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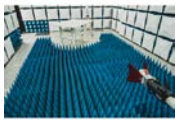

MEASUREMENT REPORT
FCC PART 15C

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
04/17 - 6/12/2020
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M2006240100-12.A3L

FCC ID:	**A3LSMN986JPN**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SCG06, SC-53A
EUT Type:	Portable Handset
Frequency Range:	110 – 148kHz, 0.53 – 0.6MHz
FCC Classification:	Part 15 Low Power Transmitter Below 1705kHz (DCD)
FCC Rule Part(s):	Part 15 Subpart C
Test Procedure(s):	ANSI C63.10-2013

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.

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

ACCREDITED
CERT #2041.01

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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 7185 Oakland Mills Road, Columbia, MD 21046. 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 Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 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 (2451B) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMN986JPN**. The test data contained in this report pertains only to the emissions generated by the IC of the EUT that receive or transmit AC power signal through magnetic induction (MI) or magnetic resonance (MR) wirelessly.

Test Device Serial No.: 0469M, 6762M

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE), NFC, Wireless Power Transfer

2.3 Test Configuration

The EUT can be configured to receive or transmit an AC power signal through magnetic induction (MI) or magnetic resonance (MR). The operating frequency range is 110 – 148kHz and can produce a maximum power of 9W.

During wireless charging testing, one of the devices is configured to be AC power transmitter, and the other is configured to be receiver. The charging area of both devices are aligned to provide for maximum power transfer.

The EUT 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 and radiated emissions test setups, respectively.

The EUT is also used with a stylus device (S-PEN). The EUT operates with the S-PEN in three different inductive coupling modes of S-PEN motion detection (Modes 1 and 2) and charging (Device to S-Pen Wireless Charging) operating in the range of 0.53 – 0.6MHz. The EUT was set to continuously transmit to the S-PEN in each of the three modes. S-PEN charging mode is also applicable during the device wireless charging condition. Data is additionally included for this condition.

2.4 EMI Suppression Device(s)/Modifications

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

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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 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. 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 an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (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 7.3. Automated test software was used to perform the AC line conducted emissions testing.

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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 measurements above 1GHz, an additional Styrodur pedestal 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 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 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

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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.

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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

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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
Agilent	N9038A	MXE EMI Receiver	7/17/2019	Annual	7/17/2020	MY51210133
Agilent	N9030A	PXA Signal Analyzer (44GHz)	6/12/2019	Annual	6/12/2020	MY52350166
Anritsu	MA2411B	Pulse Power Sensor	8/14/2019	Annual	8/14/2020	1315051
Anritsu	ML2496A	Power Meter	11/6/2019	Annual	11/6/2020	1405003
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	10/10/2019	Biennial	10/10/2021	121034
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	6/18/2018	Biennial	6/18/2020	114451
Pasternack	NMLC-2	Line Conducted Emissions Cable (NM)	6/3/2019	Annual	6/3/2020	NMLC-2
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	6/5/2019	Annual	6/5/2020	100342

Table 6-1. Annual Test Equipment Calibration Schedule

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7.0 TEST DATA

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMN986JPN

FCC Classification: Part 15 Low Power Transmitter Below 1705kHz (DCD)

Frequency Range: 110 – 594kHz

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.209	RSS-Gen [8.9]	Out-of-Band Emissions	Emissions must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])	Radiated	PASS	Section 7.2
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen)	LINE CONDUCTED	PASS	Section 7.3

Table 7-1. Summary of Test Results

Note:

This unit was tested while transferring maximum power wirelessly to a similar unit.

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7.2 Radiated Spurious Emission Measurements, Out-of-Band

§15.209; RSS-Gen (8.9)

Test Overview and Limit

The EUT was tested from 9kHz up to the 30MHz. All measurements up to 30MHz were recorded with a spectrum analyzer employing a quasi-peak detector.

All out-of-band emissions must not exceed the limits shown in Table 7-2 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 7-2. 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
3. VBW ≥ 3 x RBW
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

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Test Setup

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

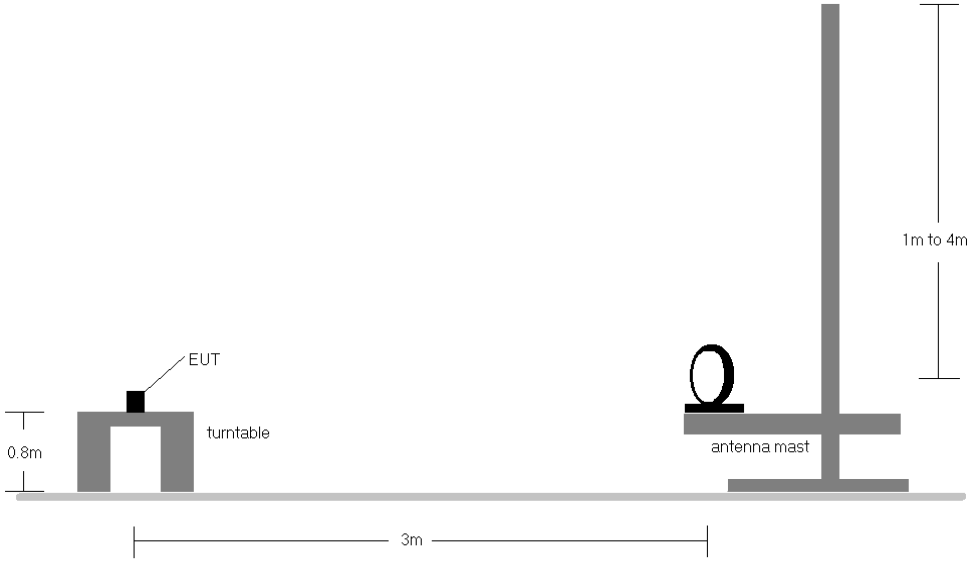

Figure 7-1. Radiated Test Setup

Test Notes:

1. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector for emissions below 30MHz.
2. A loop antenna was used to investigate emissions below 30MHz.
3. 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 investigated from 9kHz up to 30MHz per §15.33. 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 $_{[dB\mu V/m]}$ = 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 $_{[dB\mu V/m]}$

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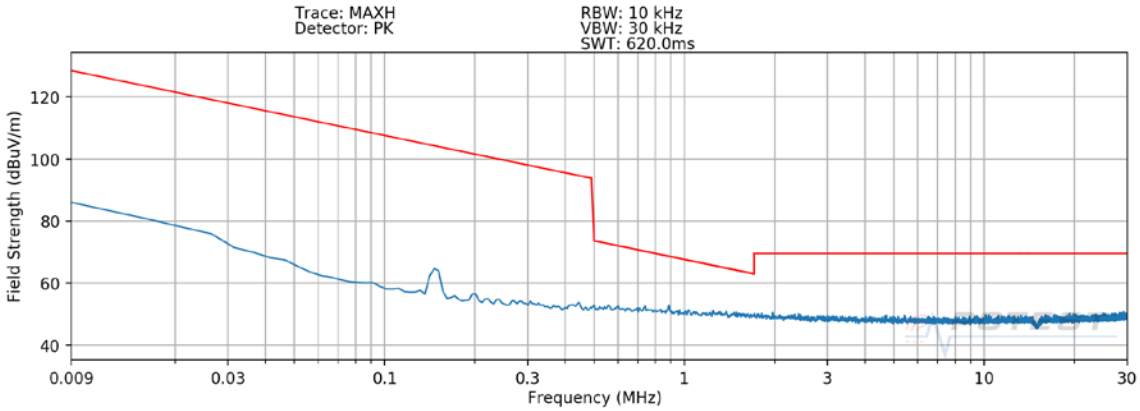
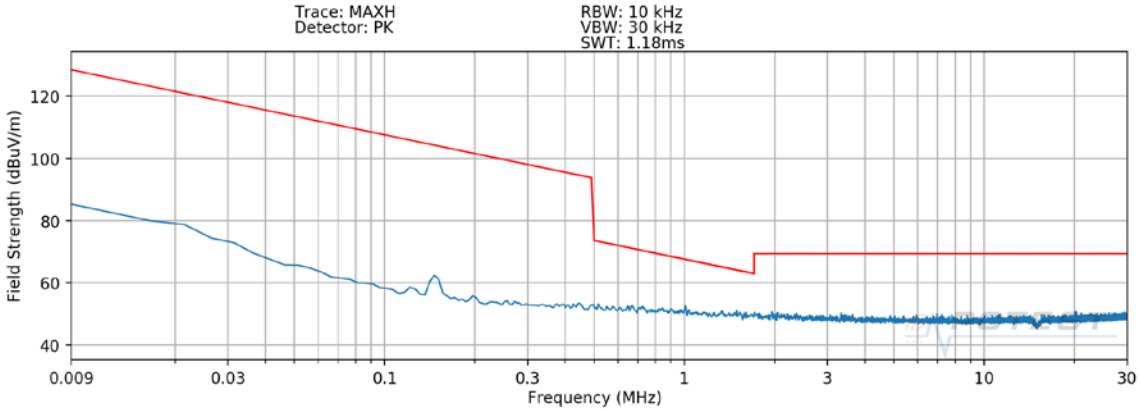
Radiated Spurious Emission Measurements, Out-of-Band

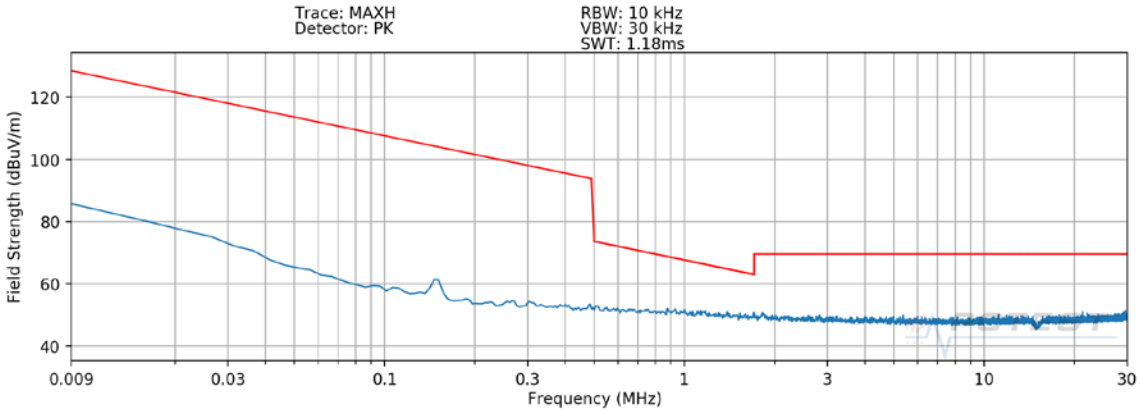
§15.209; RSS-Gen (8.9)



Plot 7-1. Radiated Spurious Plot 9kHz – 30MHz (Pol. X – Device to Device WPT)



Plot 7-2Radiated Spurious Plot 9kHz – 30MHz (Pol. Y – Device to Device WPT)



Plot 7-3. Radiated Spurious Plot 9kHz – 30MHz (Pol. Z – Device to Device WPT)

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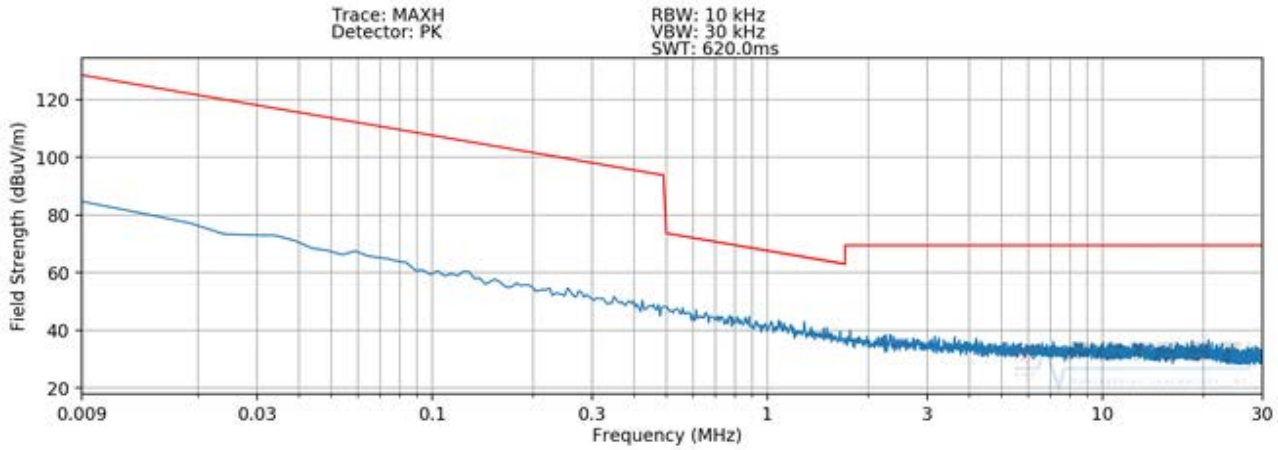
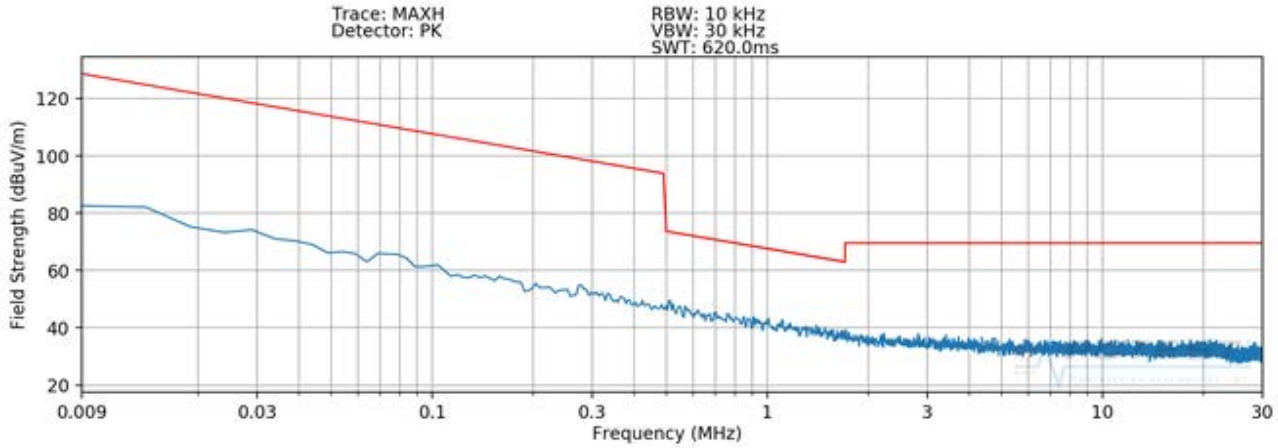
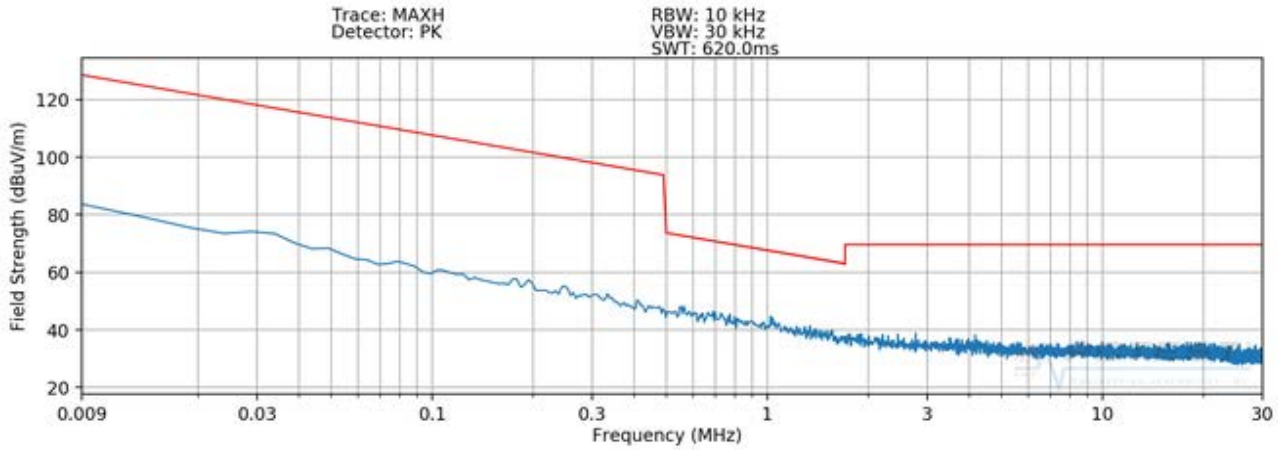


Plot 7-4. Radiated Spurious Plot 9kHz – 30MHz (Pol. X – WPT - Device to S-Pen)



Plot 7-5. Radiated Spurious Plot 9kHz – 30MHz (Pol. Y – WPT - Device to S-Pen)



Plot 7-6. Radiated Spurious Plot 9kHz – 30MHz (Pol. Z – WPT - Device to S-Pen)

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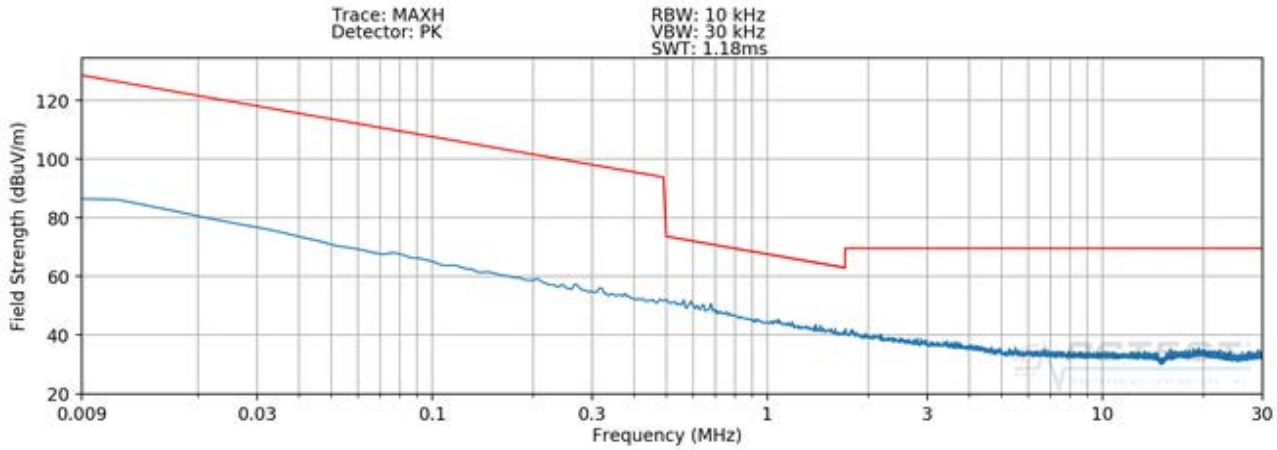
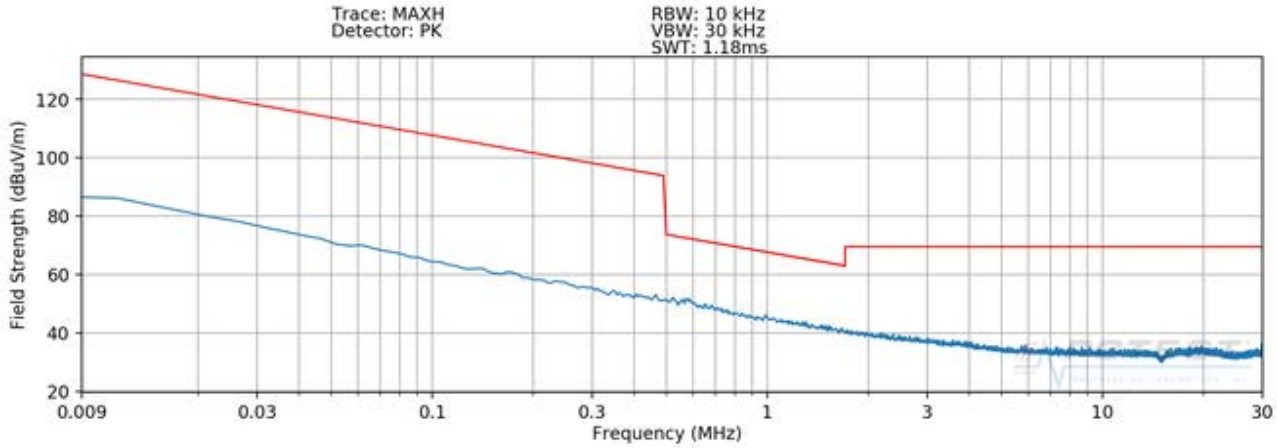
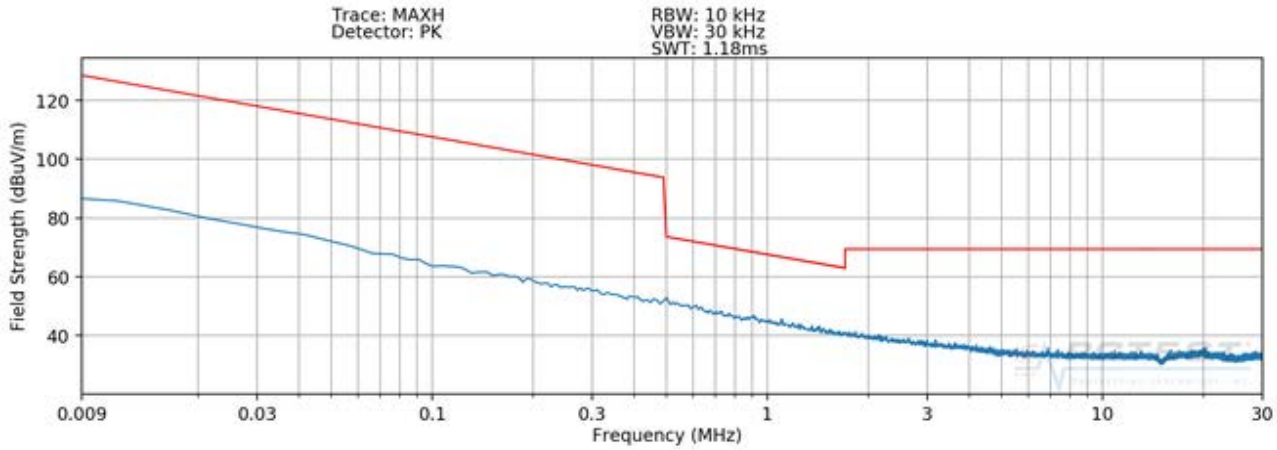


Plot 7-7. Radiated Spurious Plot 9kHz – 30MHz (Pol. X – WPT – Digitizer Hover)



Plot 7-8. Radiated Spurious Plot 9kHz – 30MHz (Pol. Y – WPT - Digitizer Hover)



Plot 7-9. Radiated Spurious Plot 9kHz – 30MHz (Pol. Z – WPT - Digitizer Hover)

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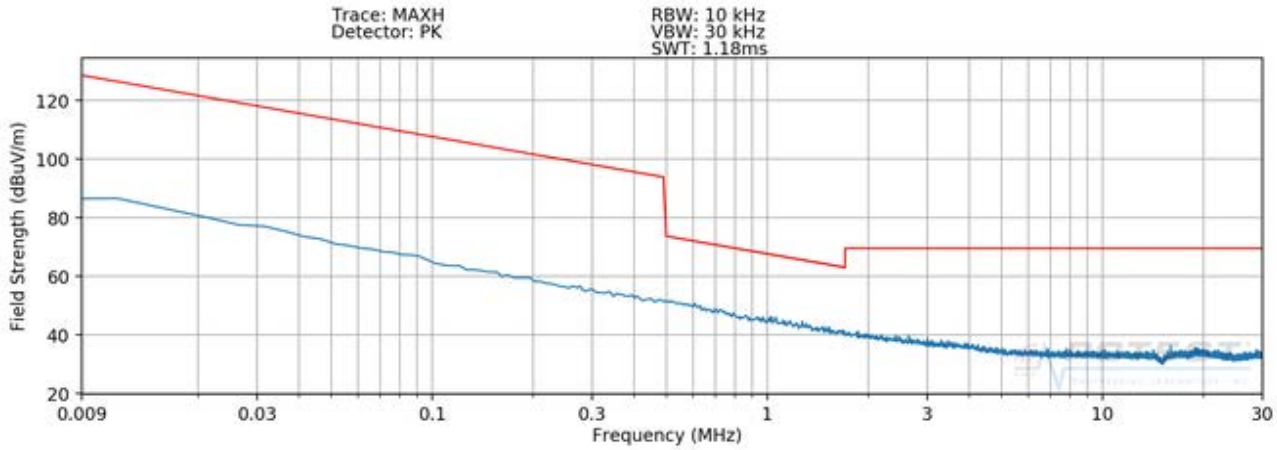
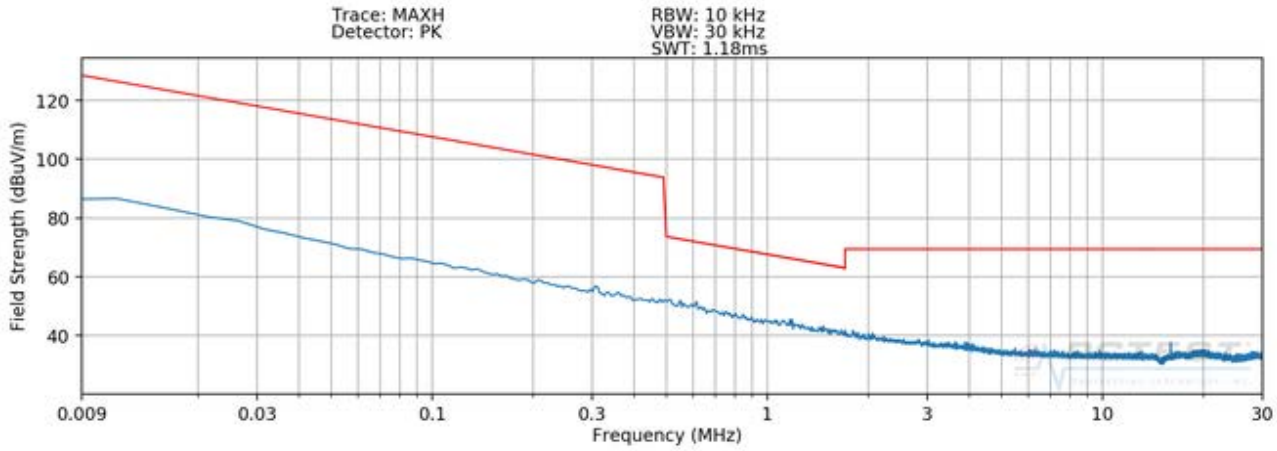
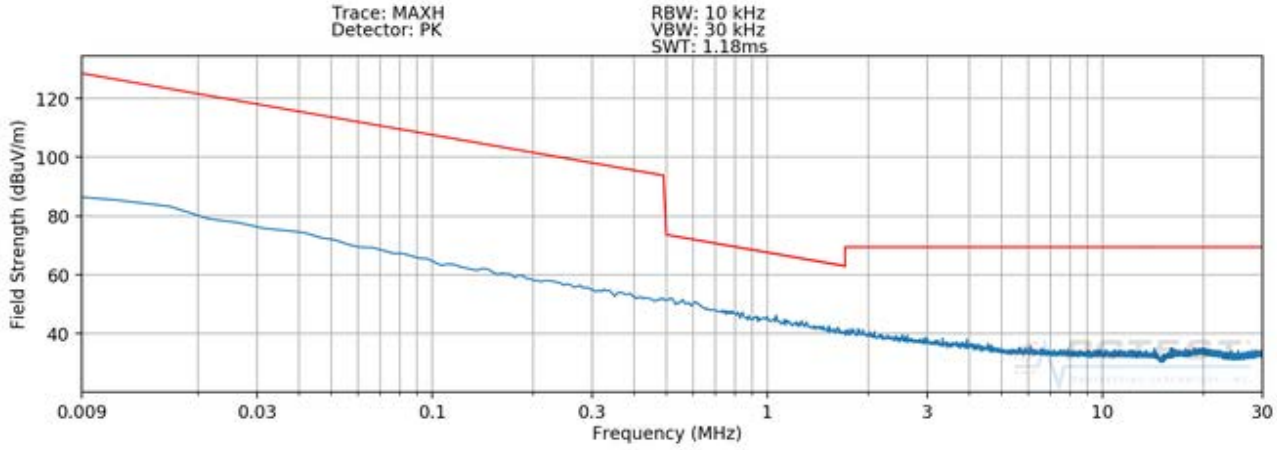


Plot 7-10. Radiated Spurious Plot 9kHz – 30MHz (Pol. X – WPT – Digitizer S-Pen Click)



Plot 7-11. Radiated Spurious Plot 9kHz – 30MHz (Pol. Y – WPT - Digitizer S-Pen Click)



Plot 7-12. Radiated Spurious Plot 9kHz – 30MHz (Pol. Z – WPT - Digitizer S-Pen Click)

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Radiated Spurious Emission Measurements, Out-of-Band
§15.209; RSS-Gen (8.9)

Tx Frequency 148kHz

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 [dBµV/m]	Margin [dB]
0.148	X	100	155	-71.10	20.28	56.18	0.26	24.20	-23.94
0.296	X	-	-	-83.02	20.25	44.23	-11.69	18.18	-29.87
0.444	X	-	-	-85.98	20.23	41.25	-14.67	14.66	-29.33
0.592	X	-	-	-85.55	20.25	41.70	-14.22	32.16	-46.38
0.740	X	-	-	-86.06	20.28	41.22	-14.70	30.22	-44.92
0.888	X	-	-	-85.87	20.28	41.41	-14.51	28.64	-43.14

Table 7-3. Radiated Measurements (Device to Device WPT)

Tx Frequency 594kHz

Measurement Distance: 3 Meters

Frequency [MHz]	Ant. Pol. [X/Y/Z]	Antenna Height	Turntable Azimuth [degree]	Level [dBm]	AFCL [dB/m]	3m Field Strength [dBµV/m]	30m Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
0.594	X	100	232	-62.28	14.44	59.16	19.16	32.13	-12.96
1.188	X	-	-	-65.28	14.80	56.52	16.52	26.11	-9.59
1.782	X	-	-	-70.39	14.89	51.50	11.50	22.59	-11.08
2.376	X	-	-	-74.39	14.99	47.60	7.60	29.54	-21.94
2.970	X	-	-	-76.24	15.09	45.85	5.85	29.54	-23.69
3.564	X	-	-	-76.97	15.29	45.32	5.32	29.54	-24.22

Table 7-4. Radiated Measurements (Device to S-Pen WPT)

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Tx Frequency 562kHz

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]	Corrected Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
0.562	Z	-	-	-86.66	20.24	40.58	0.58	32.61	-32.03
1.124	Z	-	-	-87.09	20.31	40.22	0.22	26.59	-26.37
1.686	Z	-	-	-87.59	20.40	39.81	-0.19	23.07	-23.26
2.248	Z	-	-	-88.95	20.43	38.48	-1.52	29.54	-31.06
2.810	Z	-	-	-88.86	20.47	38.61	-1.39	29.54	-30.93
3.372	Z	-	-	-89.66	20.42	37.76	-2.24	29.54	-31.78
3.934	Z	-	-	-89.69	20.39	37.70	-2.30	29.54	-31.84

Table 7-5. Radiated Measurements (Device to Digitizer - Hover WPT)

Tx Frequency 531kHz

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]	Corrected Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
0.531	X	-	-	-85.51	20.23	41.72	1.72	33.10	-31.38
1.062	X	-	-	-86.30	20.30	41.00	1.00	27.08	-26.08
1.593	X	-	-	-87.85	20.38	39.53	-0.47	23.56	-24.03
2.124	X	-	-	-88.22	20.47	39.25	-0.75	29.54	-30.29
2.655	X	-	-	-89.51	20.44	37.93	-2.07	29.54	-31.62
3.186	X	-	-	-89.28	20.43	38.15	-1.85	29.54	-31.40
3.717	X	-	-	-89.94	20.41	37.47	-2.53	29.54	-32.07

Table 7-6. Radiated Measurements (Device to S-Pen Click - Hover WPT)

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7.3 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 7-7. 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

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Test Setup

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

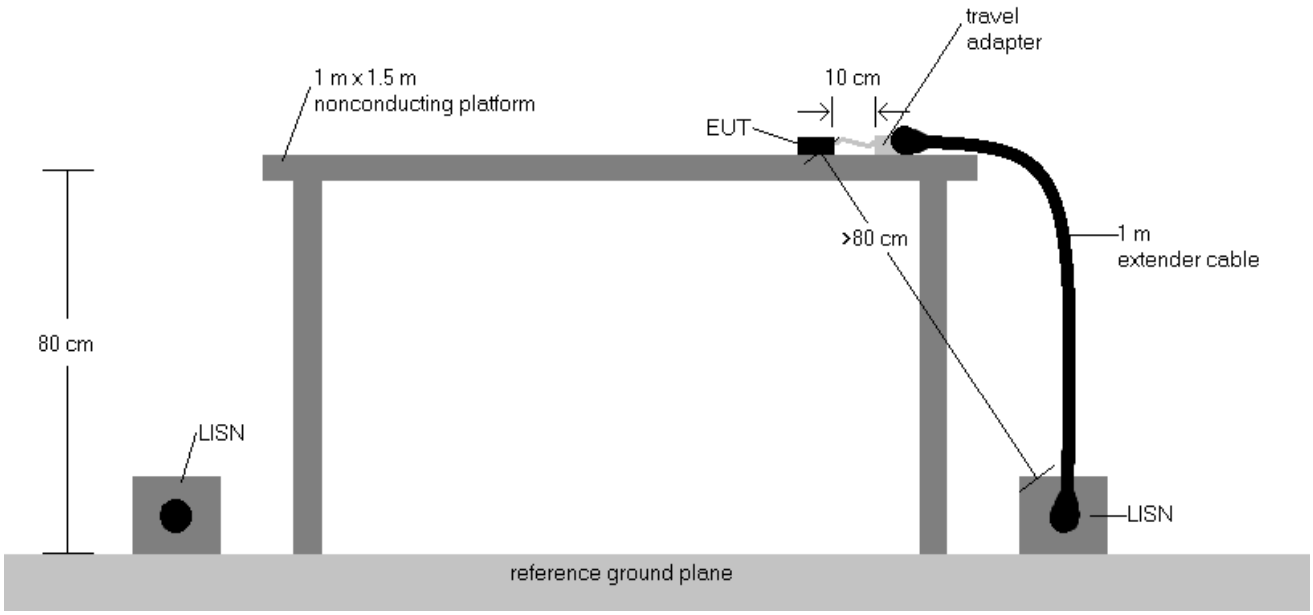

Figure 7-2. Test Instrument & Measurement Setup

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.

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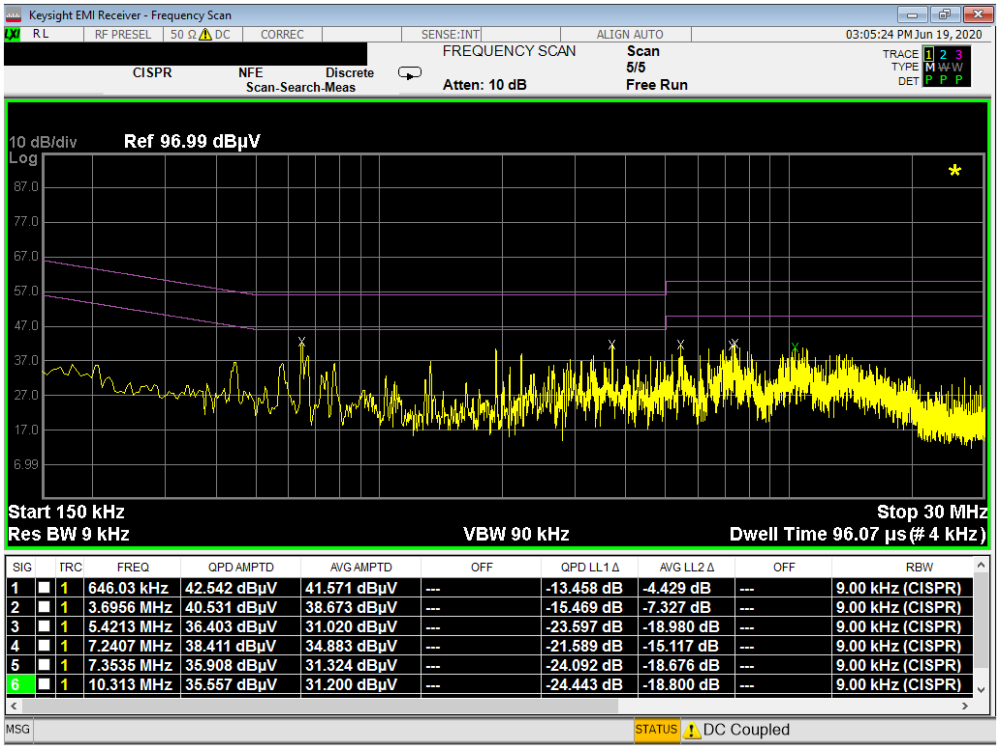
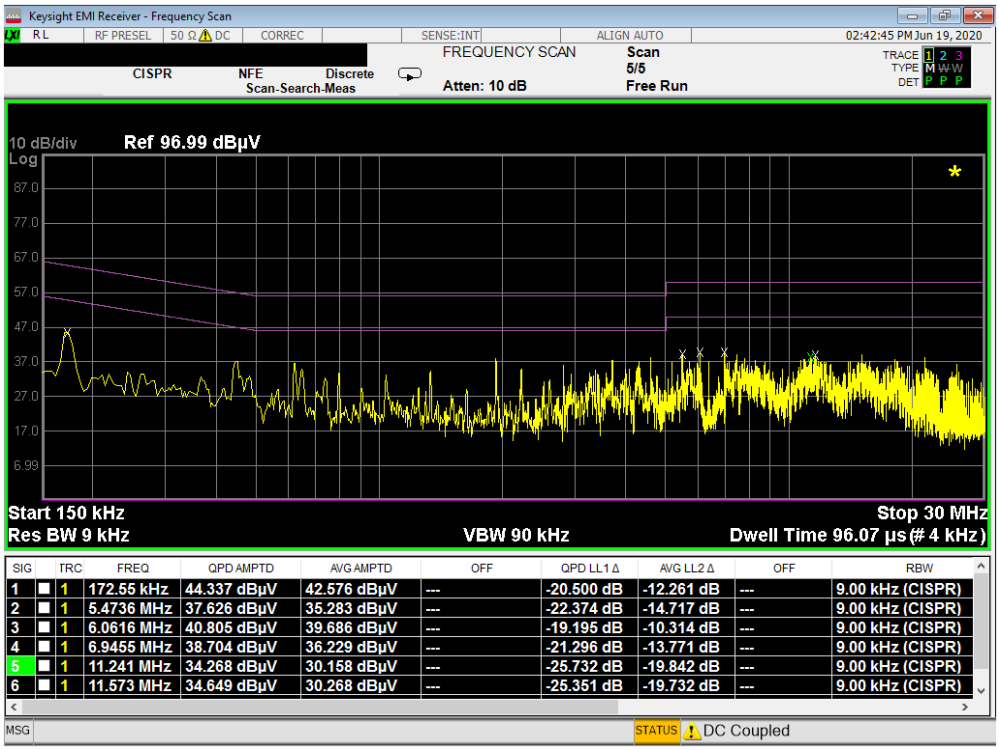


Plot 7-13. Line-Conducted Test Plot (L1) - Device to Device WPT



Plot 7-14. Line-Conducted Test Plot (N) - Device to Device WPT

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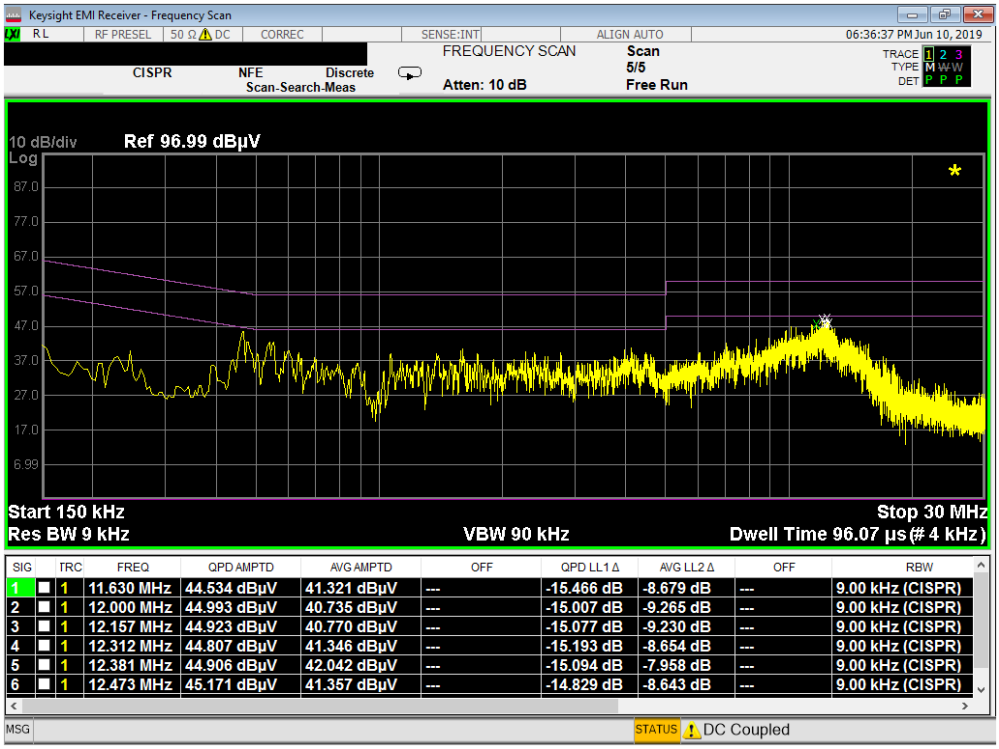
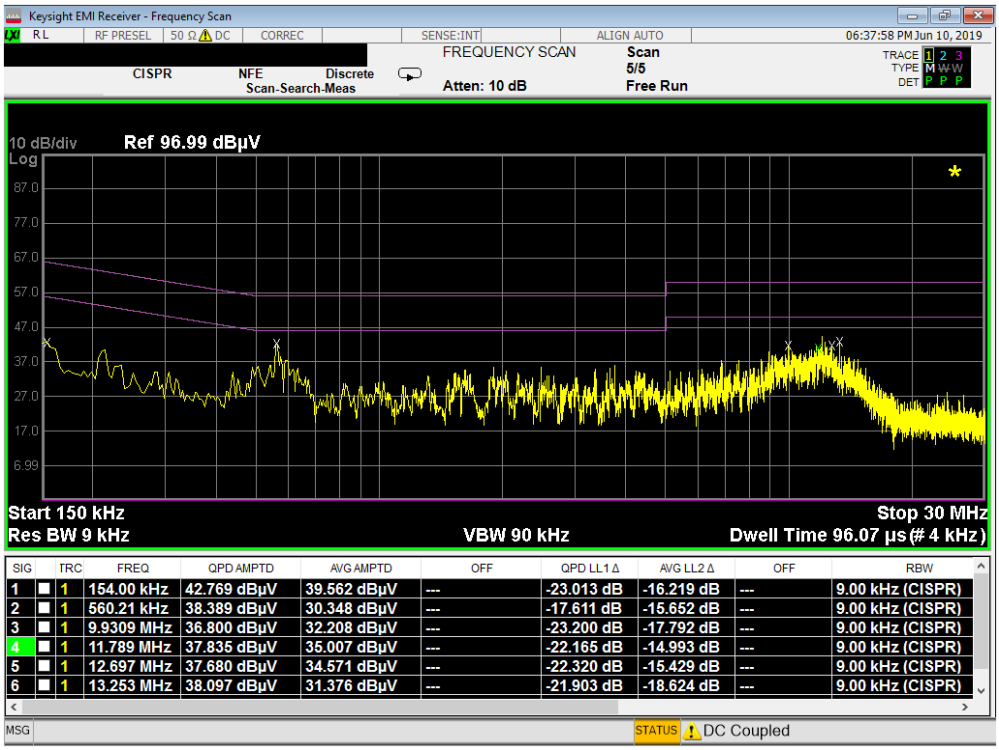


Plot 7-15. Line-Conducted Test Plot (L1) – Device to S-Pen



Plot 7-16. Line-Conducted Test Plot (N) - Device to S-Pen

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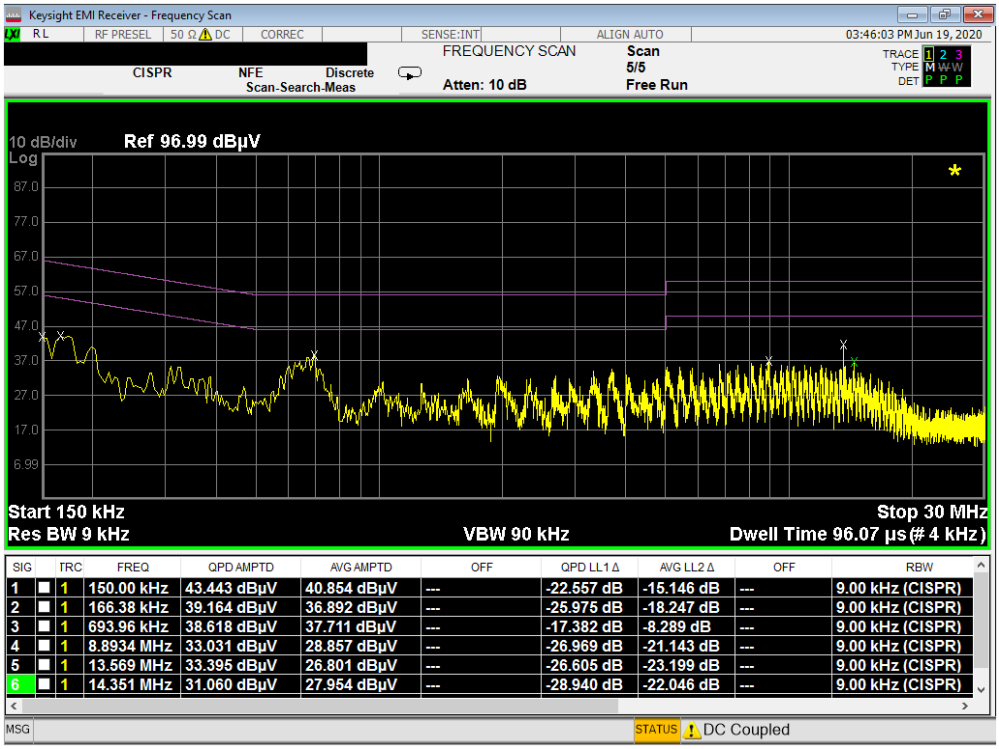
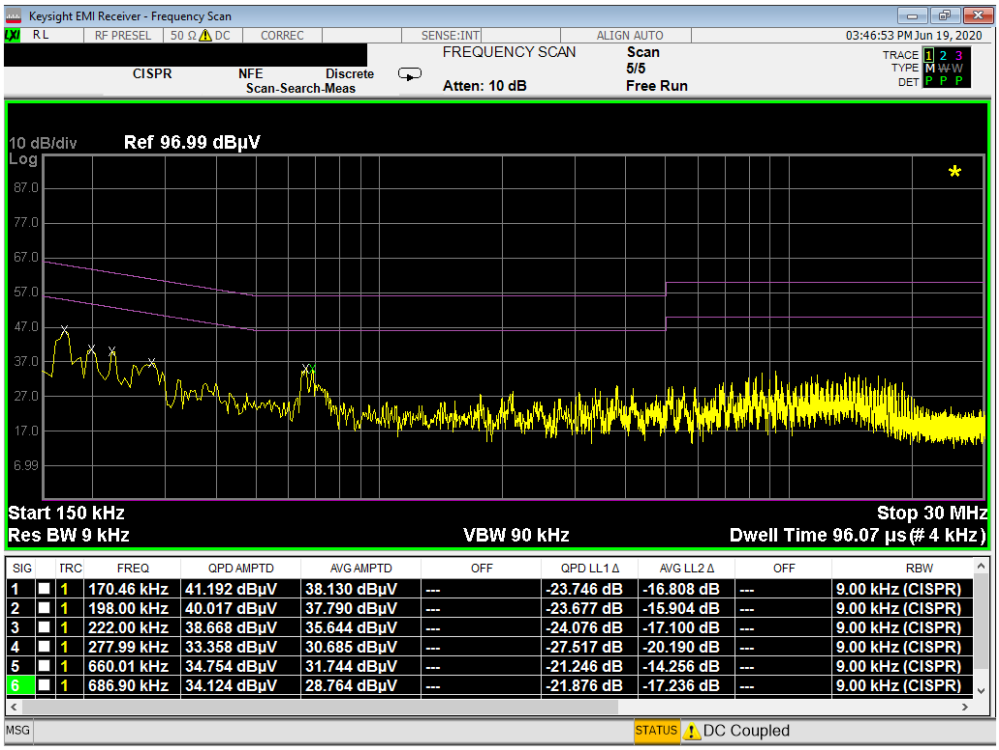


Plot 7-17. Line-Conducted Test Plot (L1) – Digitizer Hover



Plot 7-18. Line-Conducted Test Plot (N) – Digitizer Hover

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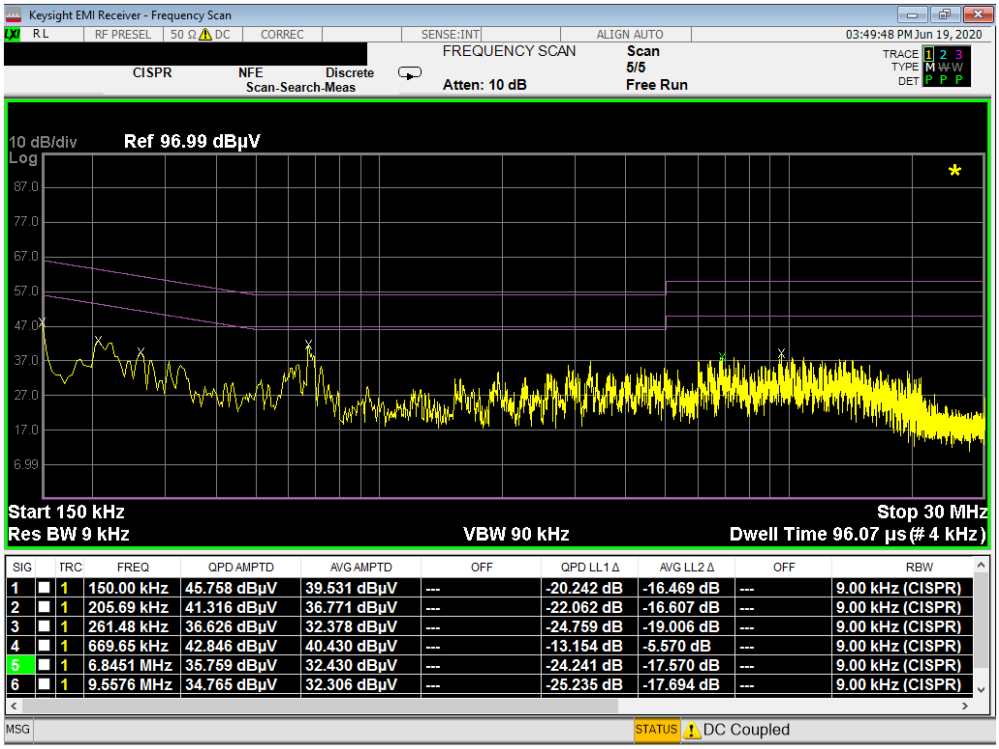
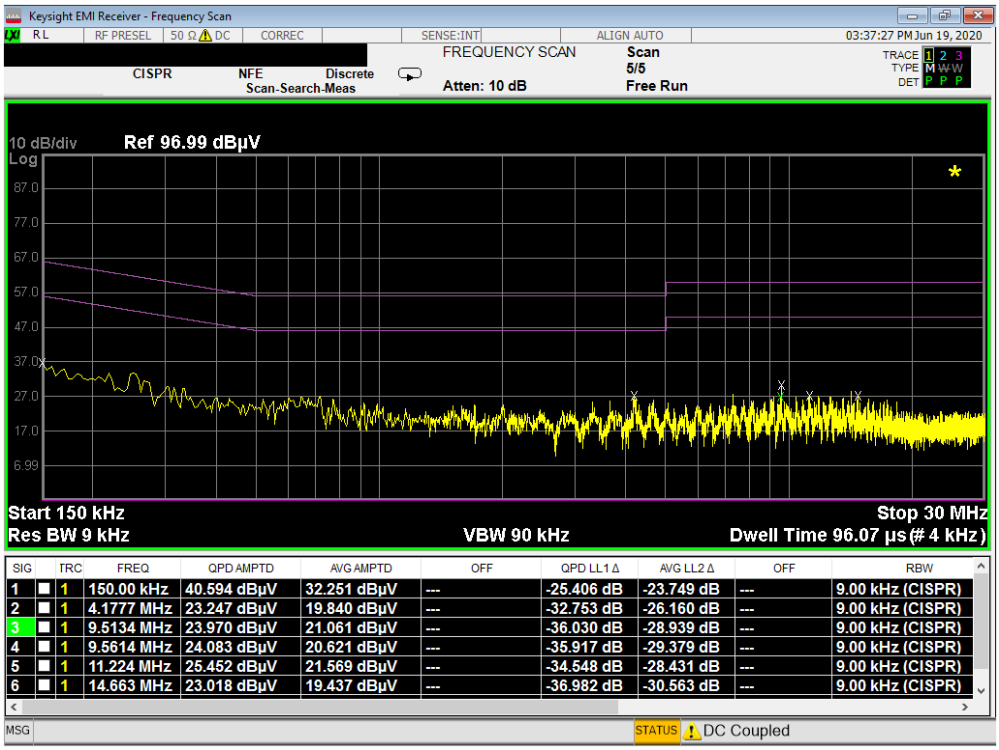


Plot 7-19. Line-Conducted Test Plot (L1) – Digitizer S-Pen Click



Plot 7-20. Line-Conducted Test Plot (N) – Digitizer S-Pen Click

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMN986JPN** has been verified to comply with the requirements specified in Part 15 (§15.207 and §15.209) of the FCC Rules.

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