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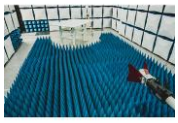

MEASUREMENT REPORT
FCC PART 15.225 / ISED RSS-210 NFC

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
5/15 - 8/18/2018
Test Site/Location:
PCTEST Lab. Morgan Hill, CA, USA
Test Report Serial No.:
1C1806040004-06-R1.BCG

FCC ID:	**BCG-A1978**
IC:	**579C-A1978**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A1978
EUT Type:	Watch
Frequency:	13.56MHz
FCC Classification:	Low Power Communications Device Transmitter (DXX)
FCC Rule Part(s):	Part 15 Subpart C (15.225)
ISED Specification:	RSS-210 Issue 9
Test Procedure(s):	ANSI C63.10-2013, KDB 648474 D03 v01r04

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 1C1806040004-06-R1.BCG) supersedes and replaces the previously issued test report (S/N: 1C1806040004-06-.BCG) on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Morgan Hill, CA 95037, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID: BCG-A1978**. The test data contained in this report pertains only to the emissions due to the NFC transmitter of the EUT.

Test Device Serial No.: C89WM04PK48C, C89W9009JPN1

2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n WLAN, Bluetooth (1x, EDR, HDR4, HDR8, LE), NFC

Note: The device supports different modes, types, and data rates of NFC signal.

Mode	Type	Data Rate
CE (Card Emulation)	A	848 kbps
	A	424 kbps
	A	212 kbps
	A	106 kbps
	B	848 kbps
	B	424 kbps
	B	212 kbps
	B	106 kbps
	F	424 kbps
	F	212 kbps
Reader	A	848 kbps
	A	424 kbps
	A	212 kbps
	A	106 kbps
	B	848 kbps
	B	424 kbps
	B	212 kbps
	B	106 kbps
	F	424 kbps
	F	212 kbps
	100% Ask 1 out of 4	26.48 kbps
	10 % Ask 1 out of 4	26.48 kbps
	100% Ask 1 out of 256	1.66 kbps
	10 % Ask 1 out of 256	1.66 kbps

Table 2-1. NFC Configuration

2.3 Test Support Equipment

1	Apple MacBook	Model:	A1398	S/N:	C2QKP008F6F3
	w/AC/DC Adapter	Model:	A1435	S/N:	
2	Apple USB Cable	Model:	Kanzi	S/N:	316F8A
	w/ Charging Dock	Model:	FAPS73	S/N:	17242000868
	w/ Dock	Model:	X241	S/N:	GW17E01ST28
3	USB Lightning Cable	Model:	N/A	S/N:	N/A
	w/ AC Adapter	Model:	A1265	S/N:	1X0450PGS8QZ
4	Wireless Charging Pad (WCP)	Model:	DVT-1d	S/N:	DLC824401XHJLW04U
5	Test Pathfinder Mogao Board	Model:	X920	S/N:	920-04087-03
	w/ EVT SiP Cradle	Model:	X920	S/N:	PF 2016
6	DC Power Supply	Model:	KPS3010D	S/N:	N/A

Table 2-2. Test Support Equipment Used

2.4 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 558074 D01 v04. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups.

The worst case configuration was investigated for various types of wristbands, metal and non-metal wristbands. The store display sample was investigated and determined as not the worst case. The EUT was also investigated with and without wireless charger. The worst case configuration found was used for all testing.

The emissions below 1GHz were tested with the highest transmitting modulation and the worst case configuration.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

For AC line conducted and radiated test below 1GHz, following configuration were investigated and worst case was reported.

- EUT powered by AC/DC adaptor via USB cable with wire charger
- EUT powered by host PC via USB cable with wire charger

2.5 Software and Firmware

The test was conducted with firmware version wOS 5.0 installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

3.0 DESCRIPTION OF TEST

3.1 Evaluation Procedure

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the EUT.

Deviation from measurement procedure…….....None

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. The shielded enclosure is manufactured by AP Americas. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-6. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is EPCOS 2X60A Power Line Filter (100dB Attenuation, 14kHz-18GHz) and the two EPCOs 2X48A filters (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.6. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 9.15.0.

3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33 depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

3.4 Environmental Conditions

The temperature is controlled within range of 15ºC to 35ºC. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antenna of the EUT are **permanently attached.**
- This unit was tested with its standard battery.

Conclusion:

The EUT complies with the requirement of §15.203.

5.0 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 indicate a 95% level of confidence. The measurement uncertainty shown below 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.

Contribution	Expanded Uncertainty (±dB)
Line Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
COM-POWER	LIN-120A	LISN	3/7/2018	Annual	3/7/2019	241296
Keysight Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	2/27/2018	Annual	2/27/2019	MY49430244
Maturo	NCD/264/205616	Mast/TT controller	N/A	N/A	N/A	NCD_264
Rohde & Schwarz	ESW44	EMI Test Receiver	11/16/2017	Annual	11/16/2018	101570
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	1/25/2018	Annual	1/25/2019	102333
Rohde & Schwarz	HL562E	Ultra Broadband Antenna (30MHz - 6GHz)	6/8/2018	Annual	6/8/2019	100810
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/13/2018	Annual	3/13/2019	100519
ESPEC	SU-241	Temperature Chamber	8/10/2018	Annual	8/10/2019	92009574

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

7.0 TEST DATA

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A1978

FCC Classification: Low Power Communications Device Transmitter (DXX)

Frequencies Examined: 13.56MHz

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	RSS-Gen [6.6]	20 dB Bandwidth	N/A	RADIATED	PASS	Section 7.2
15.225 (a)(b)(c)	RSS-210 [B.6]	In-Band Emissions	15,848µV/m @ 30m 13.553 – 13.567 MHz 334µV/m @ 30m 13.410 – 13.553 MHz 13.567 – 13.710 MHz 106µV/m @ 30m 13.110 – 13.410 MHz 13.710 – 14.010 MHz		PASS	Section 7.4
15.225 (d) 15.209	RSS-Gen [8.9]	Out-of-Band Emissions	Emissions outside of the specified band (13.110 – 14.010 MHz) must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])		PASS	Section 7.5
15.225 (e)	RSS-210 [B.6]	Frequency Stability Tolerance	± 0.01% of Operating Frequency	Temperature Chamber	PASS	Section 7.3
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen)	LINE CONDUCTED	PASS	Section 7.6

Table 7-1. Summary of Test Results

Note:

This unit was tested with its standard battery.

7.2 20dB Bandwidth Measurement

§2.1049; RSS-Gen (6.6)

Test Overview and Limit

The bandwidth at 20dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequency.

Test Procedure Used

ANSI C63.10-2013 – Section 6.9.2

Test Settings

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 level 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 "-20dB down amplitude" using [(highest in band spectral density) – 20dB].
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 "-20dB 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 level amplitude. The marker delta frequency reading at this point is the specified emission bandwidth.

Test Notes

None.

Figure 7-1. Test Instrument & Measurement Setup

Frequency	Configuration	20dB Bandwidth
13.56MHz	CE A 848kbps	47.37kHz
13.56MHz	CE B 848kbps	45.22kHz
13.56MHz	CE F 424kbps	48.44kHz
13.56MHz	Reader 100 Ask 1 out of 4	126.5kHz
13.56MHz	Reader 100 Ask 1 out of 256	130.7kHz

Table 7-2. 20dB Bandwidth Measurement

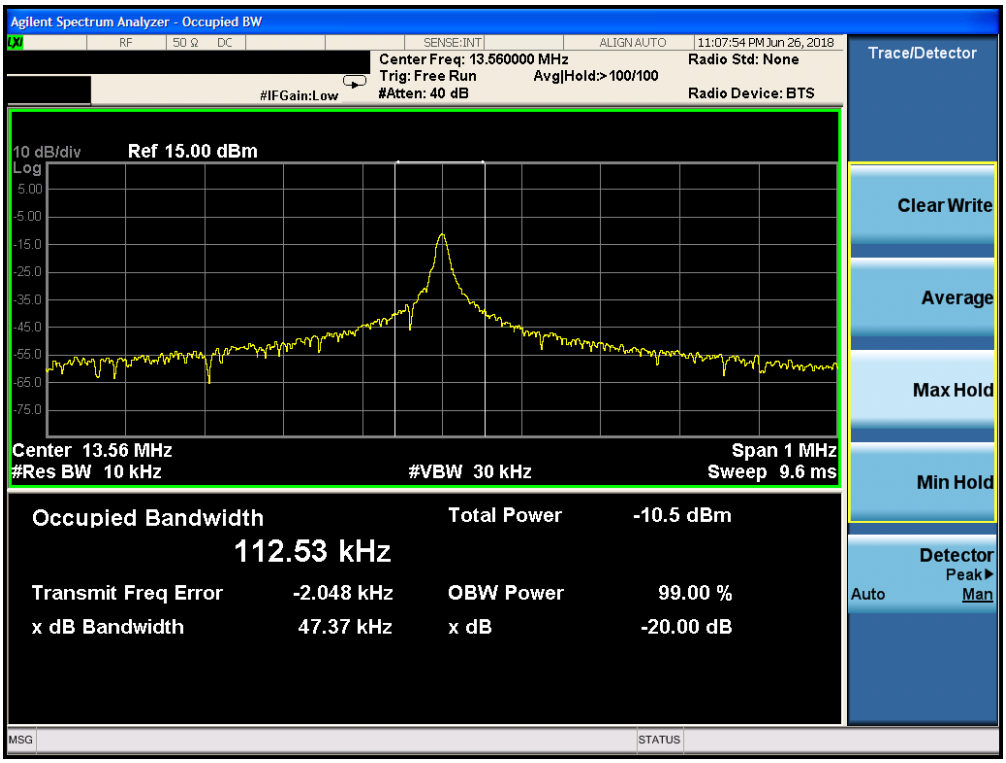


Figure 7-2. 20dB Bandwidth Plot (CE A 848kbps)

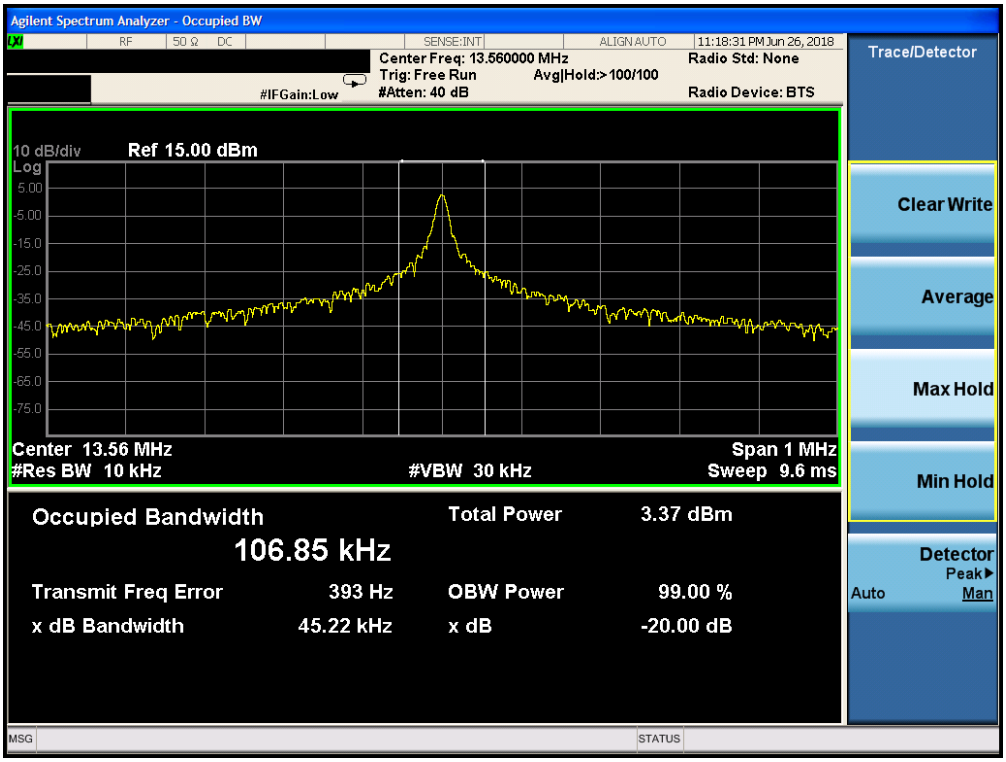


Figure 7-3. 20dB Bandwidth Plot (CE B 848kbps)

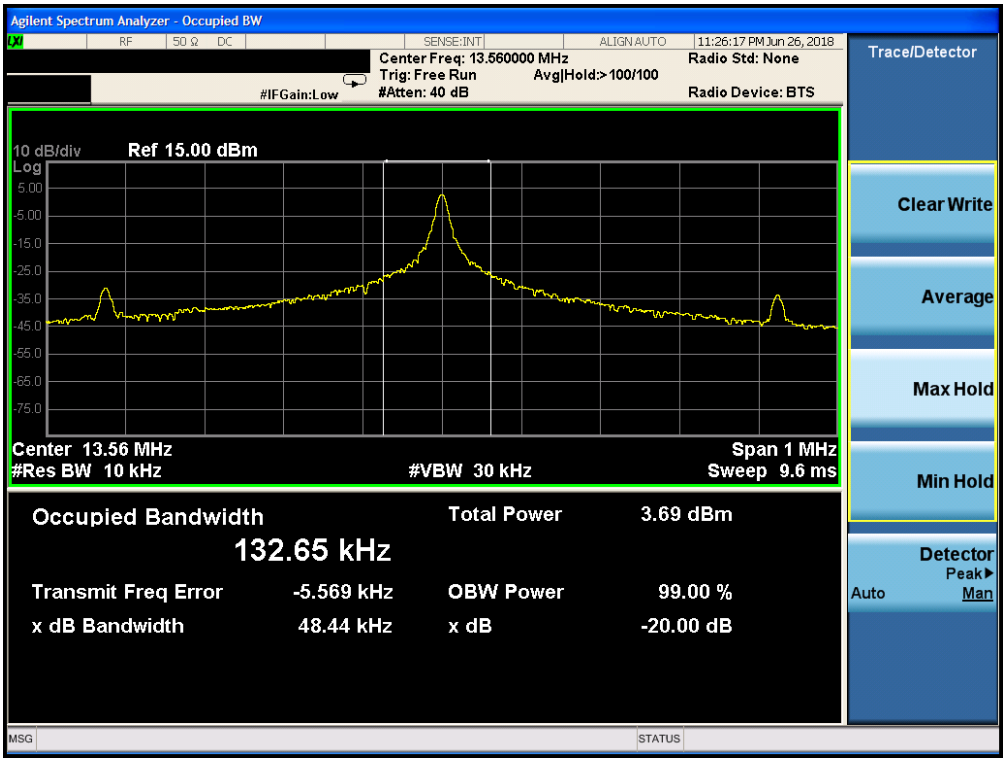


Figure 7-4. 20dB Bandwidth Plot (CE F 424kbps)

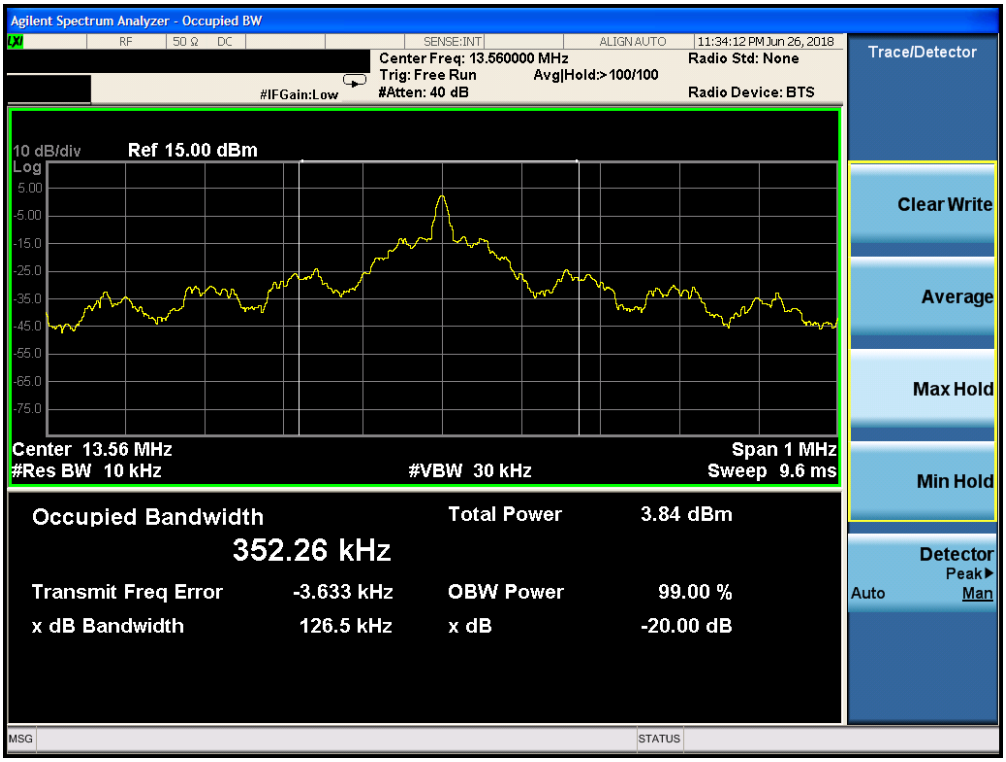


Figure 7-5. 20dB Bandwidth Plot (Reader 100 Ask 1 out of 4)

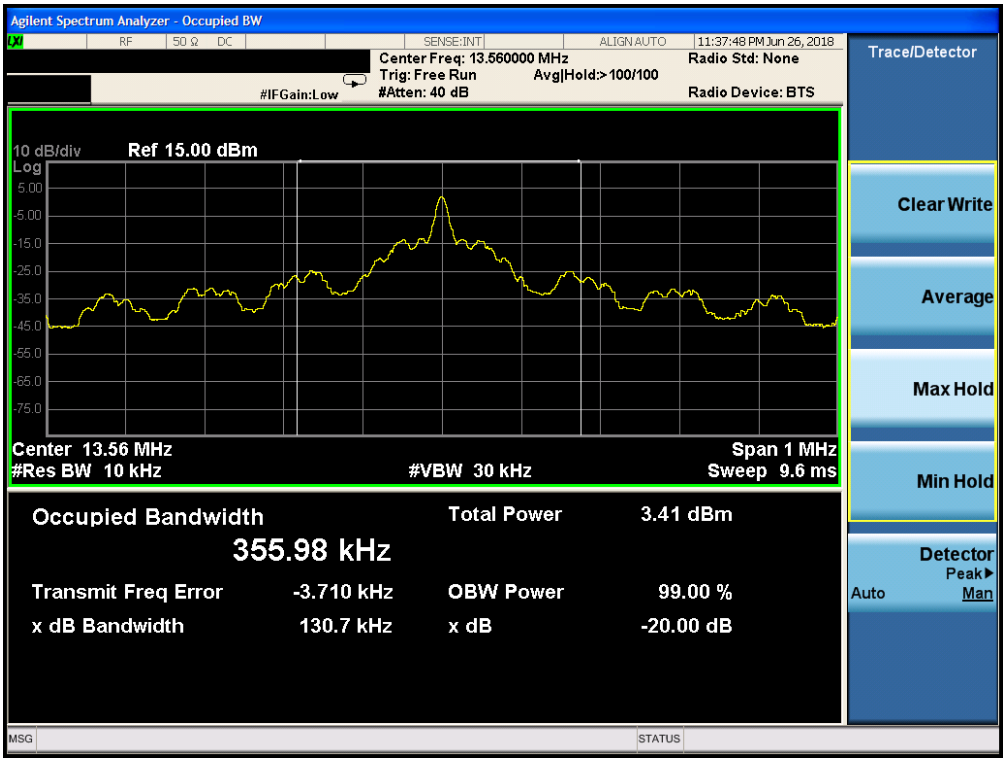


Figure 7-6. 20dB Bandwidth Plot (Reader 100 Ask 1 out of 256)

7.3 Frequency Stability Test Data

§15.225; RSS-210 (B.6)

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.10-2013. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -20°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

For Part 15.225, the frequency stability of the transmitter shall be maintained within ±0.01% of the center frequency.

Test Procedure Used

ANSI C63.10-2013 – Section 6.8

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -20°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

Test Notes

None.

Frequency Stability Test Data
§15.225; RSS-210 (B.6)

OPERATING FREQUENCY: 13,560,000 Hz

REFERENCE VOLTAGE: 3.80 VDC

DEVIATION LIMIT: ± 0.01 % = 1356Hz

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	+ 20	13,559,682	-318	-0.0023451
100 %		- 30	13,559,841	-159	-0.0011726
100 %		- 20	13,559,797	-203	-0.0014971
100 %		- 10	13,559,754	-246	-0.0018142
100 %		0	13,559,711	-289	-0.0021313
100 %		+ 10	13,559,696	-304	-0.0022419
100 %		+ 20	13,559,740	-260	-0.0019174
100 %		+ 30	13,559,667	-333	-0.0024558
100 %		+ 40	13,559,667	-333	-0.0024558
100 %		+ 50	13,559,682	-318	-0.0023451
BATT. ENDPOINT	3.40	+ 20	13,559,653	-347	-0.0025590

Table 7-3. Frequency Stability Test Data (CE A 848kbps)

Frequency Stability Test Data

§15.225; RSS-210 (B.6)

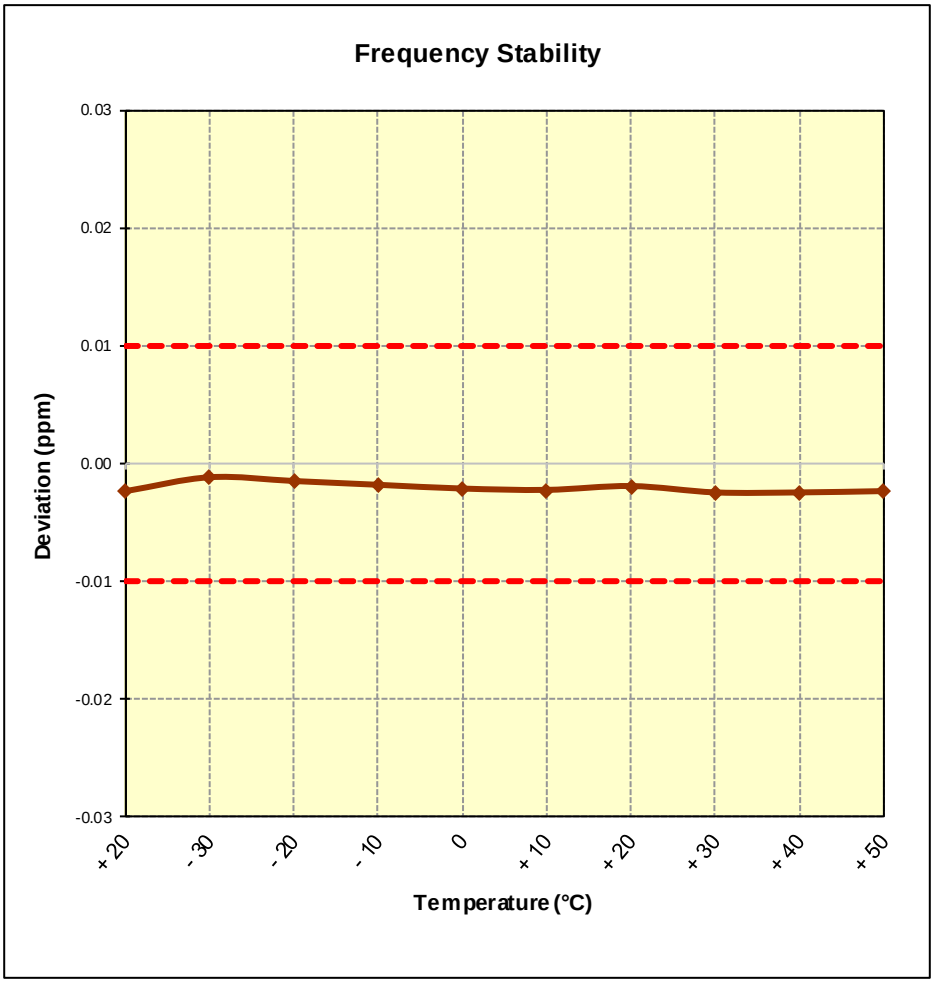


Figure 7-7. Frequency Stability Plot (CE A 848kbps)

Frequency Stability Test Data

§15.225; RSS-210 (B.6)

OPERATING FREQUENCY: 13,560,000 Hz

REFERENCE VOLTAGE: 3.80 VDC

DEVIATION LIMIT: ± 0.01 % = 1356Hz

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	+ 20	13,559,725	-275	-0.0020280
100 %		- 30	13,559,711	-289	-0.0021313
100 %		- 20	13,559,682	-318	-0.0023451
100 %		- 10	13,559,667	-333	-0.0024558
100 %		0	13,559,682	-318	-0.0023451
100 %		+ 10	13,559,740	-260	-0.0019174
100 %		+ 20	13,559,696	-304	-0.0022419
100 %		+ 30	13,559,740	-260	-0.0019174
100 %		+ 40	13,559,841	-159	-0.0011726
100 %		+ 50	13,559,971	-29	-0.0002139
BATT. ENDPOINT	3.40	+ 20	13,559,624	-376	-0.0027729

Table 7-4. Frequency Stability Test Data (Reader 100 Ask 1 out of 4)

Frequency Stability Test Data

§15.225; RSS-210 (B.6)

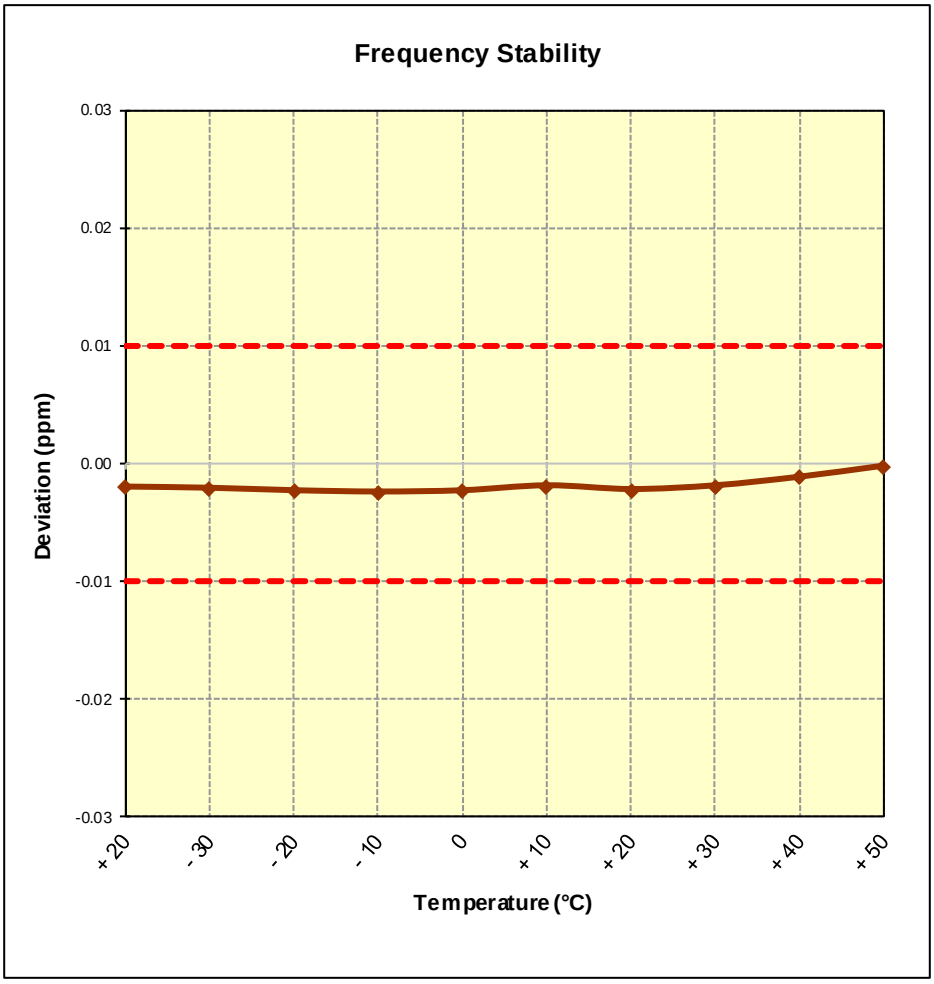


Figure 7-8. Frequency Stability Plot (Reader 100 Ask 1 out of 4)

7.4 In-Band Radiated Spurious Emission Measurements

§15.225(a)(b)(c); RSS-210 (B.6)

Test Overview and Limit

The EUT was tested from 13.110 – 14.010 MHz. All in-band radiated spurious emissions are measured with a spectrum analyzer connected to a loop antenna while the EUT is operating at appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All in-band emissions appearing in a restricted band as specified in Section 15.225 of the Title 47 CFR must not exceed the limits shown in Table 7-5.

Frequency [MHz]	Field Strength [μV/m]	Measured Distance [Meters]
13.553-13.567 MHz	15,848	30
13.410-13.553 MHz and 13.567-13.710 MHz	334	30
13.110-13.410 MHz and 13.710-14.010 MHz	106	30

Table 7-5. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Section 6.4.7

Test Settings

1. RBW = 9kHz
2. VBW ≥ 3 x RBW
3. Detector = peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

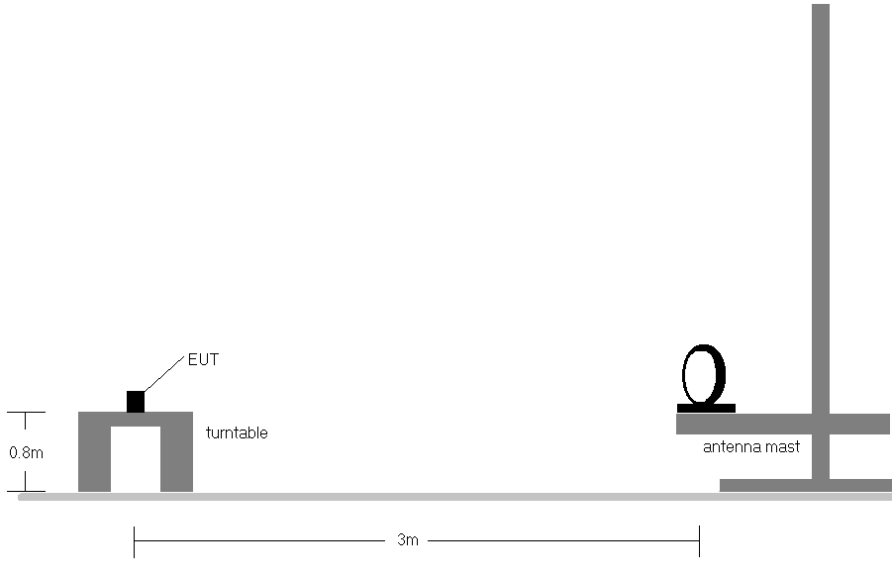


Figure 7-9. Radiated Test Setup

Test Notes:

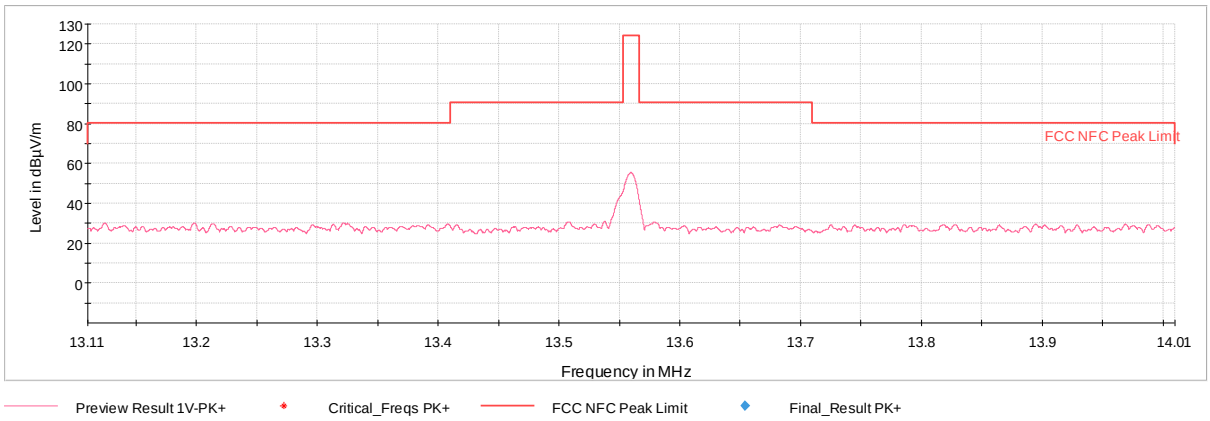
1. All emissions lying in restricted bands specified in §15.225 and RSS-210 are below the limit shown in Table 7-5.
2. All measurements were performed using a loop antenna. The antenna was positioned in three orthogonal positions (X front, Y side, Z top) and the position with the highest emission level was recorded.
3. All emissions were greater than 20 dB below the limit.
4. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
5. 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 = 20 $\log_{10}(30/3)^2$ = 40dB.
6. The spectrum was investigated from 9kHz up to 30MHz using the loop antenna. Only the emissions shown in the table below were found to be significant.
7. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Sample Calculation

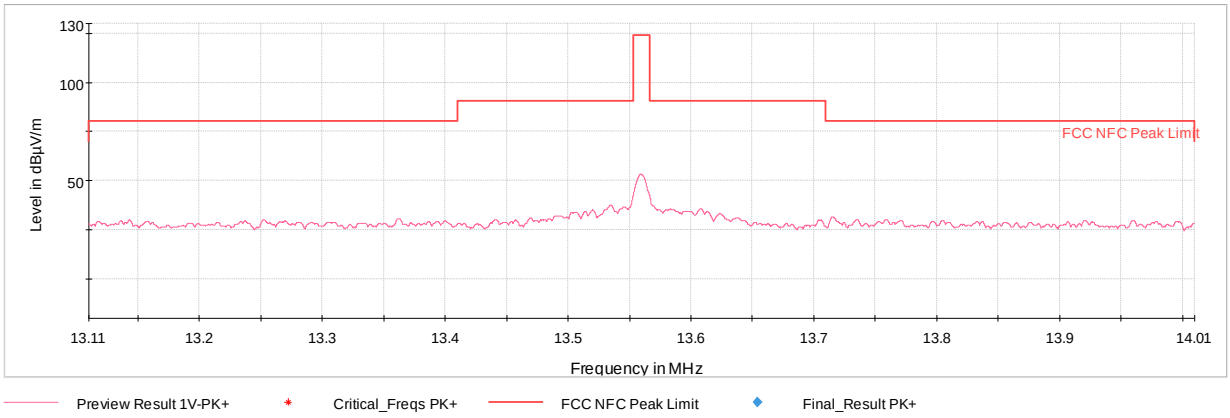
- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

In-Band Radiated Spurious Emission Measurements

§15.225(a)(b)(c); RSS-210 (B.6)



Plot 7-1. In Band Radiated Spurious Plot (CE A 848kbps, Pol. X)



Plot 7-2. In Band Radiated Spurious Plot (Reader 100 Ask 1 out of 4, Pol. X)

In-Band Radiated Spurious Emission Measurements

§15.225(a)(b)(c); RSS-210 (B.6)

Frequency: 13.56MHz

Measurement Distance: 3 Meters

Frequency [MHz]	Ant. Pol. [X/Y/Z]	Antenna Height [cm]	Turntable Azimuth [degree]	Level [dBm]	AFCL [dB/m]	3m Field Strength [dBµV/m]	30m Field Strength [dBµV/m]	Limit [µV/m]	Limit [dBµV/m]	Margin [dB]
13.322	X	-	-	-97.67	21.00	30.33	-9.67	106.00	40.51	-50.18
13.508	X	-	-	-97.31	21.00	30.69	-9.31	334.00	50.47	-59.78
13.560	X	100	199	-72.56	21.00	55.44	15.44	15848.00	84.00	-68.56
13.683	X	-	-	-98.87	21.00	29.13	-10.87	334.00	50.47	-61.34
13.895	X	-	-	-98.47	21.00	29.53	-10.47	106.00	40.51	-50.98

Table 7-6. In-Band Radiated Measurements (CE A 848kbps)

Frequency [MHz]	Ant. Pol. [X/Y/Z]	Antenna Height [cm]	Turntable Azimuth [degree]	Level [dBm]	AFCL [dB/m]	3m Field Strength [dBµV/m]	30m Field Strength [dBµV/m]	Limit [µV/m]	Limit [dBµV/m]	Margin [dB]
13.362	X	-	-	-97.27	21.00	30.73	-9.27	106.00	40.51	-49.78
13.507	X	-	-	-94.08	21.00	33.92	-6.08	334.00	50.47	-56.55
13.560	X	100	205	-74.62	21.00	53.38	13.38	15848.00	84.00	-70.62
13.608	X	-	-	-92.34	21.00	35.66	-4.34	334.00	50.47	-54.81
13.797	X	-	-	-98.63	21.00	29.37	-10.63	106.00	40.51	-51.14

Table 7-7. In-Band Radiated Measurements (Reader 100 Ask 1 out of 4)

7.5 Radiated Spurious Emission Measurements, Out-of-Band

§15.209 §15.225(d); RSS-Gen (8.9)

Test Overview and Limit

The EUT was tested from 9kHz up to the 1GHz excluding the band 13.110 – 14.010 MHz. All measurements up to 960MHz were recorded with a spectrum analyzer employing a quasi-peak detector.

All out-of-band emissions appearing in a restricted band as specified in Section 15.225 of the Title 47 CFR must not exceed the limits shown in Table 7-8 per Section 15.209.

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-8. Radiated Limits – Out of band

Test Procedures Used

ANSI C63.10-2013 – Section 6.5.4

Test Settings

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 9kHz for emissions below 30MHz and 100kHz for emissions between 30MHz and 1GHz
3. VBW ≥ 3 x RBW
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

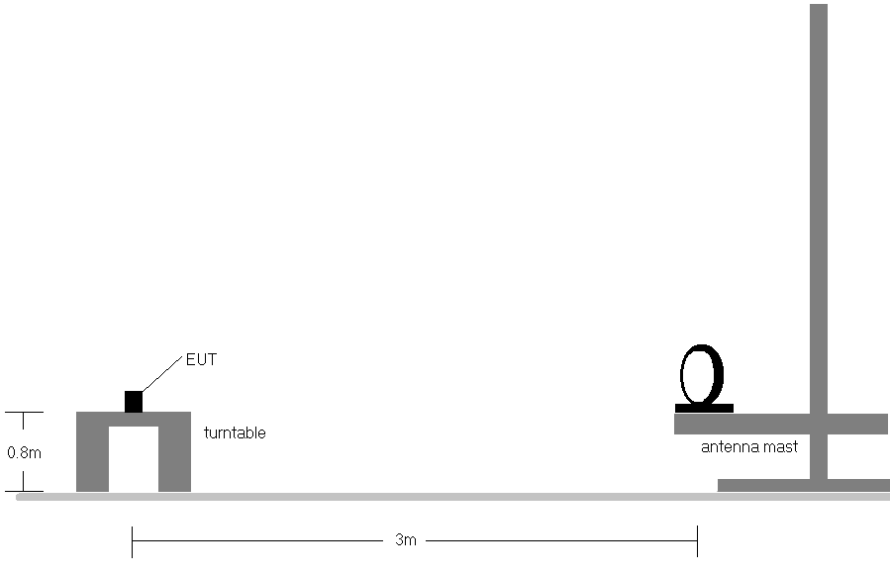


Figure 7-10. Radiated Test Setup < 30MHz

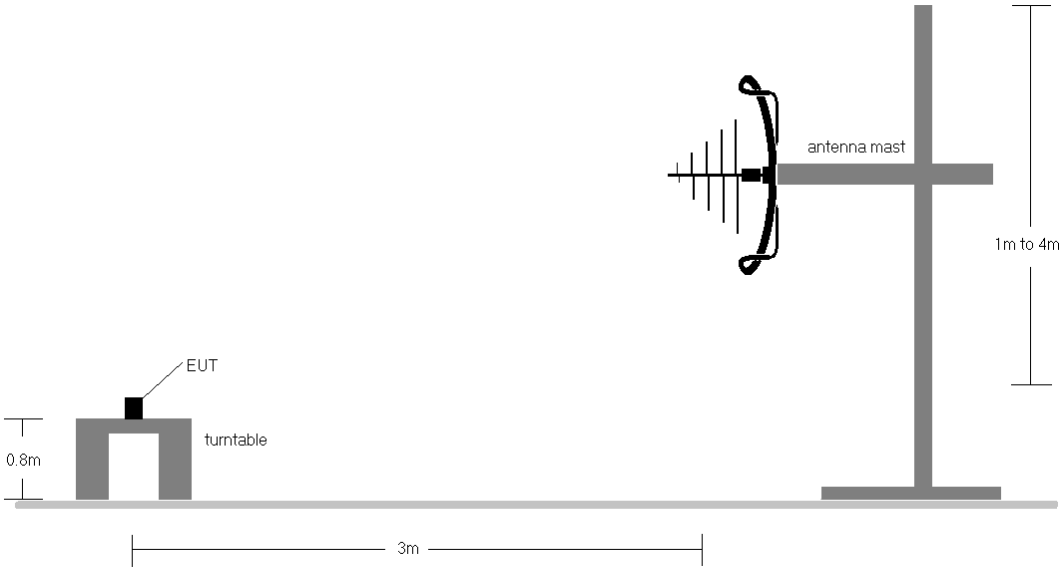


Figure 7-11. Radiated Test Setup > 30MHz

Test Notes:

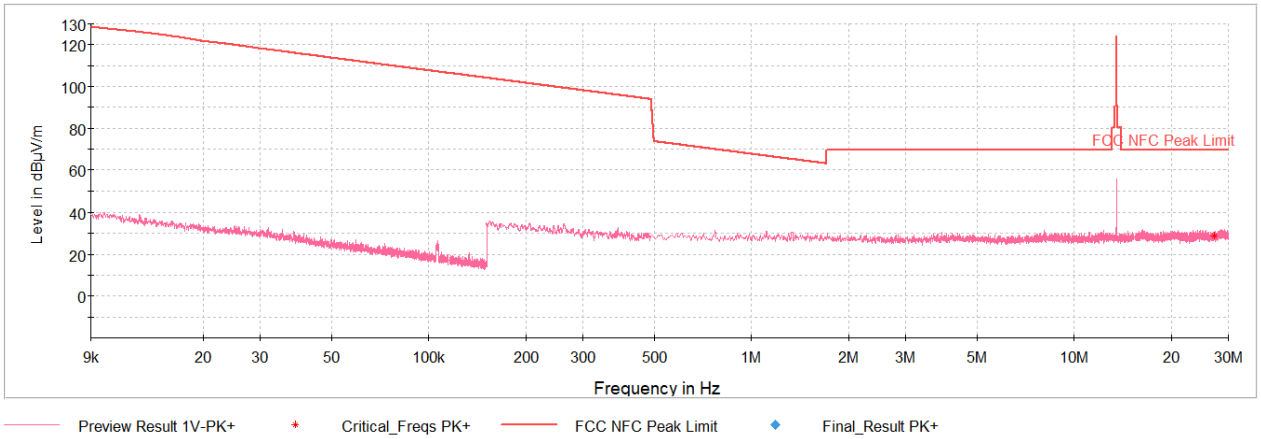
1. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector for emissions below 960MHz.
2. A loop antenna was used to investigate emissions below 30MHz.
3. Both Vertical and Horizontal polarities of the receive antenna were evaluated with the worst case emissions being reported. Below 30MHz the loop antenna was positioned in 3 orthogonal planes (X front, Y side, Z top) to determine the orientation resulting in the worst case emissions.
4. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
5. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.
6. No spurious emissions levels were found to be greater than the level of the fundamental.
7. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Sample Calculation

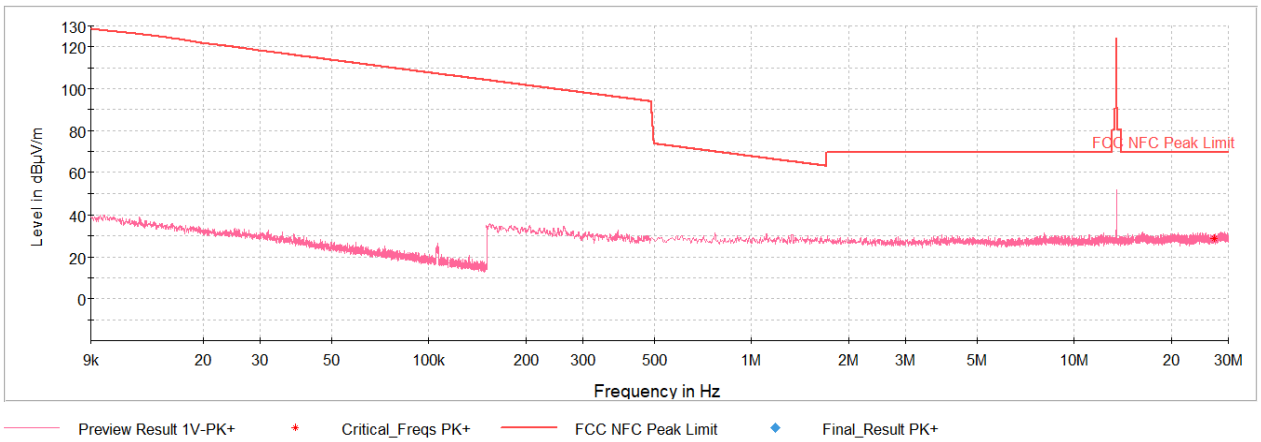
- Field Strength Level [dBµV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [dB]
- Margin [dB] = Field Strength Level [dBµV/m] – Limit [dBµV/m]

Radiated Spurious Emission Measurements, Out-of-Band

§15.209 §15.225(d); RSS-Gen (8.9)



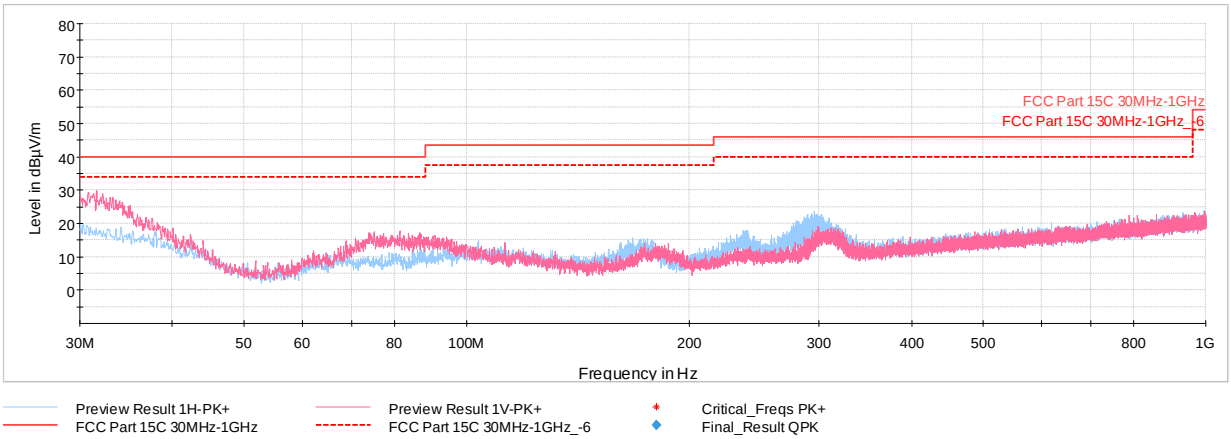
Plot 7-3. Radiated Spurious Plot 9kHz – 30MHz (CE A 848kbps, Pol. X)



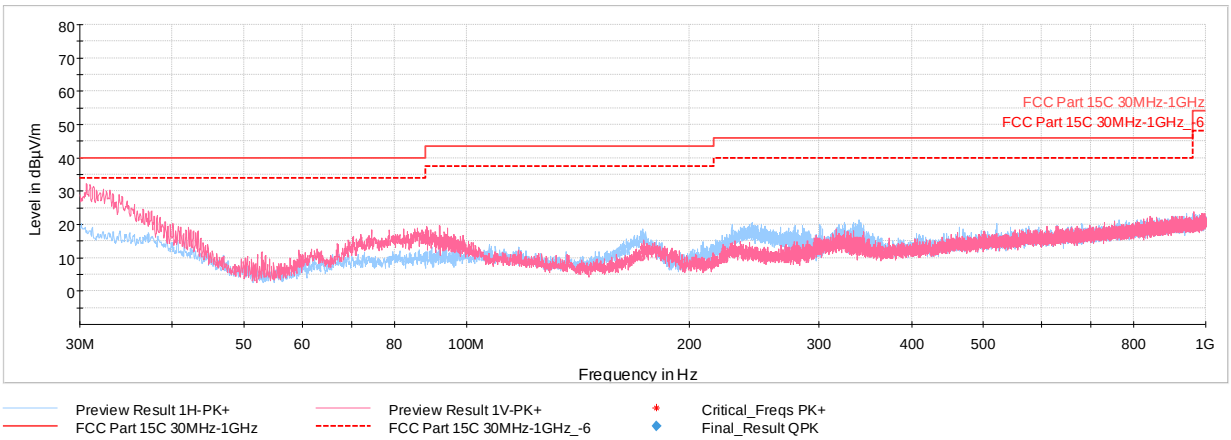
Plot 7-4. Radiated Spurious Plot 9kHz – 30MHz (Reader 100 Ask 1 out of 4, Pol. X)

Radiated Spurious Emission Measurements, Out-of-Band

§15.209 §15.225(d); RSS-Gen (8.9)



Plot 7-5. Radiated Spurious Plot 30MHz – 1GHz (CE A 848kbps, Pol. H & V, with WCP + AC/DC Adapter attached)



Plot 7-6. Radiated Spurious Plot 30MHz – 1GHz (Reader 100 Ask 1 out of 4, Pol. H & V, with WCP + AC/DC Adapter attached)

Radiated Spurious Emission Measurements, Out-of-Band

§15.209 §15.225(d); RSS-Gen (8.9)

Tx Frequency 13.56MHz

Measurement Distance: 3 Meters

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level [dBm]	AFCL [dB/m]	3m Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
27.12	X	-	-	-101.07	23.00	28.93	69.54	-40.61
40.68	V	-	-	-77.44	-16.00	13.56	40.00	-26.44
54.24	V	-	-	-78.90	-24.00	4.10	40.00	-35.90
67.80	V	-	-	-75.19	-21.00	10.81	40.00	-29.19
81.36	V	-	-	-73.15	-19.00	14.85	40.00	-25.15
94.92	V	-	-	-74.92	-19.00	13.08	43.52	-30.44
108.48	H	-	-	-79.29	-18.00	9.71	43.52	-33.81

Table 7-9. Radiated Measurements (CE A 848kbps, with WCP + AC/DC Adapter attached)

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level [dBm]	AFCL [dB/m]	3m Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
27.12	X	-	-	-101.25	23.00	28.75	69.54	-40.79
40.68	V	-	-	-74.46	-16.00	16.54	40.00	-23.46
54.24	V	-	-	-78.23	-24.00	4.77	40.00	-35.23
67.80	V	-	-	-75.77	-21.00	10.23	40.00	-29.77
81.36	V	-	-	-72.94	-19.00	15.06	40.00	-24.94
94.92	V	-	-	-72.26	-19.00	15.74	43.52	-27.78
108.48	H	-	-	-76.87	-18.00	12.13	43.52	-31.39

Table 7-10. Radiated Measurements (Reader 100 Ask 1 out of 4, with WCP + AC/DC Adapter attached)

7.6 Line Conducted Measurement Data

§15.207; RSS-Gen (8.8)

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

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

Table 7-11. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

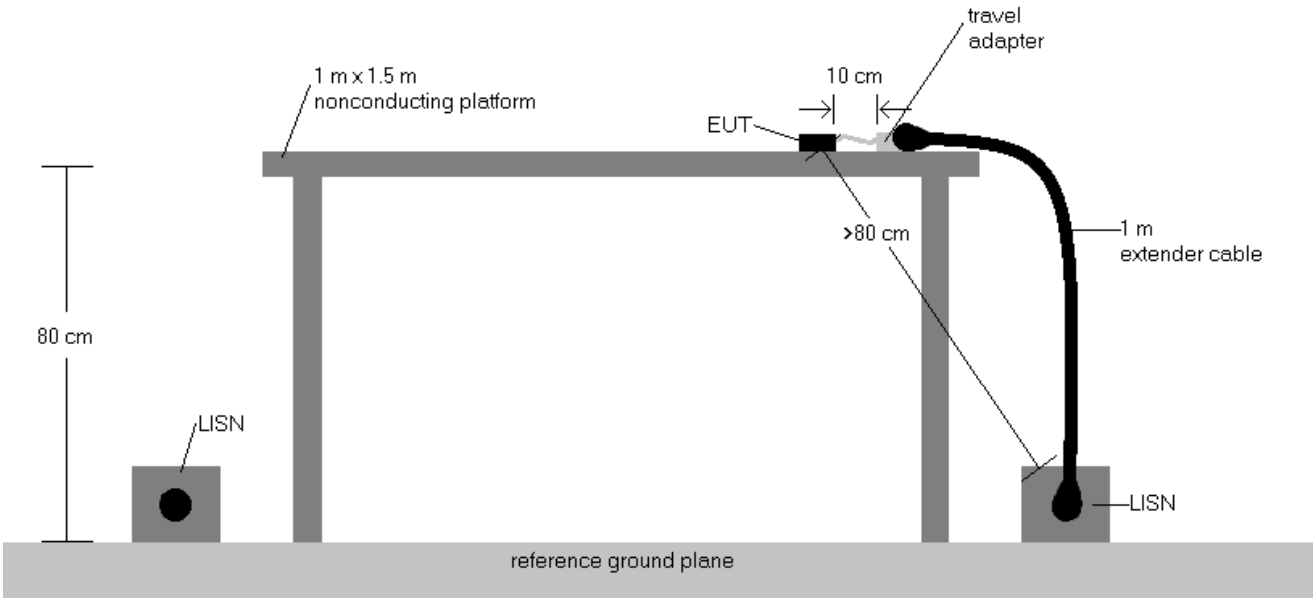
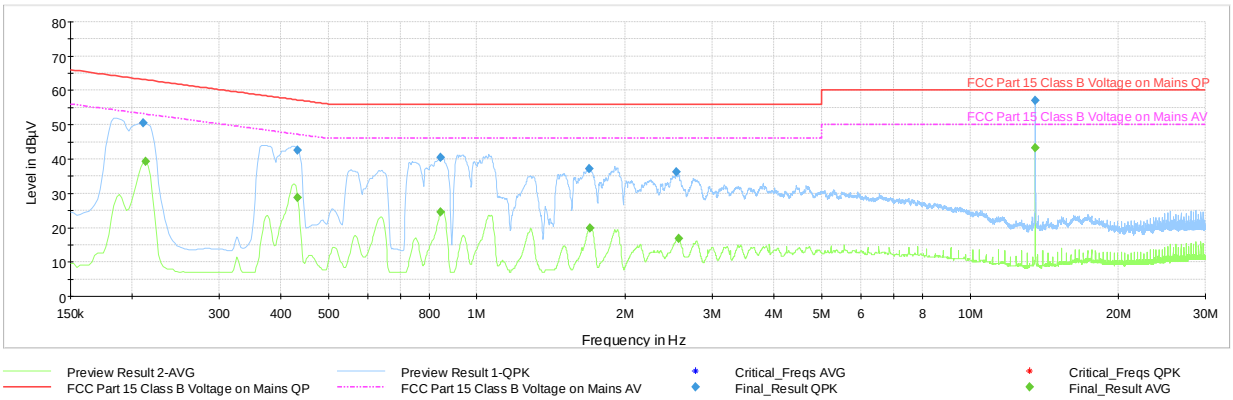


Figure 7-12. Test Instrument & Measurement Setup

Test Notes

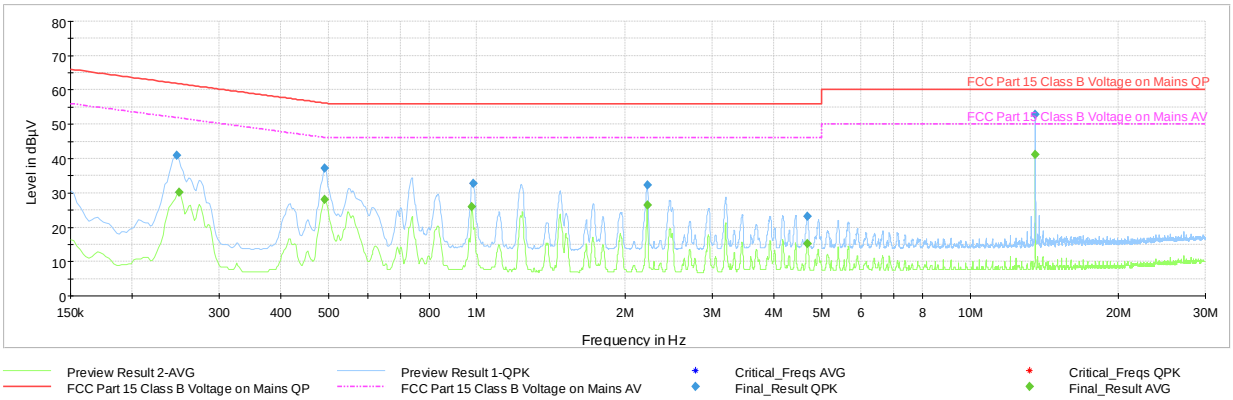
1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBμV) = QP/AV Analyzer/Receiver Level (dBμV) + Corr. (dB)
5. Margin (dB) = QP/AV Limit (dBμV) - QP/AV Level (dBμV)
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.
8. EUT was tested with the antenna terminated.



Plot 7-7. Line-Conducted Test Plot (L1, with WCP + AC/DC Adapter attached)

Frequency MHz	Process State	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Bandwidth kHz	Line	PE
0.210750	FINAL	50.55	—	63.18	12.62	9.000	L1	GND
0.213000	FINAL	—	39.32	53.09	13.77	9.000	L1	GND
0.433500	FINAL	—	28.66	47.19	18.53	9.000	L1	GND
0.433500	FINAL	42.48	—	57.19	14.70	9.000	L1	GND
0.845250	FINAL	—	24.67	46.00	21.33	9.000	L1	GND
0.845250	FINAL	40.41	—	56.00	15.59	9.000	L1	GND
1.691250	FINAL	37.28	—	56.00	18.72	9.000	L1	GND
1.693500	FINAL	—	19.95	46.00	26.05	9.000	L1	GND
2.537250	FINAL	36.21	—	56.00	19.79	9.000	L1	GND
2.566500	FINAL	—	16.93	46.00	29.07	9.000	L1	GND
13.560000	FINAL	—	43.27	50.00	6.73	9.000	L1	GND
13.560000	FINAL	56.97	—	60.00	3.03	9.000	L1	GND

Table 7-12. Line-Conducted Test Data (L1, with WCP + AC/DC Adapter attached)



Plot 7-8. Line-Conducted Test Plot (N, with WCP + AC/DC Adapter attached)

Frequency MHz	Process State	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Bandwidth kHz	Line	PE
0.246750	FINAL	40.94	—	61.87	20.93	9.000	N	GND
0.249000	FINAL	—	30.25	51.79	21.54	9.000	N	GND
0.492000	FINAL	—	28.04	46.13	18.09	9.000	N	GND
0.492000	FINAL	37.10	—	56.13	19.03	9.000	N	GND
0.978000	FINAL	—	26.02	46.00	19.98	9.000	N	GND
0.982500	FINAL	32.84	—	56.00	23.16	9.000	N	GND
2.215500	FINAL	—	26.42	46.00	19.58	9.000	N	GND
2.220000	FINAL	32.29	—	56.00	23.71	9.000	N	GND
4.672500	FINAL	23.26	—	56.00	32.74	9.000	N	GND
4.672500	FINAL	—	15.16	46.00	30.84	9.000	N	GND
13.560000	FINAL	—	41.26	50.00	8.74	9.000	N	GND
13.560000	FINAL	52.76	—	60.00	7.24	9.000	N	GND

Table 7-13. Line-Conducted Test Data (N, with WCP + AC/DC Adapter attached)

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Watch FCC ID: BCG-A1978** has been tested to show compliance with Part 15 Subpart C (15.225) of the FCC Rules and RSS-210 of the Innovation, Science and Economic Development Canada Rules.