PCTEST ENGINEERING LABORATORY, INC.
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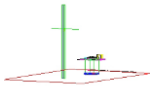

MEASUREMENT REPORT
FCC Part 15.225 NFC

Applicant Name:
Apple Inc.
1 Infinite Loop
Cupertino, CA 95014
United States

Date of Testing:
6/9-8/4/2017
Test Site/Location:
PCTEST Lab., Morgan Hill, CA, USA
Test Report Serial No.:
1C1706160002-92-07-R4.BCG

FCC ID:	**BCG-A1892**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model:	A1892, A1973
EUT Type:	Watch
Frequency:	13.56MHz
FCC Classification:	Low Power Communications Device Transmitter (DXX)
FCC Rule Part(s):	FCC Part 15 Subpart C (15.225)
Test Procedure(s):	ANSI C63.10-2013, KDB 648474 D03 v01r04, KDB 414788 D01 Radiated Test Site v01

The device bearing the FCC Identifier specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in ANSI C63.10-2013 (See Test Report). These measurements were performed with no deviation from the standards. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 1C1706160002-92-07-R4.BCG) supersedes and replaces the previously issued test report (S/N: 1C1706160002-92-07-R3.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 authorize and 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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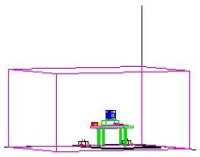
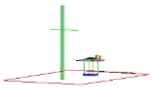


MEASUREMENT REPORT
FCC Part 15.225



§ 2.1033 General Information

APPLICANT:	Apple Inc.
APPLICANT ADDRESS:	1 Infinite Loop Cupertino, CA 95014 United States
TEST SITE:	PCTEST ENGINEERING LABORATORY, INC.
TEST SITE ADDRESS:	18855 Adams Court, Morgan Hill, CA 95037 USA
FCC RULE PART(S):	Part 15 Subpart C (15.225)
BASE MODEL:	A1892, A1973
FCC ID:	BCG-A1892
FCC CLASSIFICATION:	Low Power Communications Device Transmitter (DXX)
Test Device Serial No.:	FH7TR00GJ79V ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	6/9-8/4/2017
TEST REPORT S/N:	1C1706160002-92-07-R4.BCG

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.

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 Industry Canada Certification and Engineering Bureau.

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.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID: BCG-A1892**. The test data contained in this report pertains only to the emissions due to the NFC transmitter of the EUT. According to the manufacturer, models A1892, A1973 and A1973 are electrically identical. Model A1892 was used for final testing

2.2 Device Capabilities

This device contains the following capabilities:

Single-band LTE, 802.11b/g/n WLAN, Bluetooth (1x, EDR, 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	106 kbps
	B	848 kbps
	B	106 kbps
	F	424 kbps
	F	212 kbps
Reader	A	848 kbps
	A	106 kbps
	B	848 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. Different NFC Configurations

2.3 Test Support Equipment

1	Apple MacBook	Model:	A1502	S/N:	C02NQ01YG465
	w/ AC/DC Adapter	Model:	A1435	S/N:	C04325505K1F288BG
2	Apple USB Cable	Model:	Kanzi	S/N:	20153D
	w/ Charging Dock	Model:	FAPS61	S/N:	6304000736
	w/ Dock	Model:	X241	S/N:	SJH3002AP2AS
3	USB Cable	Model:	N/A	S/N:	N/A
			Shielded USB Cable		
4	w/ AC Adapter	Model:	B353	S/N:	N/A
5	Test Pathfinder Board	Model:	X988	S/N:	FGH7648700BDHMV323
6	Wireless Charging Pad (WCP)	Model:	A1598	FCC ID:	BCGA1598

Table 2-2. Test Support Equipment Used

2.4 Test Configuration

The EUT was set to continuously transmit at 13.56MHz. This was performed using manufacturer software loaded on the device. This device was tested in accordance with the guidance of ANSI C63.10-2013. See Sections 3.2 and 3.3 of this test report for a description of the AC line conducted emissions and radiated emissions test setups, respectively.

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emissions measurements were performed with the EUT on a certified wireless charging pad (WCP) while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

The worst case configuration was investigated for all combinations of the three materials, aluminum, ceramic, and stainless steel, and various types of wristbands, metal and non-metal wrist bands. The store display sample was investigated with the three types of EUTs. The EUT was also investigated with and without wireless charger.

The worst case configuration found was used for all testing. The worst case material was aluminum. The worst case accessory was metal wristband but no significant difference was found between various types of wrist bands.

The emissions below 1GHz and above 18GHz were tested with the highest transmitting power channel 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.

CE, or Card Emulation, was the worst case emission.

For AC line conducted and radiated test below 1GHz, following configuration were investigated and EUT powered by AC/DC was the worst case.

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

2.5 Software and Firmware

The test was conducted with firmware version 15R328 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 10.20.01.

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 in Clause 5 of ANSI C63.4-2014. A raised turntable is used for radiated measurement. It is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. 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 high Styrodur Plastic Test Table is placed on top of the turntable. For measurements above 1GHz, another Styrodur Plastic Test Table of 70cm height is placed on top of the test table to bring the total table height to 1.5m.

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(b)(1) 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 C63.5-2006.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	ACLC Conducted	ACLC Emissions Cable Set	3/17/2017	Biennial	10/1/2017	CAACLC1
-	EMI HL562E-ESW1	Radiated Cable Set	2/28/2017	Biennial	2/28/2018	N/A
COM-POWER	LIN-120A	LISN	2/22/2017	Annual	2/22/2018	241296
ESPEC	SU-241	Temperature Chamber	3/10/2017	Annual	3/10/2018	92009574
Keysight Technologies	N9030A	3Hz-44Ghz PXA Signal Analyzer	3/13/2017	Annual	3/13/2018	MY49430244
Pasternack	NC100	Torque Wrench	8/21/2015	Biennial	8/21/2017	81968
Rohde & Schwarz	ERTS.2	Loop Antenna Cable Set	3/17/2017	Biennial	3/17/2018	AM Loop1
Rohde & Schwarz	ESW26	ESW26 EMI Test Receiver	1/20/2017	Annual	1/20/2018	101299
Rohde & Schwarz	FSV40	Signal Analyzer	12/23/2016	Annual	12/23/2017	101619
Rohde & Schwarz	HFH2-Z2	Loop Antenna	1/13/2017	Annual	1/13/2018	100519
Rohde & Schwarz	HL562E	Bi-Log Antenna	1/19/2017	Annual	1/19/2018	100610
Rohde & Schwarz	OSP130	Open Switch and Control Unit	1/18/2017	Annual	1/18/2018	100970
Rohde & Schwarz	TS-PR8	Pre-amplifer (30MHz - 8GHz)	2/3/2017	Annual	2/3/2018	102325

Table 6-1. Annual Test Equipment Calibration Schedule

7.0 TEST DATA

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A1892

FCC Classification: Low Power Communications Device Transmitter (DXX)

Frequencies Examined: 13.56MHz

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	20 dB Bandwidth	N/A	RADIATED	PASS	Section 7.2
15.225 (a)(b)(c)	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	Out-of-Band Emissions	Emissions outside of the specified band (13.110 – 14.010 MHz) must meet the radiated limits detailed in 15.209		PASS	Section 7.5
15.225 (e)	Frequency Stability Tolerance	± 0.01% of Operating Frequency	Temperature Chamber	PASS	Section 7.3
15.207	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits	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

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	20dB Bandwidth
13.56MHz	26kHz

Table 7-2. 20dB Bandwidth Measurement (CE A 848kbps)

Frequency	20dB Bandwidth
13.56MHz	26kHz

Table 7-3. 20dB Bandwidth Measurement(CE B 848kbps)

Frequency	20dB Bandwidth
13.56MHz	26kHz

Table 7-4. 20dB Bandwidth Measurement (CE F 424kbps)

Frequency	20dB Bandwidth
13.56MHz	130kHz

Table 7-5. 20dB Bandwidth Measurement (Reader 100% Ask 1 out of 4)

Frequency	20dB Bandwidth
13.56MHz	37kHz

Table 7-6. 20dB Bandwidth Measurement (Reader 100% Ask 1 out of 256)

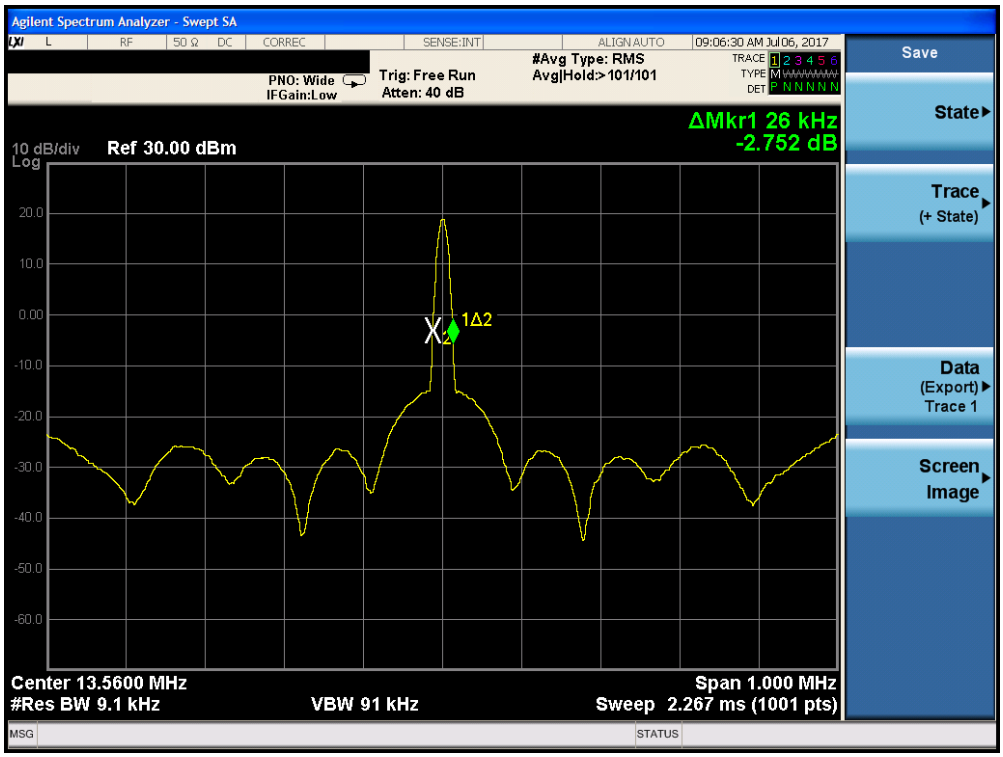


Figure 7-2. 20dB Bandwidth Plot (CE A 848kbps)

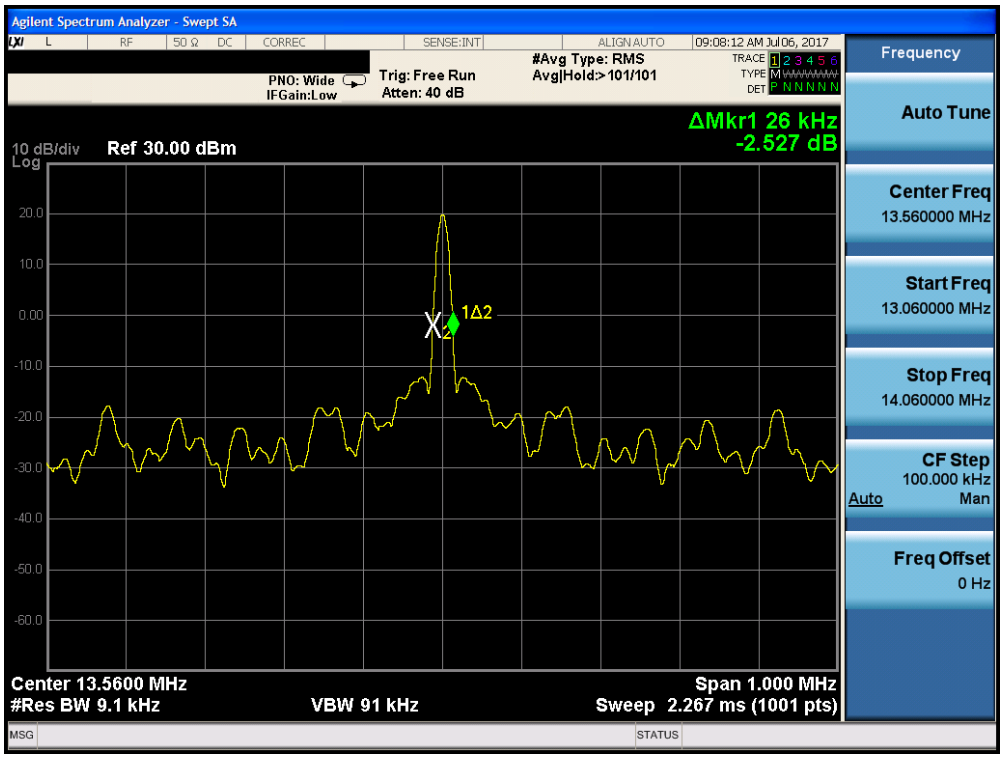


Figure 7-3. 20dB Bandwidth Plot (CE B 848kbps)

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

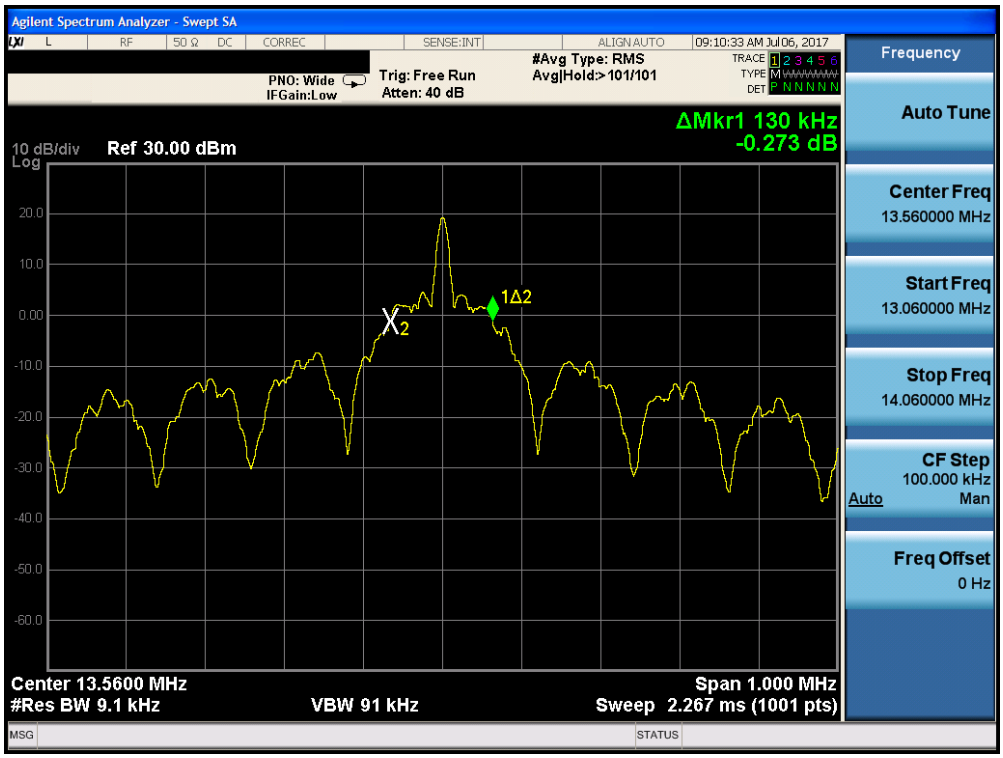


Figure 7-5. 20dB Bandwidth Plot (Reader 100% Ask 1 out of 4)

V 6.6
06/06/2017

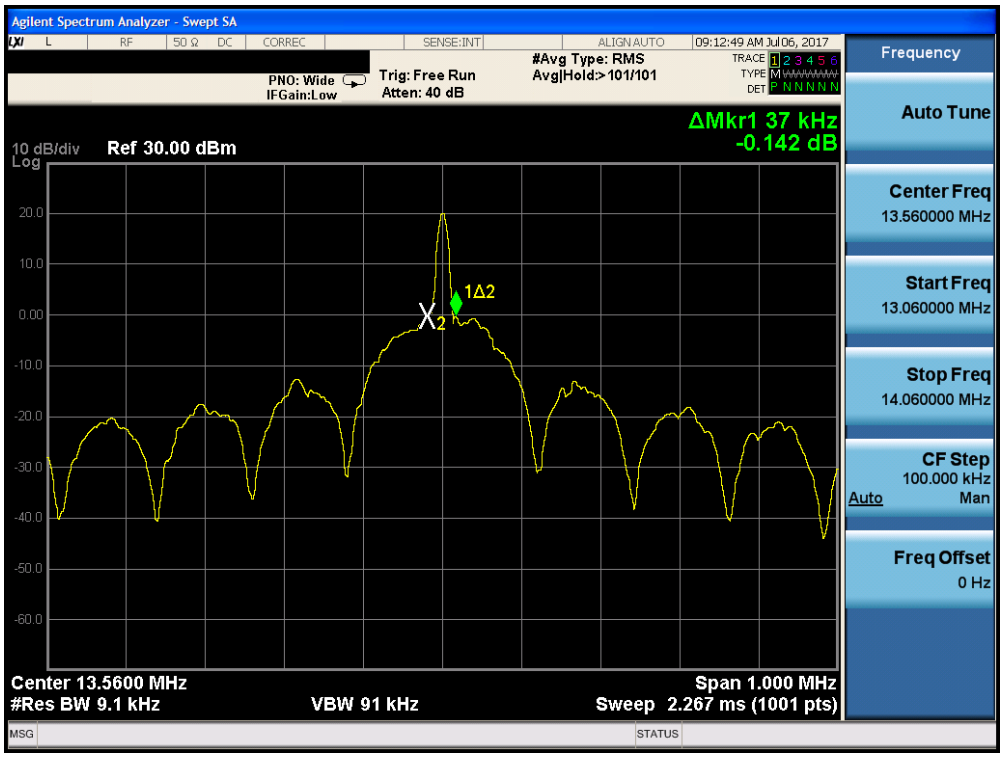


Figure 7-6. 20dB Bandwidth Plot (Reader 100% Ask 1 out of 256)

7.3 Frequency Stability Test Data

§15.225

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

OPERATING FREQUENCY: 13,560,000 Hz

REFERENCE VOLTAGE: 3.82 VDC

DEVIATION LIMIT: ± 0.01 % = 1356Hz

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.82	+ 20 (Ref)	13,559,885	-115	-0.0008481
100 %		- 30	13,559,978	-22	-0.0001622
100 %		- 20	13,560,078	78	0.0005752
100 %		- 10	13,559,901	-99	-0.0007301
100 %		0	13,559,753	-247	-0.0018215
100 %		+ 10	13,560,011	11	0.0000811
100 %		+ 20	13,560,281	281	0.0020723
100 %		+ 30	13,560,411	411	0.0030310
100 %		+ 40	13,559,967	-33	-0.0002434
100 %		+ 50	13,560,006	6	0.0000442
BATT. ENDPOINT	3.42	+ 20	13,560,128	128	0.0009440

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

Frequency Stability Test Data

§15.225

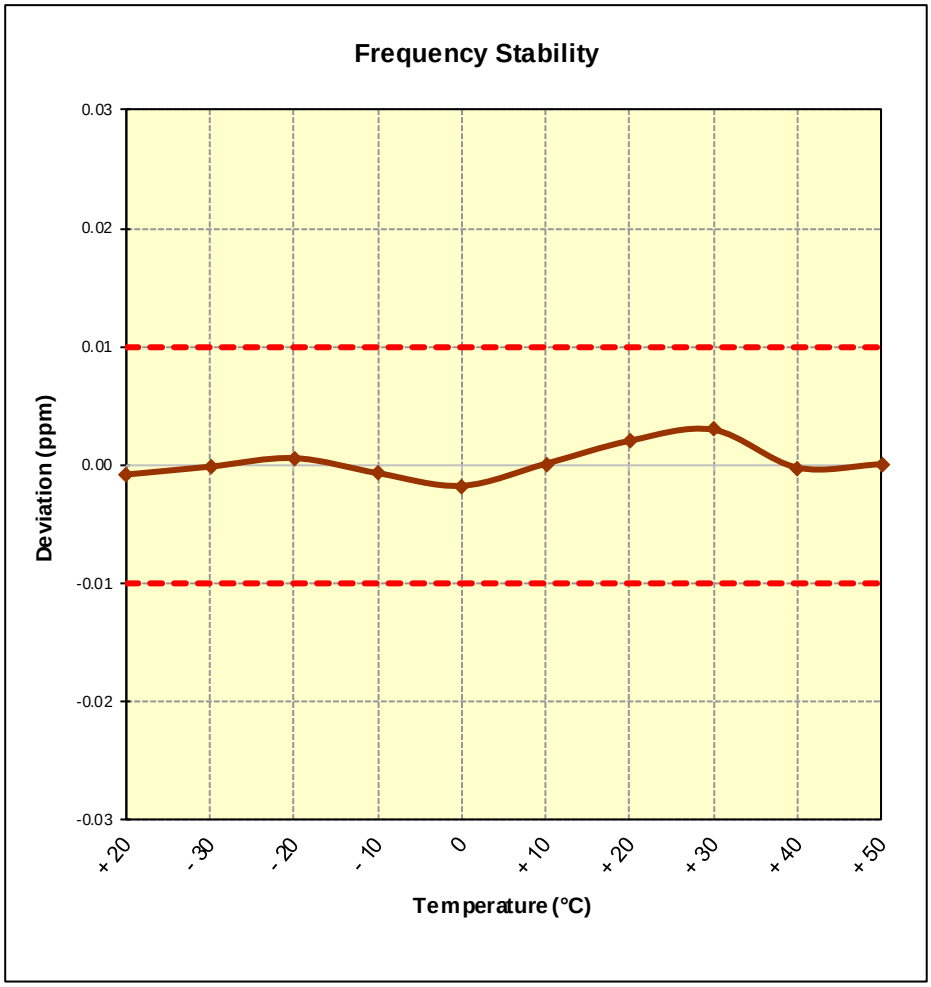


Figure 7-7. Frequency Stability Plot (CE A 848kbps)

Frequency Stability Test Data

§15.225

OPERATING FREQUENCY: 13,560,000 Hz

REFERENCE VOLTAGE: 3.82 VDC

DEVIATION LIMIT: ± 0.01 % = 1356Hz

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.82	+ 20 (Ref)	13,560,149	149	0.0010988
100 %		- 30	13,560,020	20	0.0001475
100 %		- 20	13,560,320	320	0.0023599
100 %		- 10	13,560,096	96	0.0007080
100 %		0	13,560,090	90	0.0006637
100 %		+ 10	13,560,060	60	0.0004425
100 %		+ 20	13,560,033	33	0.0002434
100 %		+ 30	13,559,559	-441	-0.0032522
100 %		+ 40	13,559,676	-324	-0.0023894
100 %		+ 50	13,560,068	68	0.0005015
BATT. ENDPOINT	3.42	+ 20	13,560,439	439	0.0032375

Table 7-8. Frequency Stability Test Data (CE B 848kbps)

Frequency Stability Test Data

§15.225

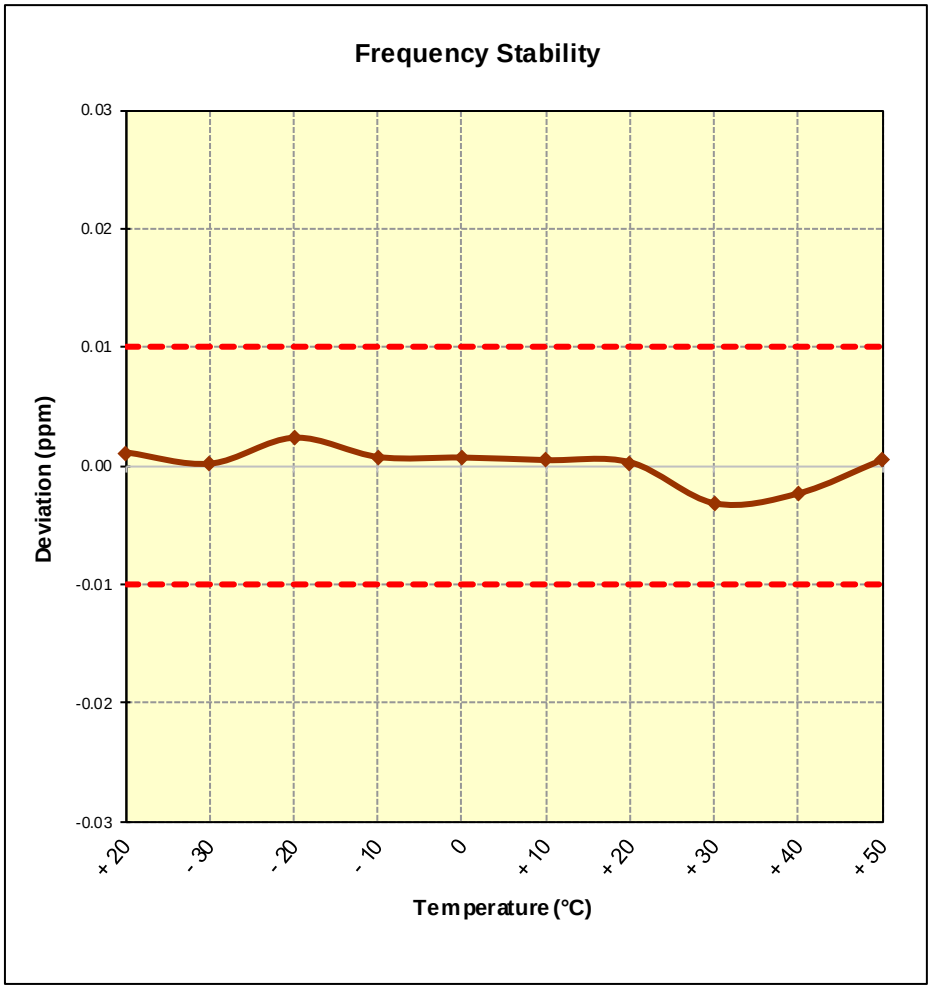


Figure 7-8. Frequency Stability Plot (CE B 848kbps)

Frequency Stability Test Data

§15.225

OPERATING FREQUENCY: 13,560,000 Hz

REFERENCE VOLTAGE: 3.82 VDC

DEVIATION LIMIT: ± 0.01 % = 1356Hz

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.82	+ 20 (Ref)	13,560,226	226	0.0016667
100 %		- 30	13,559,987	-13	-0.0000959
100 %		- 20	13,560,223	223	0.0016445
100 %		- 10	13,560,095	95	0.0007006
100 %		0	13,560,072	72	0.0005310
100 %		+ 10	13,559,934	-66	-0.0004867
100 %		+ 20	13,560,321	321	0.0023673
100 %		+ 30	13,559,934	-66	-0.0004867
100 %		+ 40	13,559,989	-11	-0.0000811
100 %		+ 50	13,560,273	273	0.0020133
BATT. ENDPOINT	3.42	+ 20	13,559,950	-50	-0.0003687

Table 7-9. Frequency Stability Test Data (CE F 424kbps)

Frequency Stability Test Data

§15.225

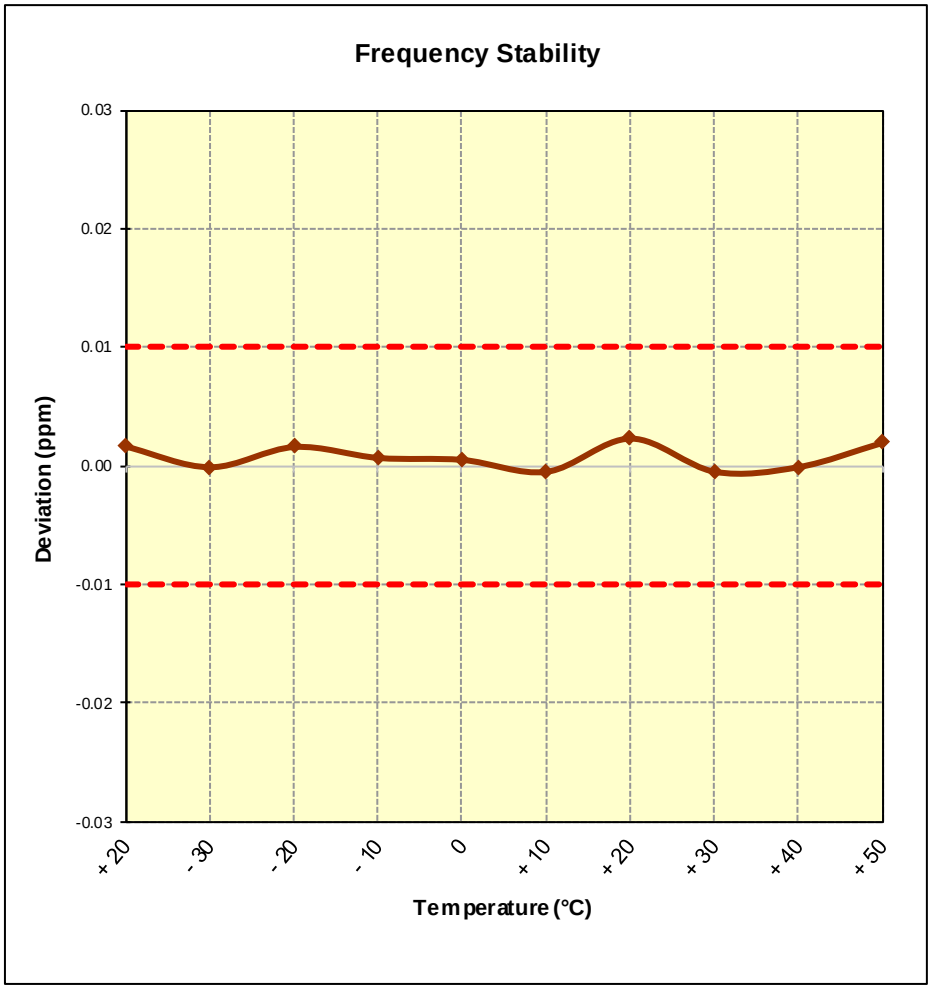


Figure 7-9. Frequency Stability Plot (CE F 424kbps)

Frequency Stability Test Data

§15.225

OPERATING FREQUENCY: 13,560,000 Hz

REFERENCE VOLTAGE: 3.82 VDC

DEVIATION LIMIT: ± 0.01 % = 1356Hz

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.82	+ 20 (Ref)	13,559,713	-287	-0.0021165
100 %		- 30	13,559,745	-255	-0.0018805
100 %		- 20	13,560,037	37	0.0002729
100 %		- 10	13,559,887	-113	-0.0008333
100 %		0	13,560,071	71	0.0005236
100 %		+ 10	13,560,134	134	0.0009882
100 %		+ 20	13,560,082	82	0.0006047
100 %		+ 30	13,559,983	-17	-0.0001254
100 %		+ 40	13,559,832	-168	-0.0012389
100 %		+ 50	13,559,942	-58	-0.0004277
BATT. ENDPOINT	3.42	+ 20	13,560,230	230	0.0016962

Table 7-10. Frequency Stability Test Data (Reader 100% Ask 1 out of 4)

Frequency Stability Test Data

§15.225

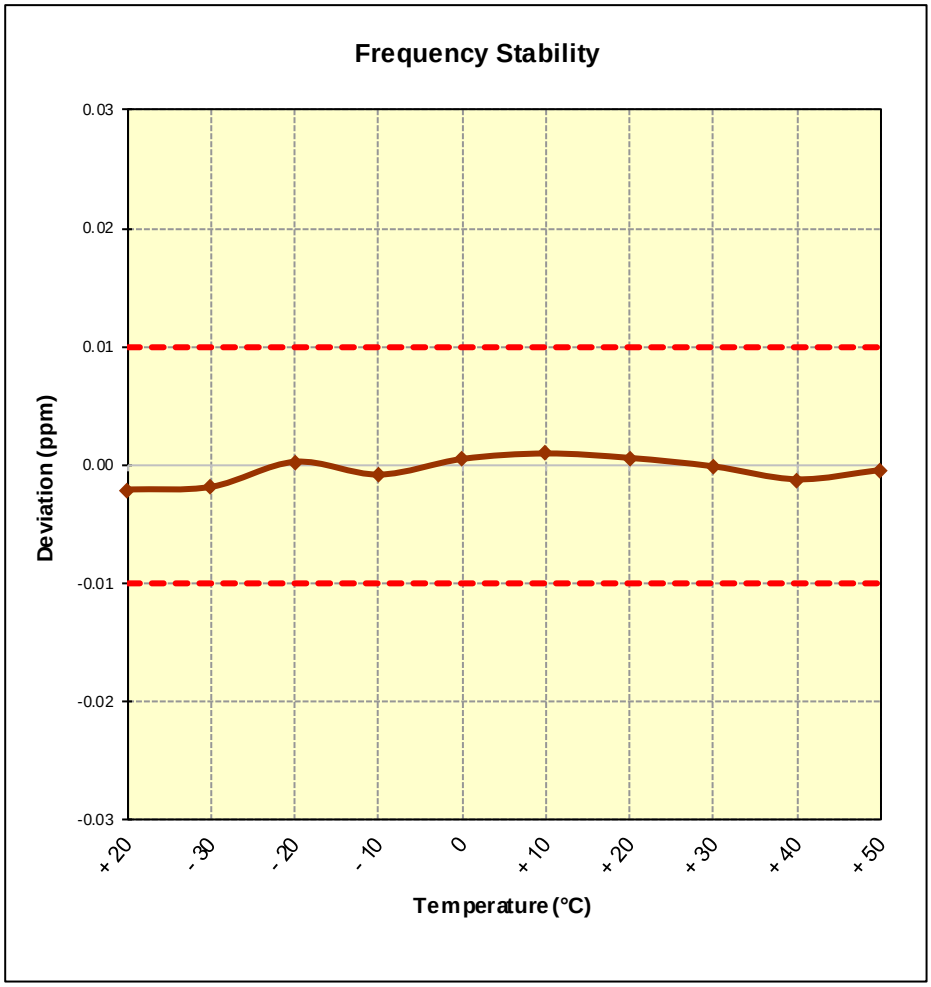


Figure 7-10. Frequency Stability Plot (Reader 100% Ask 1 out of 4)

Frequency Stability Test Data

§15.225

OPERATING FREQUENCY: 13,560,000 Hz

REFERENCE VOLTAGE: 3.82 VDC

DEVIATION LIMIT: ± 0.01 % = 1356Hz

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.82	+ 20 (Ref)	13,559,984	-16	-0.0001180
100 %		- 30	13,559,954	-46	-0.0003392
100 %		- 20	13,559,617	-383	-0.0028245
100 %		- 10	13,559,707	-293	-0.0021608
100 %		0	13,559,703	-297	-0.0021903
100 %		+ 10	13,560,161	161	0.0011873
100 %		+ 20	13,560,023	23	0.0001696
100 %		+ 30	13,560,431	431	0.0031785
100 %		+ 40	13,560,142	142	0.0010472
100 %		+ 50	13,560,110	110	0.0008112
BATT. ENDPOINT	3.42	+ 20	13,560,054	54	0.0003982

Table 7-11. Frequency Stability Test Data (Reader 100% Ask 1 out of 256)

Frequency Stability Test Data

§15.225

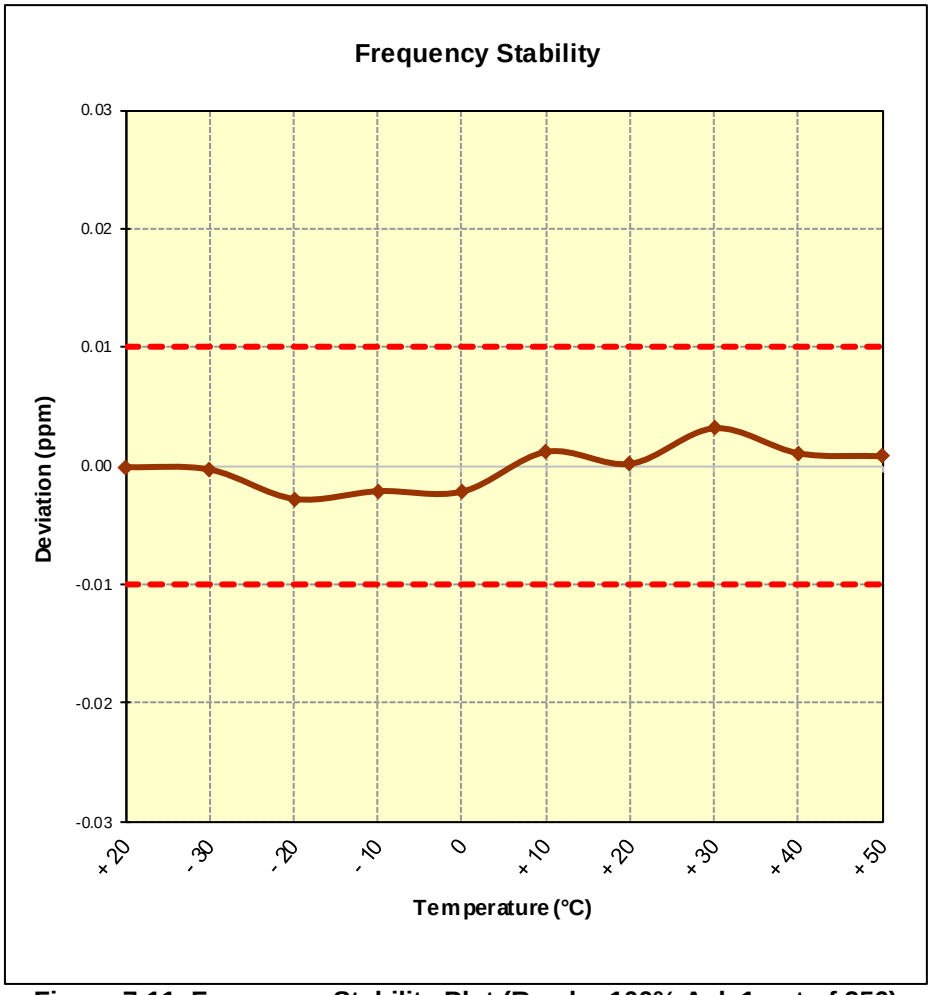


Figure 7-11. Frequency Stability Plot (Reader 100% Ask 1 out of 256)

7.4 In-Band Radiated Spurious Emission Measurements

§15.225(a)(b)(c)

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 7-12.

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	106	30

Table 7-12. 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.

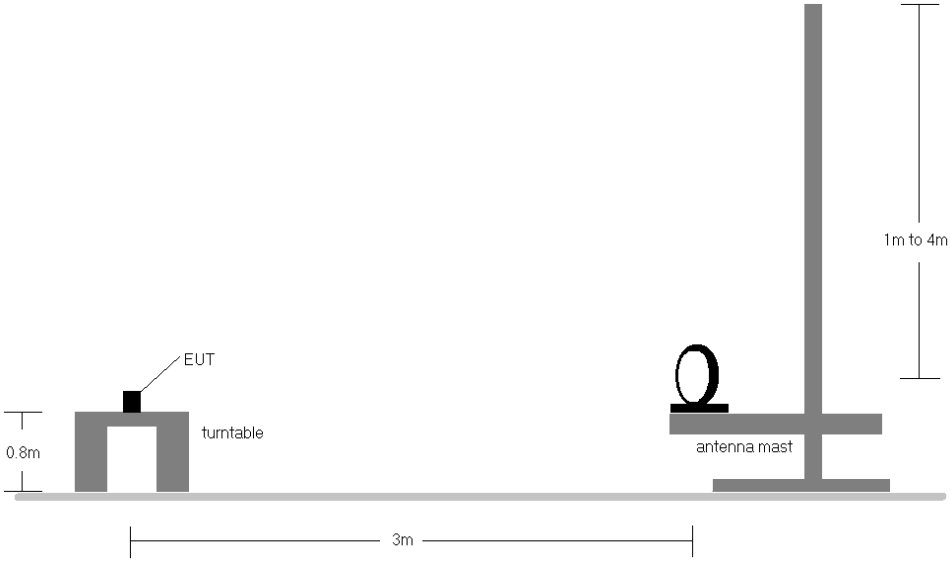


Figure 7-12. Radiated Test Setup

Test Notes:

1. All emissions lying in restricted bands specified in §15.225 are below the limit shown in Table 7-12.
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. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
4. 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.
5. 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.
6. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector.
7. 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)

Frequency: 13.56MHz

Measurement Distance: 3 Meters

Frequency [MHz]	Antenna Position	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]
13.166	X	100	219	-90.29	20.40	37.11	-2.89	106.00	40.51	-43.40
13.248	X	100	219	-90.21	20.40	37.19	-2.81	106.00	40.51	-43.32
13.313	X	100	219	-89.97	20.40	37.43	-2.57	106.00	40.51	-43.08
13.560	X	100	219	-76.17	20.40	51.23	11.23	15848.00	84.00	-72.77
13.596	X	100	219	-89.37	20.40	38.03	-1.97	334.00	50.47	-52.44
13.753	X	100	219	-89.47	20.40	37.93	-2.07	106.00	40.51	-42.58
13.873	X	100	219	-89.92	20.40	37.48	-2.52	106.00	40.51	-43.03

Table 7-13. In-Band Radiated Measurements (CE A 848kbps)

Frequency [MHz]	Antenna Position	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]
13.235	X	100	219	-94.01	20.40	33.39	-6.61	106.00	40.51	-47.12
13.319	X	100	219	-93.92	20.40	33.48	-6.52	106.00	40.51	-47.03
13.423	X	100	219	-93.85	20.40	33.55	-6.45	334.00	50.47	-56.92
13.560	X	100	219	-75.86	20.40	51.54	11.54	15848.00	84.00	-72.46
13.713	X	100	219	-94.30	20.40	33.10	-6.90	106.00	40.51	-47.41
13.851	X	100	219	-94.26	20.40	33.14	-6.86	106.00	40.51	-47.37
13.974	X	100	219	-92.87	20.40	34.53	-5.47	106.00	40.51	-45.98

Table 7-14. In-Band Radiated Measurements (CE B 848kbps)

Frequency [MHz]	Antenna Position	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]
13.139	X	100	216	-93.46	20.40	33.94	-6.06	106.00	40.51	-46.57
13.236	X	100	216	-93.82	20.40	33.58	-6.42	106.00	40.51	-46.93
13.418	X	100	216	-94.27	20.40	33.13	-6.87	334.00	50.47	-57.34
13.560	X	100	216	-76.18	20.40	51.22	11.22	15848.00	84.00	-72.78
13.692	X	100	216	-94.36	20.40	33.04	-6.96	334.00	50.47	-57.43
13.796	X	100	216	-93.33	20.40	34.07	-5.93	106.00	40.51	-46.44
13.984	X	100	216	-92.29	20.40	35.11	-4.89	106.00	40.51	-45.40

Table 7-15. In-Band Radiated Measurements (CE F 424kbps)

Frequency [MHz]	Antenna Position	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]
13.269	X	100	197	-93.65	20.40	33.75	-6.25	106.00	40.51	-46.76
13.371	X	100	197	-93.51	20.40	33.89	-6.11	106.00	40.51	-46.62
13.510	X	100	197	-89.18	20.40	38.22	-1.78	334.00	50.47	-52.25
13.560	X	100	197	-76.65	20.40	50.75	10.75	15848.00	84.00	-73.25
13.587	X	100	197	-87.80	20.40	39.60	-0.40	334.00	50.47	-50.87
13.750	X	100	197	-92.94	20.40	34.46	-5.54	106.00	40.51	-46.05
13.942	X	100	197	-93.71	20.40	33.69	-6.31	106.00	40.51	-46.82

Table 7-16. In-Band Radiated Measurements (Reader 100% Ask 1 out of 4)

Frequency [MHz]	Antenna Position	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]
13.182	X	100	200	-94.93	20.40	32.47	-7.53	106.00	40.51	-48.04
13.277	X	100	200	-93.81	20.40	33.59	-6.41	106.00	40.51	-46.92
13.521	X	100	200	-90.94	20.40	36.46	-3.54	334.00	50.47	-54.01
13.560	X	100	200	-76.82	20.40	50.58	10.58	15848.00	84.00	-73.42
13.612	X	100	200	-91.78	20.40	35.62	-4.38	334.00	50.47	-54.85
13.724	X	100	200	-93.76	20.40	33.64	-6.36	106.00	40.51	-46.87
13.860	X	100	200	-92.81	20.40	34.59	-5.41	106.00	40.51	-45.92

Table 7-17. In-Band Radiated Measurements (Reader 100% Ask 1 out of 256)

7.5 Radiated Spurious Emissions Measurements, Out-of-Band

§15.209 §15.225(d)

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 7-18 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 7-18. 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.

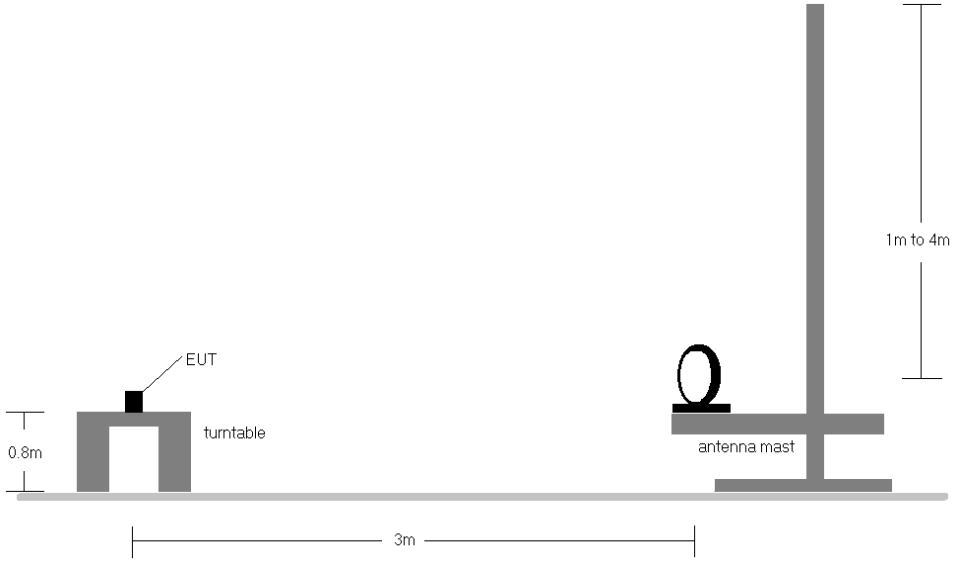


Figure 7-13. Radiated Test Setup < 30MHz

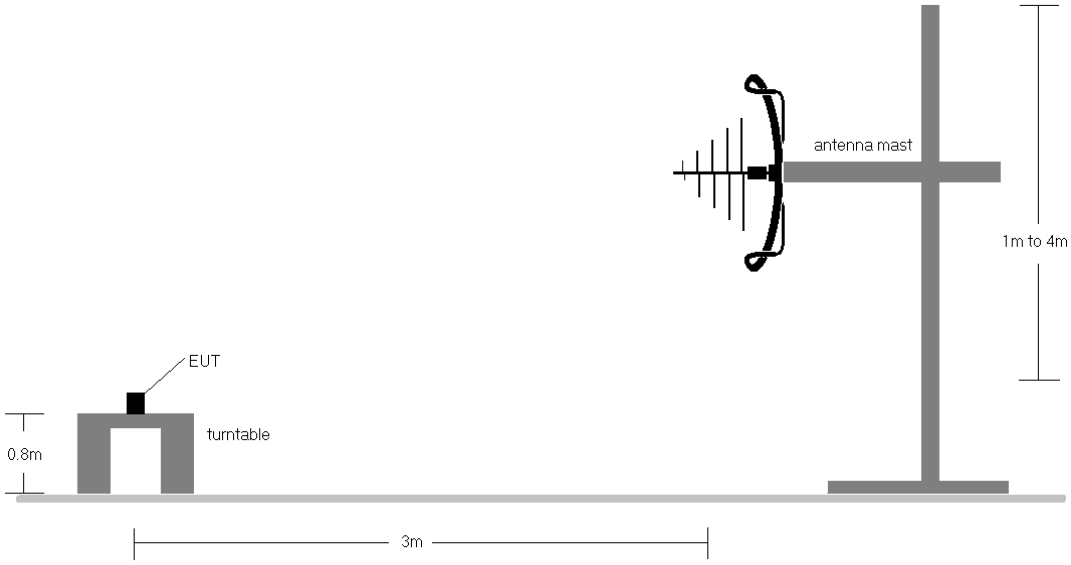


Figure 7-14. Radiated Test Setup > 30MHz

Test Notes:

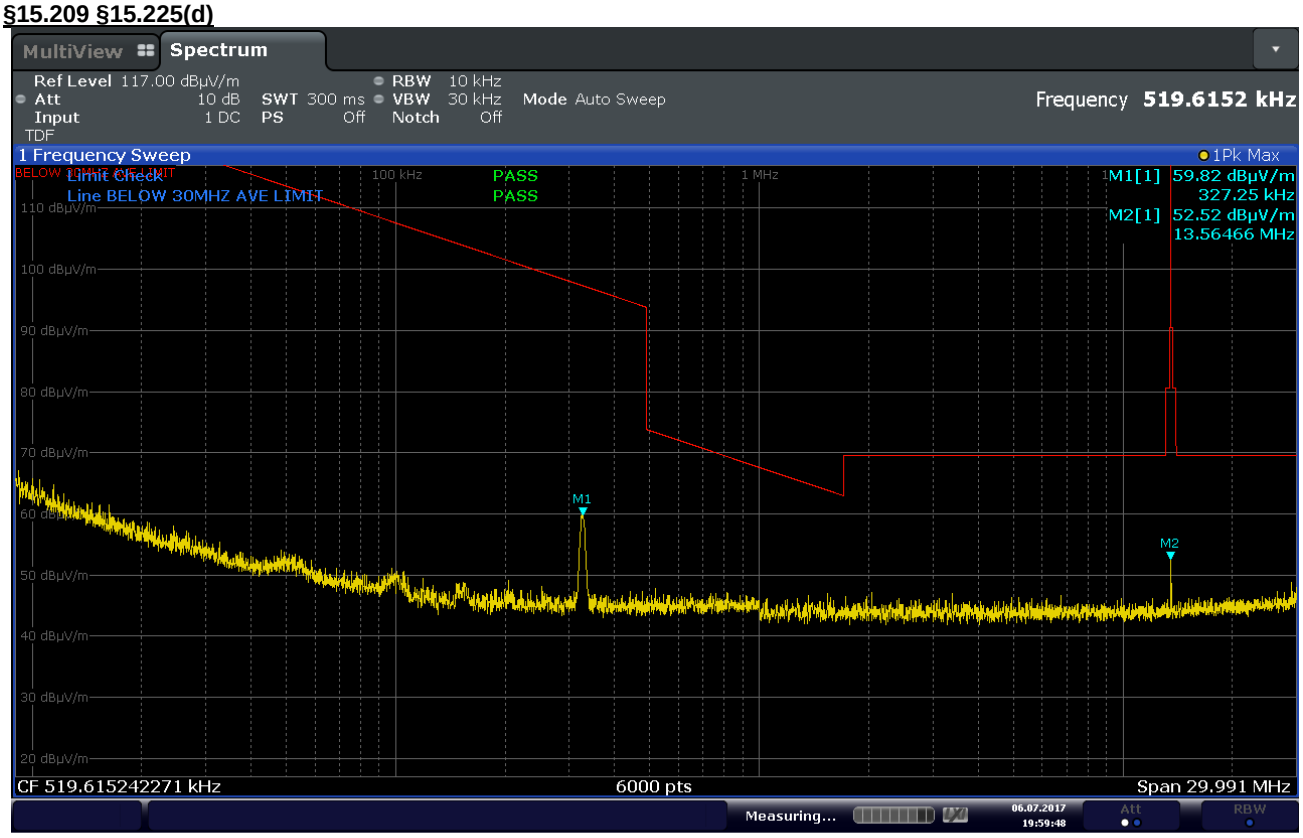
1. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector for emissions below 960MHz.
2. A loop antenna was used to investigate emissions below 30MHz.
3. Both Vertical and Horizontal polarities of the receive antenna were evaluated with the worst case emissions being 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.
8. The unit was tested with all possible mode and power schemes and only the highest emission is reported.

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]

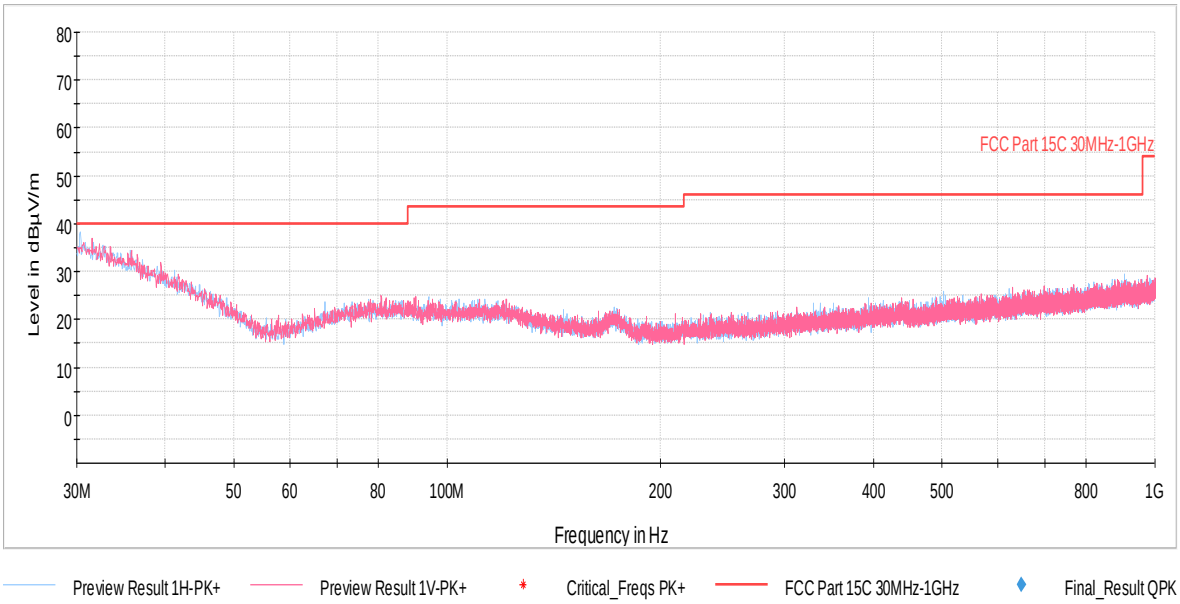
Radiated Spurious Emission Measurements, Out-of-Band

§15.209 §15.225(d)



Date: 6.JUL.2017 19:59:48

Plot 7-1. Radiated Spurious Plot 9kHz – 30MHz (CE A 848kbps, Pol. X)



Plot 7-2. Radiated Spurious Plot 30MHz – 1GHz (CE A 848kbps, Pol. X)

Radiated Spurious Emission Measurements, Out-of-Band

§15.209 §15.225(d)

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	-	-	-95.38	20.60	32.22	69.54	-37.32
40.68	V	100	259	-65.54	-22.14	19.32	40.00	-20.68
54.24	V	-	-	-63.10	-31.20	12.70	40.00	-27.30
67.80	V	-	-	-68.36	-27.71	10.93	40.00	-29.07
81.36	V	-	-	-66.17	-25.60	15.23	40.00	-24.77
94.92	V	-	-	-69.26	-25.47	12.27	43.52	-31.26
108.48	V	-	-	-67.14	-25.17	14.69	43.52	-28.83

Table 7-19. Radiated Measurements (CE A 848 kbps)

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	-	-	-94.89	20.60	32.71	69.54	-36.83
40.68	V	100	260	-67.14	-22.14	17.72	40.00	-22.28
54.24	V	-	-	-64.37	-31.20	11.43	40.00	-28.57
67.80	V	-	-	-67.41	-27.71	11.88	40.00	-28.12
81.36	V	-	-	-65.60	-25.60	15.80	40.00	-24.20
94.92	V	-	-	-71.02	-25.47	10.51	43.52	-33.02
108.48	V	-	-	-68.74	-25.17	13.09	43.52	-30.43

Table 7-20. Radiated Measurements (CE B 848 kbps)

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	-	-	-93.91	20.60	33.69	69.54	-35.85
40.68	V	100	264	-66.57	-22.14	18.29	40.00	-21.71
54.24	V	-	-	-63.46	-31.20	12.34	40.00	-27.66
67.80	V	-	-	-68.76	-27.71	10.53	40.00	-29.47
81.36	V	-	-	-66.07	-25.60	15.33	40.00	-24.67
94.92	V	-	-	-70.86	-25.47	10.67	43.52	-32.86
108.48	V	-	-	-67.48	-25.17	14.35	43.52	-29.17

Table 7-21. Radiated Measurements (CE F 424kbps)

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	-	-	-93.38	20.60	34.22	69.54	-35.32
40.68	V	100	254	-66.34	-22.14	18.52	40.00	-21.48
54.24	V	-	-	-64.17	-31.20	11.63	40.00	-28.37
67.80	V	-	-	-67.56	-27.71	11.73	40.00	-28.27
81.36	V	-	-	-65.99	-25.60	15.41	40.00	-24.59
94.92	V	-	-	-68.44	-25.47	13.09	43.52	-30.44
108.48	V	-	-	-67.89	-25.17	13.94	43.52	-29.58

Table 7-22. Radiated Measurements (Reader 100% Ask 1 out of 4)

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	-	-	-93.93	20.60	33.67	69.54	-35.87
40.68	V	100	268	-66.30	-22.14	18.56	40.00	-21.44
54.24	V	-	-	-63.28	-31.20	12.52	40.00	-27.48
67.80	V	-	-	-68.77	-27.71	10.52	40.00	-29.48
81.36	V	-	-	-67.49	-25.60	13.91	40.00	-26.09
94.92	V	-	-	-70.30	-25.47	11.23	43.52	-32.30
108.48	V	-	-	-69.25	-25.17	12.58	43.52	-30.94

Table 7-23. Radiated Measurements (Reader 100% Ask 1 out of 256)

7.6 Line Conducted Measurement Data

§15.207

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 15.207.

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 7-24. 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.

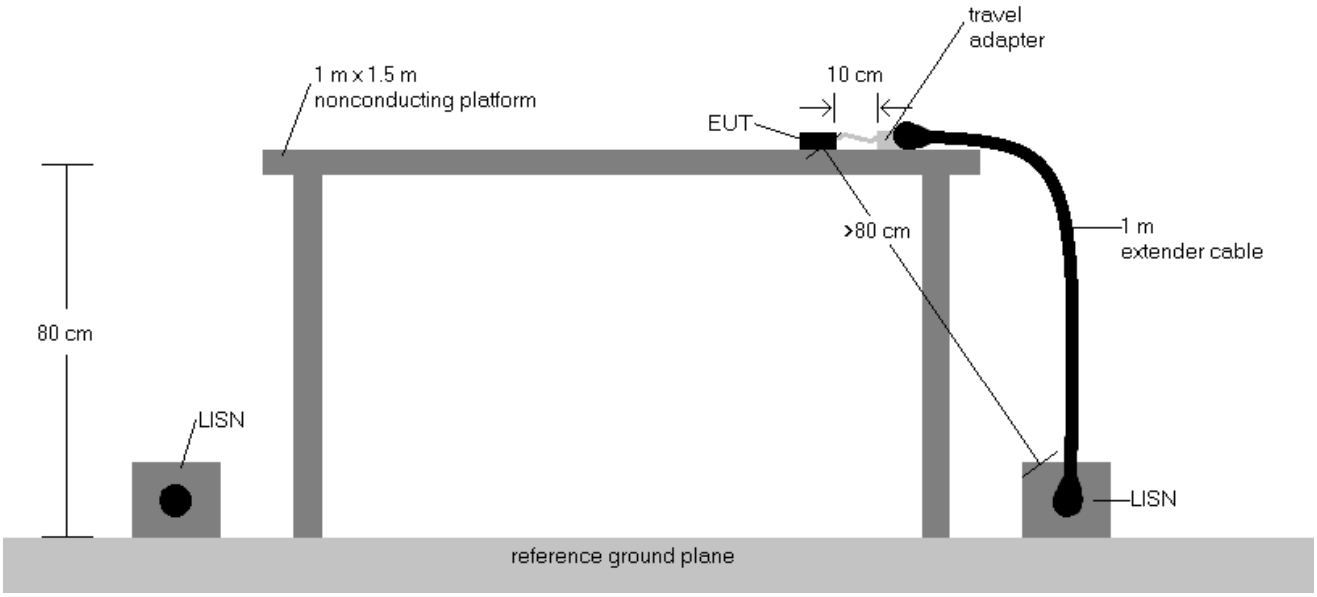
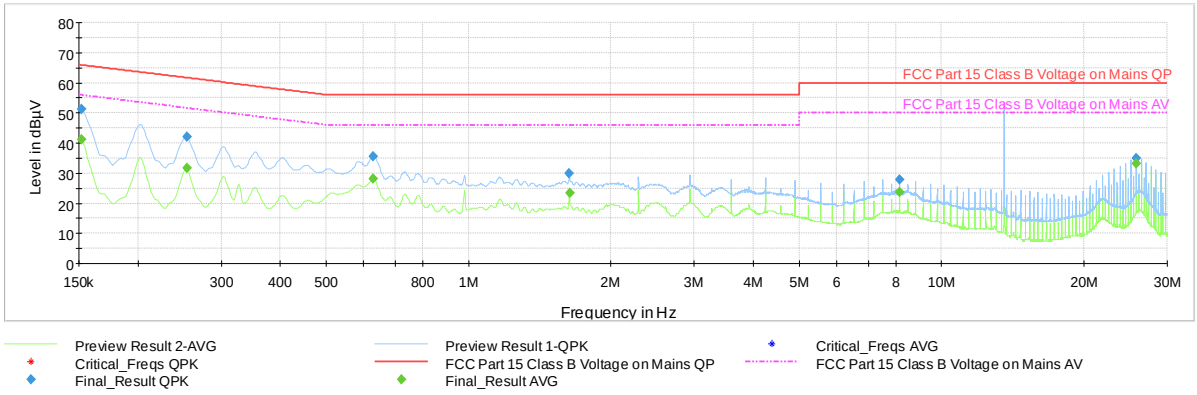


Figure 7-15. Test Instrument & Measurement Setup

Test Notes

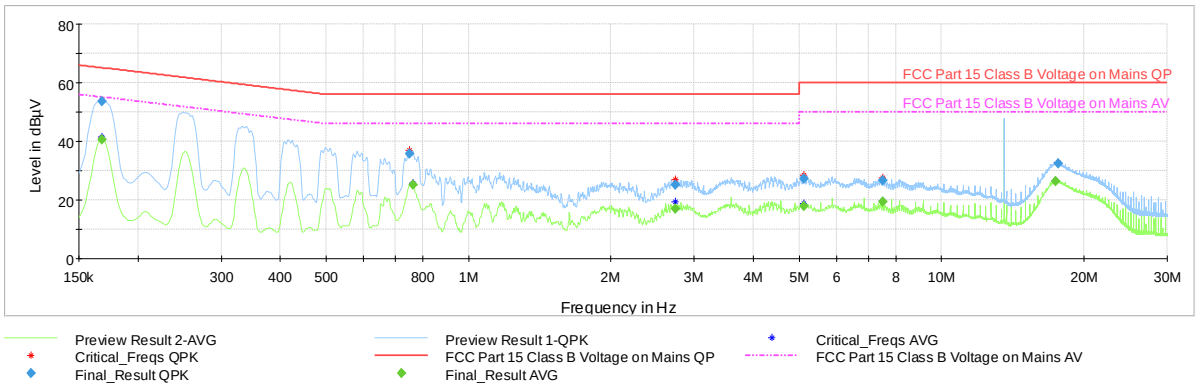
1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207.
3. Corr. (dB) = Cable loss (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.



Plot 7-3. Line-Conducted Test Plot (L1)

Frequency MHz	Process State	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Bandwidth kHz	Line	PE
0.152250	FINAL	51.20	—	65.88	14.68	9.000	L1	GND
0.152250	FINAL	—	41.07	55.88	14.80	9.000	L1	GND
0.253500	FINAL	42.12	—	61.64	19.52	9.000	L1	GND
0.253500	FINAL	—	31.72	51.64	19.92	9.000	L1	GND
0.627000	FINAL	35.57	—	56.00	20.43	9.000	L1	GND
0.627000	FINAL	—	28.04	46.00	17.96	9.000	L1	GND
1.632750	FINAL	29.87	—	56.00	26.13	9.000	L1	GND
1.635000	FINAL	—	23.35	46.00	22.65	9.000	L1	GND
8.162250	FINAL	—	23.57	50.00	26.43	9.000	L1	GND
8.162250	FINAL	27.92	—	60.00	32.08	9.000	L1	GND
25.795500	FINAL	35.10	—	60.00	24.90	9.000	L1	GND
25.795500	FINAL	—	33.14	50.00	16.86	9.000	L1	GND

Table 7-25. Line-Conducted Test Table (L1)



Plot 7-4. Line-Conducted Test Plot (N)

Frequency MHz	Process State	QuasiPeak dBµV	Average dBµV	Limit dBµV	Margin dB	Bandwidth kHz	Line	PE	Corr. dB
0.168000	FINAL	—	40.65	55.06	14.41	9.000	N	GND	10.6
0.168000	FINAL	53.50	—	65.06	11.56	9.000	N	GND	10.6
0.748500	FINAL	35.89	—	56.00	20.11	9.000	N	GND	10.1
0.762000	FINAL	—	25.16	46.00	20.84	9.000	N	GND	10.1
2.730750	FINAL	—	16.89	46.00	29.11	9.000	N	GND	10.1
2.730750	FINAL	25.26	—	56.00	30.74	9.000	N	GND	10.1
5.109000	FINAL	27.19	—	60.00	32.81	9.000	N	GND	10.2
5.122500	FINAL	—	18.03	50.00	31.97	9.000	N	GND	10.2
7.509750	FINAL	26.68	—	60.00	33.32	9.000	N	GND	10.3
7.509750	FINAL	—	19.29	50.00	30.71	9.000	N	GND	10.3
17.425500	FINAL	—	26.30	50.00	23.70	9.000	N	GND	10.3
17.632500	FINAL	32.53	—	60.00	27.47	9.000	N	GND	10.3

Table 7-26. Line-Conducted Test Table (N)

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Watch** **FCC ID: BCG-A1892** has been tested to show compliance with the requirements specified in §15.225 of the FCC Rules.