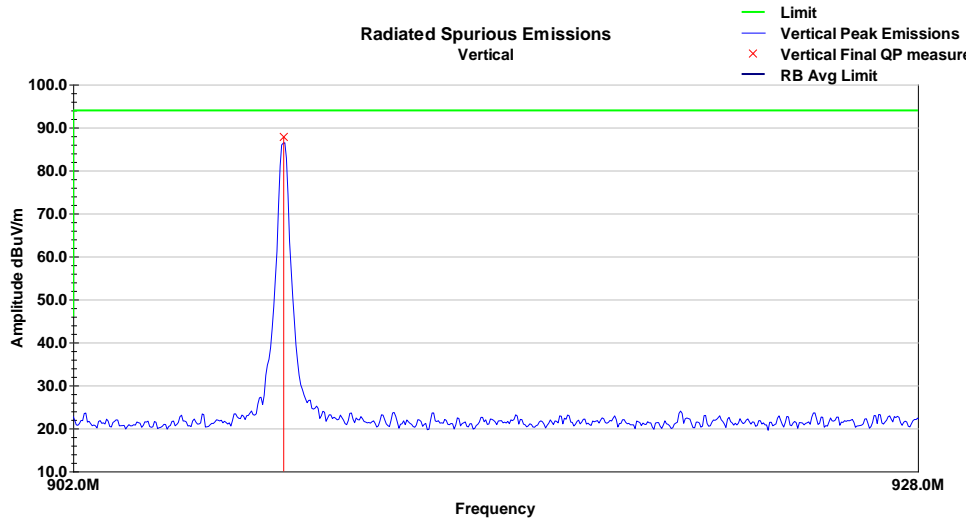
Test End Date: 8-Apr-2020

Tester: ZH

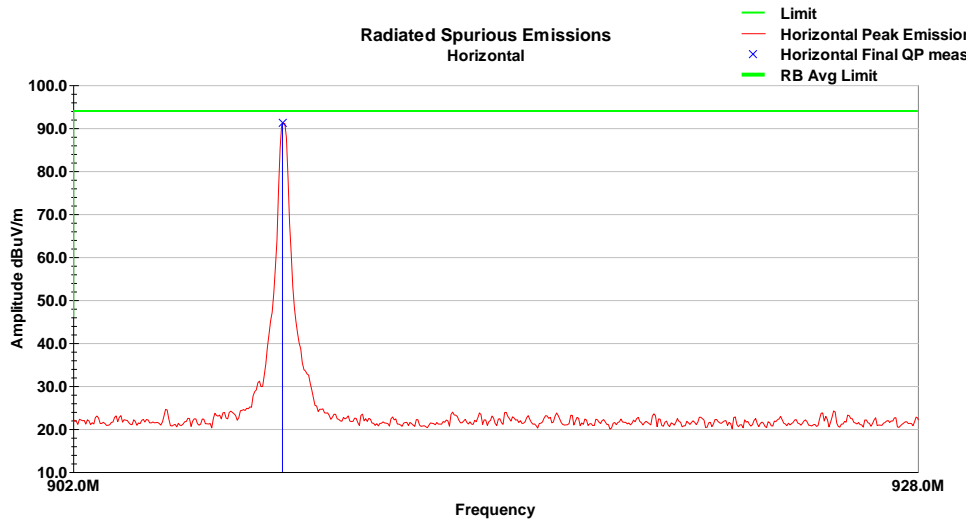
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	30-Oct-2020
RF Cable Nm to Nm, 0.01-18GHz	90-195-354	TELEDYNE STORM MICROWAVE	20120	2-Mar-2021
RF CABLE	NFS-290-78.7-NFS	FLORIDARF LABS	B095019	6-Sep-2020
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20126	2-Mar-2021
RF CABLE	SUC OFLEX 100	Huber & Suhner	B108523	5-Sep-2020
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	3-Dec-2020
EMITEST RECEIVER	ESW 44	ROHDE & SCHWARZ	101585	3-Dec-2020

Note: The equipment calibration period is 1 year.

3.5 Test Data



Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
908.41	96.8	V	262.0	161.0	22.9	3.0	35.0	87.7	94.0	-6.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										



Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
908.37	100.2	H	357.0	250.0	22.9	3.0	35.0	91.1	94.0	-2.8
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

4 Field Strength of Spurious Radiation

4.1 Test Result

Test Description	Test Specification	Test Result
Field Strength of Spurious Radiation	15.249(a)(d) and 15.209 RSS-210 F.1(a)(b)(e)	Compliant

4.2 Test Method

The initial exploratory scans were performed over the frequency ranges as indicated in the table below using the max hold function using TILE! software. The pre-scans were performed with the EUT oriented in each of its three orthogonal axes to determine the orientation that produces the highest emissions. The final test data was measured using a Quasi-Peak detector below 1GHz and Peak and Average detectors above 1GHz. The receiver's resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements 1GHz and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Frequency	QP / Average Limits		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 ⁽¹⁾	--
88 - 216 MHz	150	43.5 ⁽¹⁾	--
216 - 960 MHz	200	46 ⁽¹⁾	--
960 - 1000 MHz	500	54 ⁽¹⁾	--
1 - 40 GHz	500	54 ⁽²⁾	74

(1) Quasi-peak limit

(2) Average limit

4.3 Test Site

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 22.2 °C
 Relative Humidity: 51.5 %
 Atmospheric Pressure: 97.05 kPa

4.4 Test Equipment

30-1000 MHz

Test End Date: 8-Apr-2020

Tester: ZH

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	30-Oct-2020
RF Cable Nm to Nm, 0.01-18GHz	90-195-354	TELEDYNE STORM MICROWAVE	20120	2-Mar-2021
RF CABLE	NFS-290-78.7-NFS	FLORIDA RF LABS	B095019	6-Sep-2020
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20126	2-Mar-2021
RF CABLE	SUCOFLEX 100	Huber & Suhner	B108523	5-Sep-2020
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	3-Dec-2020
EMI TEST RECEIVER	ESW 44	ROHDE & SCHWARZ	101585	3-Dec-2020

1-10 GHz

Test End Date: 9-Apr-2020

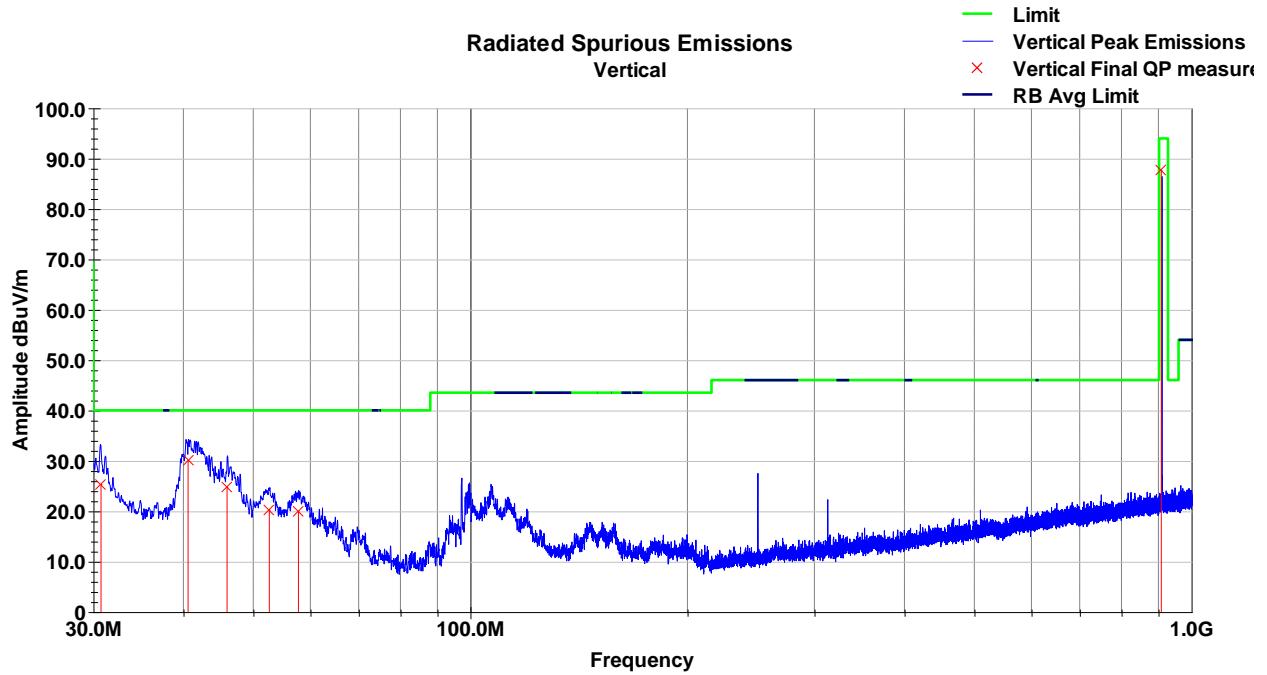
Tester: CBO

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS Lindgren	B079691	10-Aug-2020
RF Cable Nm to Nm, 0.01-18GHz	90-195-354	TELEDYNE STORM MICROWAVE	20120	2-Mar-2021
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	3-Dec-2020
RF CABLE	SUCOFLEX 100	Huber & Suhner	B108523	5-Sep-2020
EMI TEST RECIEVER	ESW-44	ROHDE & SCHWARZ	101585	3-Dec-2020

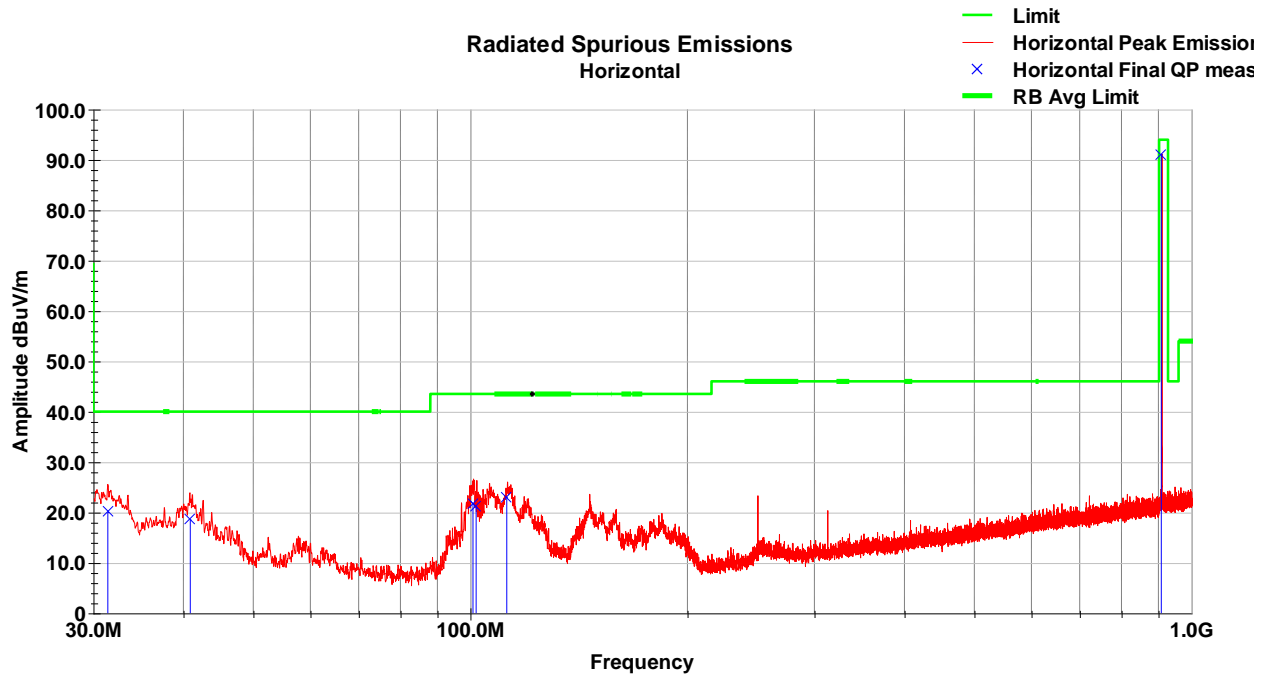
Note: The equipment calibration period is 1 year.

4.5 Test Data

4.5.1 30-1000 MHz



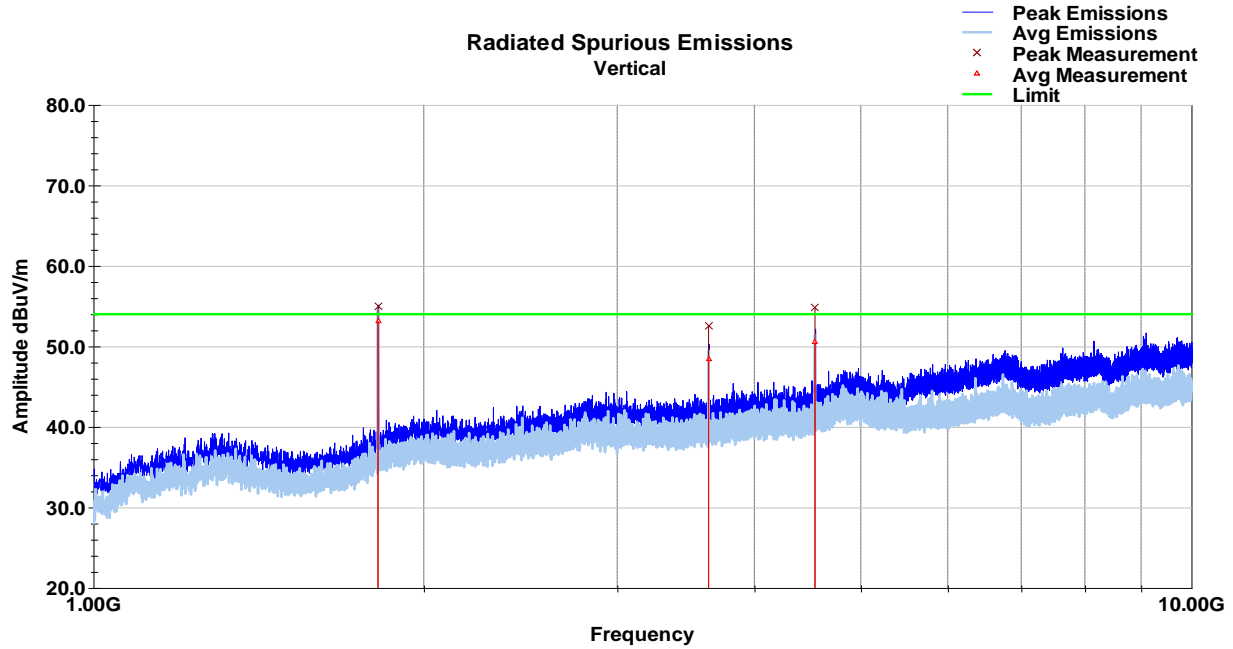
Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.75	37.9	V	326.0	128.0	21.7	0.5	34.7	25.4	40.0	-14.6
40.60	50.6	V	230.0	110.0	14.0	0.6	35.0	30.1	40.0	-9.9
45.99	48.7	V	246.0	101.0	10.6	0.6	35.1	24.8	40.0	-15.2
52.63	46.6	V	21.0	128.0	8.2	0.7	35.2	20.3	40.0	-19.7
57.77	47.0	V	95.0	119.0	7.5	0.7	35.2	20.0	40.0	-20.0
908.41	96.8	V	262.0	161.0	22.9	3.0	35.0	87.7	94.0	-6.3



Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.43	33.2	H	95.0	176.0	21.2	0.5	34.7	20.1	40.0	-19.9
40.89	39.3	H	220.0	200.0	13.8	0.6	35.0	18.6	40.0	-21.4
100.86	45.7	H	162.0	250.0	10.8	0.9	35.5	21.9	43.5	-21.7
101.88	44.9	H	172.0	250.0	11.0	0.9	35.6	21.2	43.5	-22.3
112.33	44.6	H	0.0	247.0	13.0	1.0	35.6	23.0	43.5	-20.5
908.37	100.2	H	357.0	250.0	22.9	3.0	35.0	91.1	94.0	-2.8

4.5.2 1-10 GHz

Face Up
Vertical Plot



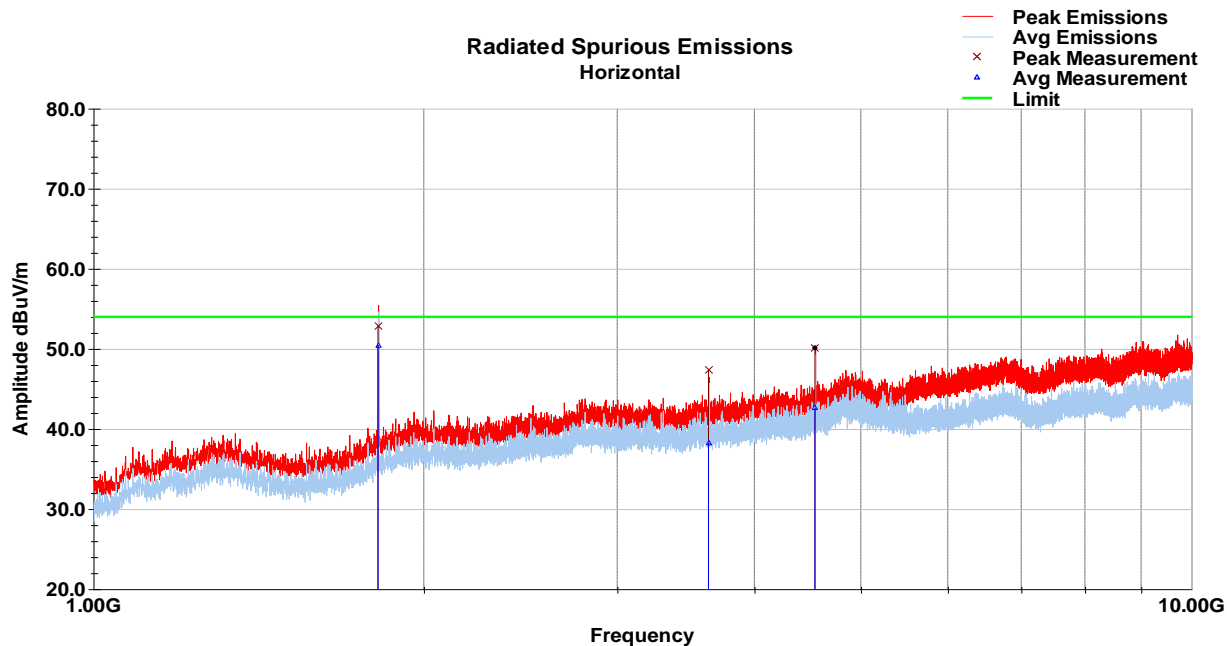
Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
1816.76	56.3	V	190.0	128.0	30.8	2.6	34.8	54.9	74.0	-19.1
3633.52	50.6	V	201.0	237.0	33.1	3.8	34.9	52.6	74.0	-21.4
4542.20	51.0	V	286.0	249.0	34.3	4.2	34.8	54.8	74.0	-19.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
1816.76	54.5	V	190.0	128.0	30.8	2.6	34.8	53.2	54.0	-0.8
3633.52	46.5	V	201.0	237.0	33.1	3.8	34.9	48.5	54.0	-5.5
4542.20	46.9	V	286.0	249.0	34.3	4.2	34.8	50.6	54.0	-3.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Plot



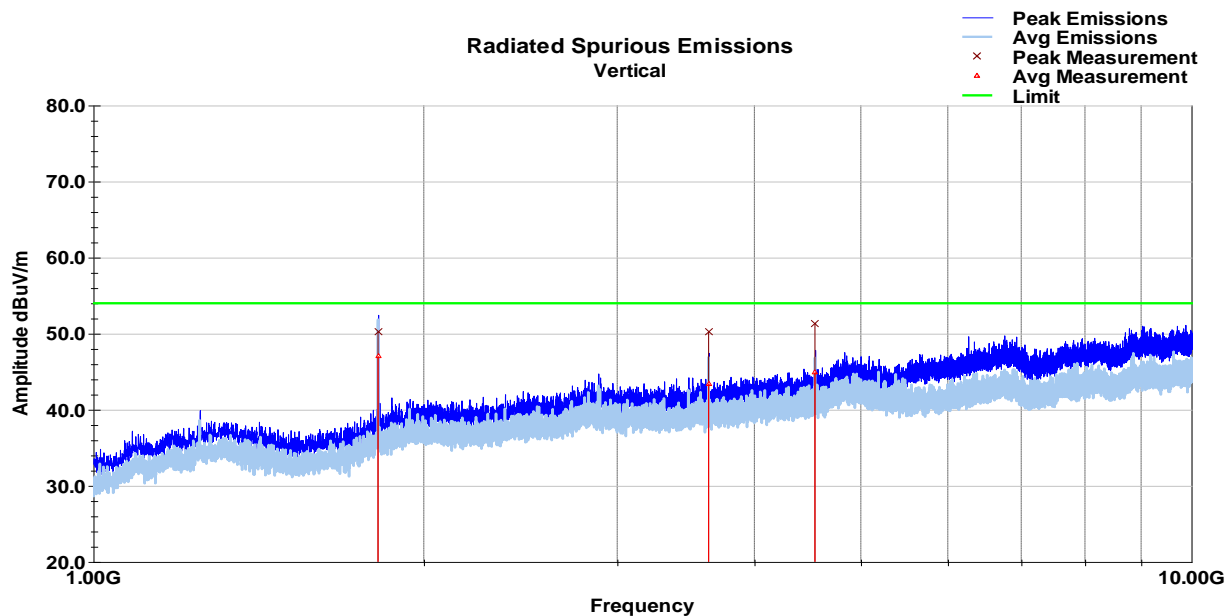
Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
1816.88	54.2	H	73.0	249.0	30.8	2.6	34.8	52.8	74.0	-21.2
3633.28	45.4	H	178.0	249.0	33.1	3.8	34.9	47.4	74.0	-26.6
4541.72	46.4	H	253.0	250.0	34.3	4.2	34.8	50.1	74.0	-23.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
1816.88	51.9	H	73.0	249.0	30.8	2.6	34.8	50.5	54.0	-3.5
3633.28	36.3	H	178.0	249.0	33.1	3.8	34.9	38.3	54.0	-15.7
4541.72	38.9	H	253.0	250.0	34.3	4.2	34.8	42.6	54.0	-11.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Face Down
Vertical Plot



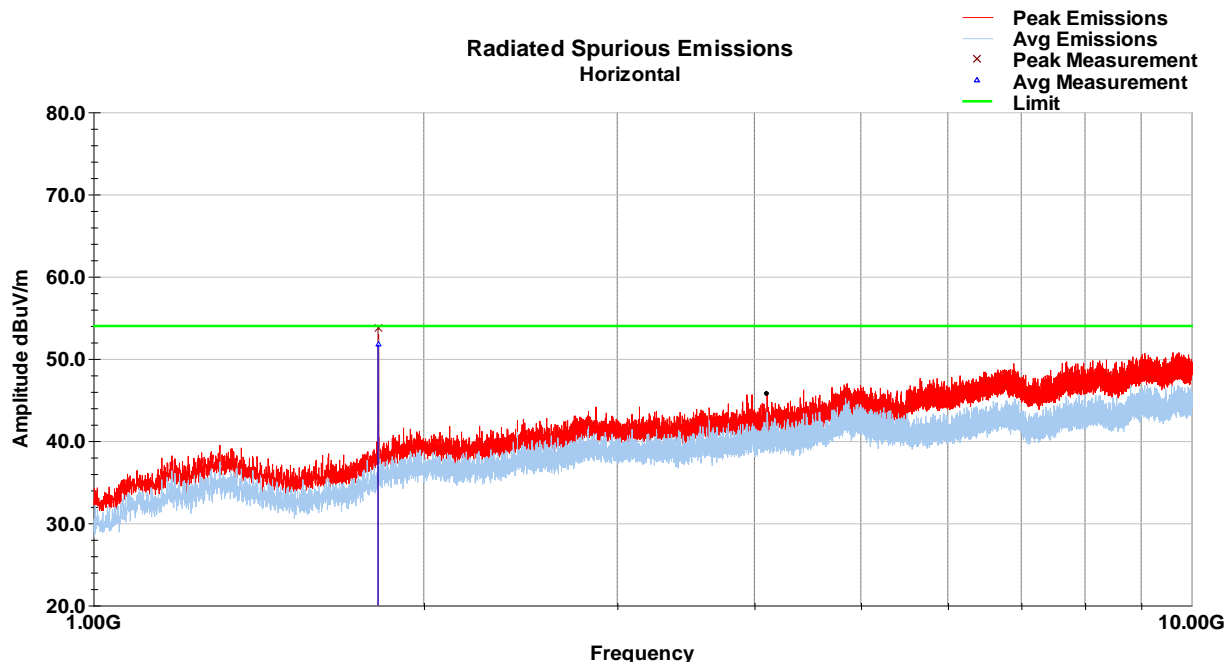
Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
1816.76	51.7	V	131.0	250.0	30.8	2.6	34.8	50.3	74.0	-23.7
3633.64	48.3	V	337.0	126.0	33.1	3.8	34.9	50.3	74.0	-23.7
4541.84	47.6	V	243.0	114.0	34.3	4.2	34.8	51.4	74.0	-22.6
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
1816.76	48.4	V	131.0	250.0	30.8	2.6	34.8	47.0	54.0	-7.0
3633.64	41.5	V	337.0	126.0	33.1	3.8	34.9	43.4	54.0	-10.6
4541.84	41.2	V	243.0	114.0	34.3	4.2	34.8	44.9	54.0	-9.1
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Plot



Peak

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
1816.76	55.1	H	189.0	113.0	30.8	2.6	34.8	53.7	74.0	-20.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
1816.76	53.1	H	189.0	113.0	30.8	2.6	34.8	51.7	54.0	-2.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

5 Bandwidth

5.1 Test Result

Test Description	Basic Standards	Test Result
20 dB Bandwidth	15.215(c)	Reported
99% Occupied Bandwidth	RSS-GEN 6.7	Reported

5.2 Test Method

The procedures from ANSI C63.10 clause 6.9 were used to determine the 20 dB Bandwidth and the 99% Occupied Bandwidth.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.2 °C

Relative Humidity: 32.5 %

Atmospheric Pressure: 97.5 kPa

5.4 Test Equipment

Test End Date: 1-Apr-2020

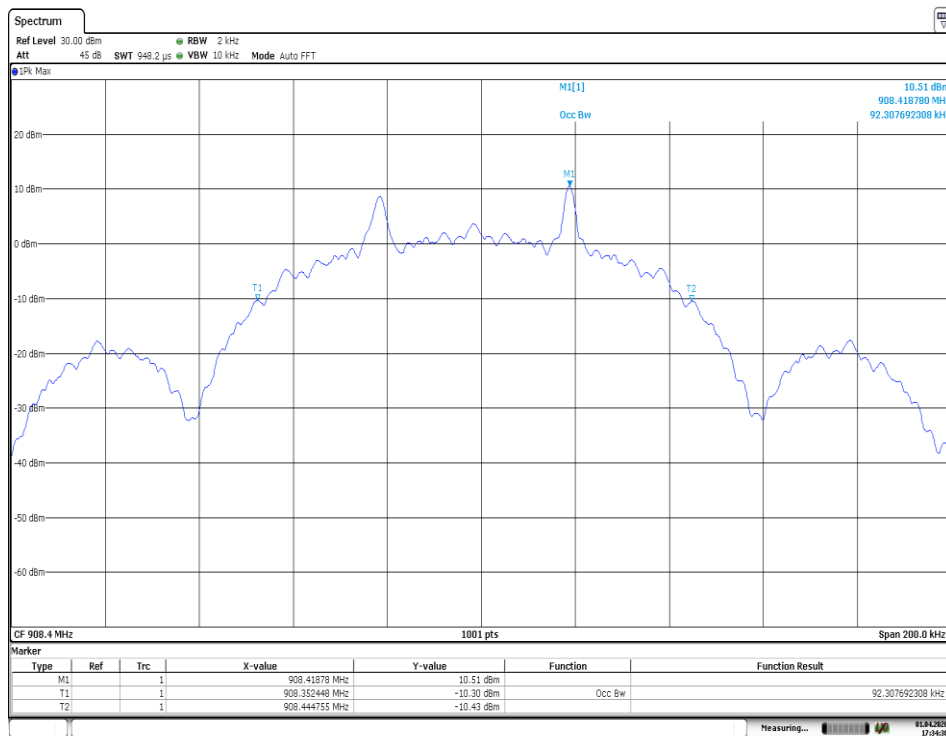
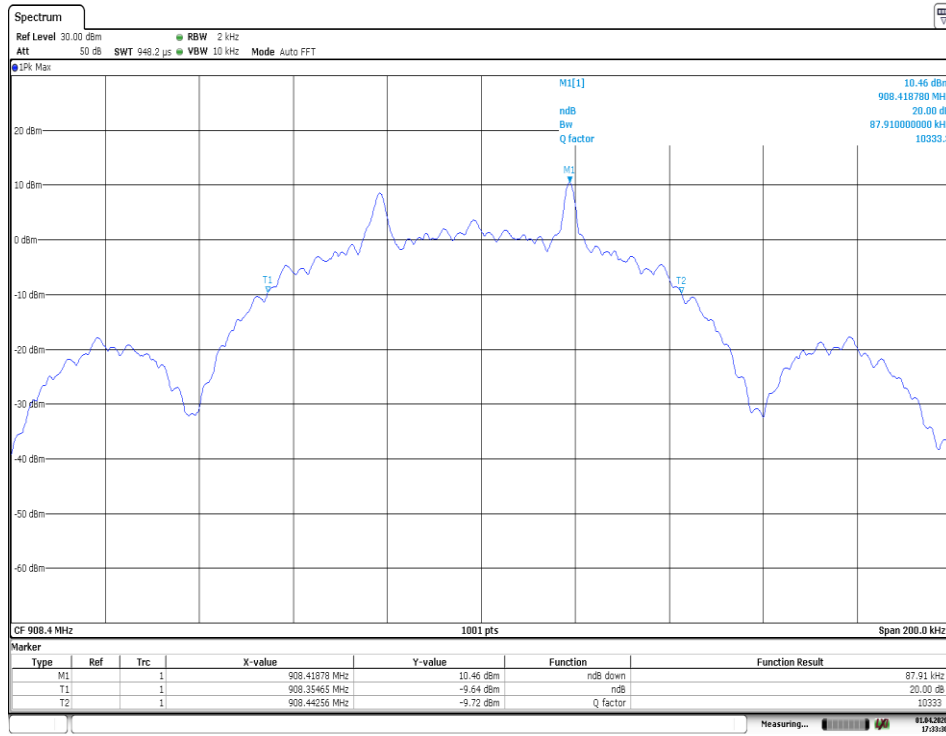
Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	6-Sep-2020
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2021

Note: The equipment calibration period is 1 year.

5.5 Test Data

Test Description	EUT Frequency	Bandwidth
20 dB Bandwidth	908.4 MHz	87.9 kHz
99% Occupied Bandwidth	908.4 MHz	92.3 kHz



6 AC Powerline Conducted Emissions

6.1 Test Result

Test Description	Basic Standards	Test Result
AC Powerline Conducted Emissions	FCC 15.107, 15.207 RSS-GEN 8.8 ANSI C63.10: 2013	Compliant

6.2 Test Method

With the receiver's resolution bandwidth was set to 9 kHz, exploratory scans were performed over the measuring frequency range (0.15 MHz to 30 MHz) using a max hold mode incorporating a Peak detector and Average detector and using the TILE! software. The final test data was measured using a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

Frequency Range	Limits (dBuV)
0.15 to 0.5 MHz	Avg 56 to 46 QP 66 to 56
0.5 to 5 MHz	Avg 46 Pk 56
5 to 30 MHz	Avg 50 Pk 60

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions:

Temperature: 21.8 °C

Relative Humidity: 47.2 %

Atmospheric Pressure 98.7 kPa

6.4 Test Equipment

Test End Date: 14-Apr-2020

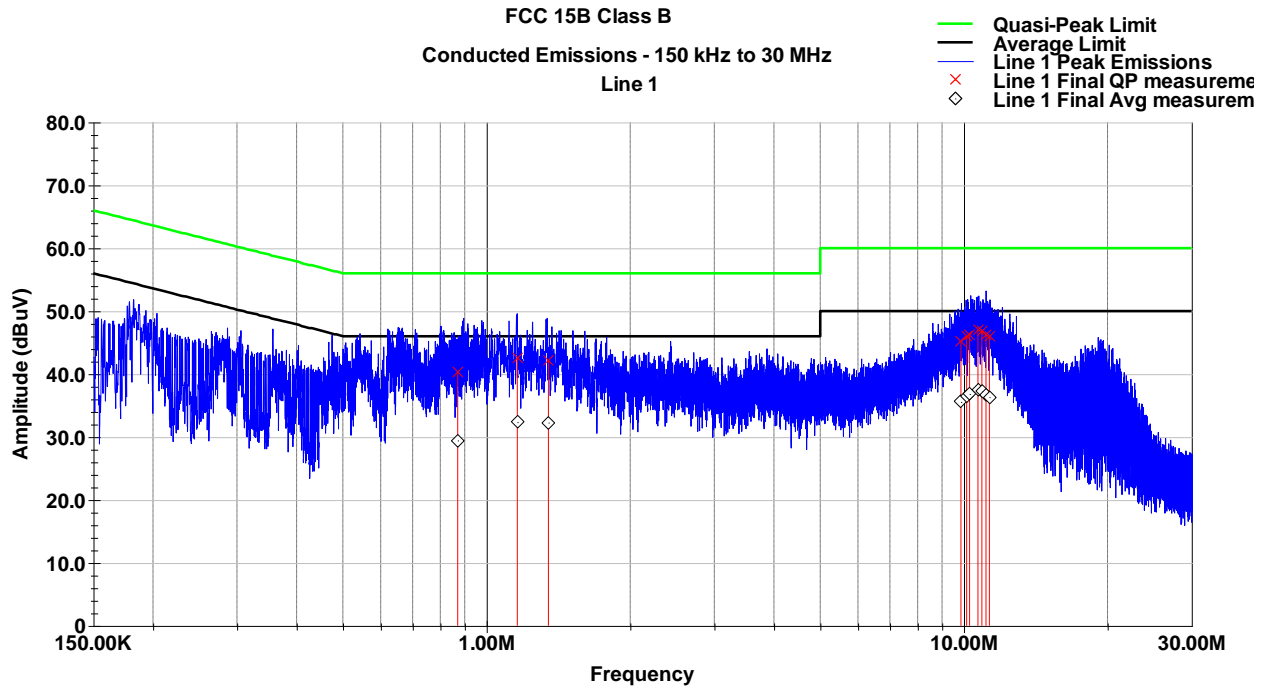
Tester: CBO

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	5-Sep-2020
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	16-Dec-2020
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	6-Apr-2021

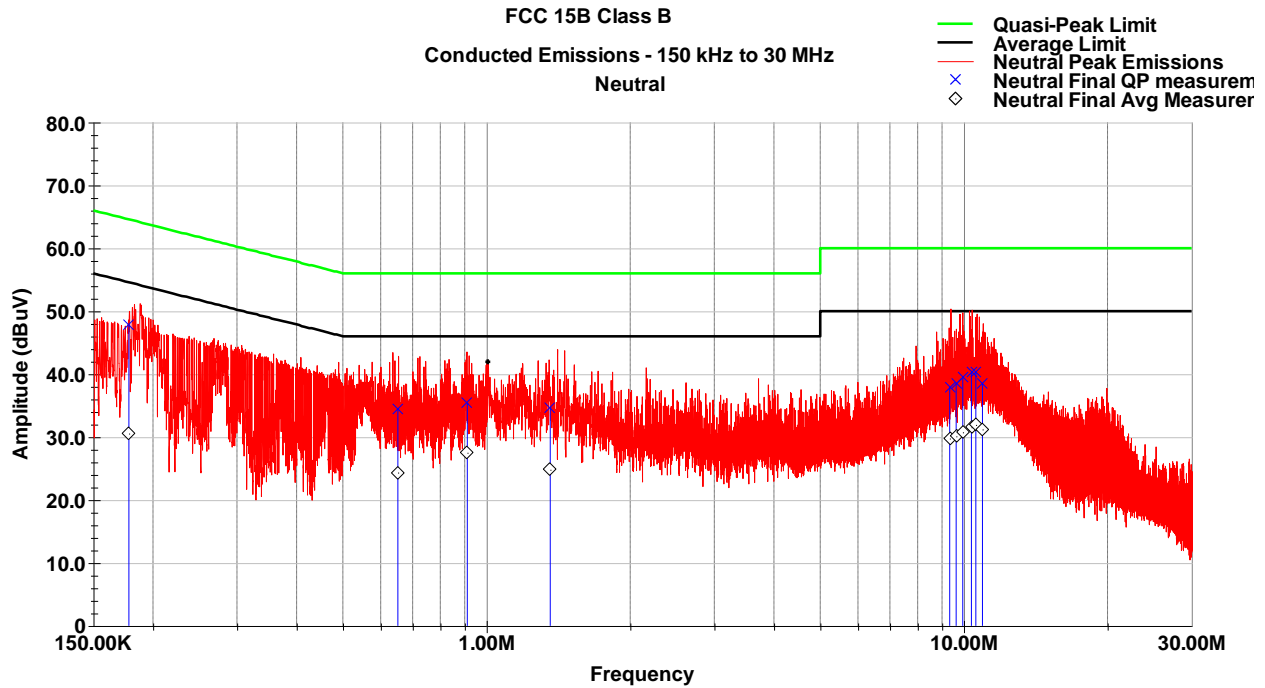
Note: The equipment calibration period is 1 year.

Software: "181112 Conducted Emissions TILE7" TILE! profile dated 12 Nov 2018

6.5 Test Data



Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.870	40.4	56.0	-15.6	29.5	46.0	-16.5
1.160	42.7	56.0	-13.3	32.4	46.0	-13.6
1.348	42.2	56.0	-13.8	32.3	46.0	-13.7
9.859	45.2	60.0	-14.8	35.6	50.0	-14.4
10.133	46.1	60.0	-13.9	36.4	50.0	-13.6
10.279	46.3	60.0	-13.7	36.9	50.0	-13.1
10.701	47.0	60.0	-13.0	37.4	50.0	-12.6
10.906	46.7	60.0	-13.3	37.2	50.0	-12.8
11.125	46.2	60.0	-13.8	36.7	50.0	-13.3
11.310	45.9	60.0	-14.1	36.3	50.0	-13.7



Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.178	47.7	64.6	-16.8	30.6	54.6	-24.0
0.652	34.5	56.0	-21.5	24.4	46.0	-21.6
0.911	35.4	56.0	-20.6	27.5	46.0	-18.5
1.359	34.7	56.0	-21.3	24.8	46.0	-21.2
9.340	37.9	60.0	-22.1	29.8	50.0	-20.2
9.634	38.6	60.0	-21.4	30.1	50.0	-19.9
9.949	39.5	60.0	-20.5	30.8	50.0	-19.2
10.370	40.3	60.0	-19.7	31.6	50.0	-18.4
10.594	40.3	60.0	-19.7	31.9	50.0	-18.1
10.937	38.5	60.0	-21.5	31.2	50.0	-18.8

7 Measurement Uncertainty

The measurement uncertainty figures are be calculated in accordance with TR 100 028-1 [2] and correspond to an expansion factor (coverage factor) $k = 2$ (which provide confidence levels of 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Parameter	Expanded Uncertainty for Normal k factor equal to 2	
	Required	Laboratory Actual
Radio Frequency	$\pm 1 \times 10^{-5}$	$\pm 9.8 \times 10^{-8}$
total RF power, conducted	± 1.5 dB	± 1.2 dB
RF power density, conducted	± 3 dB	± 0.7 dB
spurious emissions, conducted	± 3 dB	± 2.1 dB
all emissions, radiated	± 6 dB	± 4.8 dB
temperature	$\pm 1^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$
humidity	± 5 %	$\pm 3.5\%$
DC and low frequency voltages	± 3 %	$\pm 0.4\%$

8 Revision History

Revision Level	Description of changes	Revision Date
0	Initial Release	28 April 2020
1	Added Modulation type and Firmware Version to Section 2.3 Added test software description to section 2.4 Added Section 7 Measurement Uncertainty	6 May 2020
2	Added Test mode software description to section 2.4	26 May 2020