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Report On

Radio Testing of the
Panasonic Corporation
Model BN-SW60SNL0 New Generation Inter Carriage Link System

FCC Part 15 Subpart C §15.255

Report No. SD72132947-1117A Rev1.0 **April 2018**

REPORT ON	Radio testing of the Panasonic Corporation Model No. BN-SW60SNL0
TEST REPORT NUMBER	SD72132947-1117A Rev1.0
REPORT DATE	April 2018
PREPARED FOR	Panasonic Corporation 571-8504, Osaka Prefecture, Kadoma City, Matsuo-machi 1-15
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APPROVED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/ Senior Wireless Test Engineer
DATED	April 03, 2018

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Revision History

SD72132947-1117A Rev1.0 Panasonic Corporation New Generation Inter Carriage Link System BN-SW60SNL0					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
03/21/2018	-	Initial Release			Ferdinand S. Custodio
04/03/2018	Initial Release	Rev 1.0	Correct EUT general description, test equipment Include HW and SW Version.	8, 9, 34	Ferdinand S. Custodio

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Panasonic Corporation
New Generation Inter Carriage Link System

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1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Panasonic Corporation Model BN-SW60SNL0 New Generation Inter Carriage Link System to the requirements of FCC Part 15 Subpart C §15.255 as per client test plan..

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Panasonic Corporation
Model Name	BN-SW60SNL0 New Generation Inter Carriage Link System
Model Number(s)	BN-SW60SNL0
FCC ID Number	ACJBN-SW60ANL0
Serial Number(s)/MAC address	#1 a8:13:74:85:bc:18 #2 a8:13:74:85:bc:19 #3 a8:13:74:85:bc:1b #4 a8:13:74:85:bc:3e
Number of Samples Tested	1
Test Specification/Issue/Date	FCC Part 15 Subpart C §15.255 (October 1, 2016).
Start of Test	December 06, 2017
Finish of Test	January 02, 2018
Name of Engineer(s)	Ivan Retana
Related Document(s)	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.255 and client's test plan is shown below:

Section	FCC Part 15	Test Description	Result	Comments/Base Standard
2.1	§15.255 (b)(1)	Transmitter Output Power	Compliant	
2.2	§15.255 (e)	Frequency Stability	Compliant	
2.3	§2.1049 and §2.202(a)	Occupied Bandwidth	Compliant	
2.4	§15.255 (c)	Field Strength Of Spurious Radiation	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Panasonic Corporation Model BN-SW60SNL0 New Generation Inter Carriage Link System. It is a system to connect information network between carriages wirelessly. The EUT is integrated in on-board train system.

1.3.2 EUT General Description

EUT Description	New Generation Inter Carriage Link System
Model Number(s)	BN-SW60SNL0
Rated Voltage	PoE from Industrial PoE Switching Hub 10Base-T/100Base-TX type
Intermediate Frequency	60.48 GHz
Capability	MCS6 is LDPC1/2and MCS5 is LDPC13/16
Modulation	Mode 1: π/2-BPSK (MCS-5) Mode 2: π/2-QPSK (MCS-6)
Data Rate	1251.25 Mbps/1540 Mbps
Channel Verified	Channel 2 (60.48 GHz)
Frequency Range	59.4 to 63.72 GHz
Antenna	N/A, printed antenna.
Size	N/A, printed antenna.
Antenna Gain	7 dBi

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1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	Tx Modulated Continuous Wave mode. EUT transmitting @ 60.48GHz with either MCS5 or MCS6 modulation.

1.4.2 EUT Exercise Software

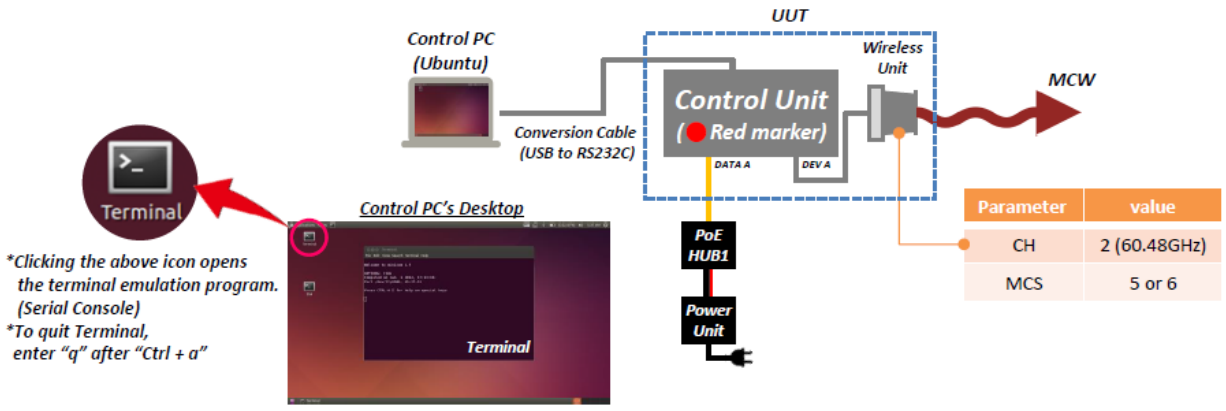
HW Ver. : 1.0
SW Ver. : 0.1.1.43025

Manufacturer provided a support laptop running Ubuntu with Terminal interface. Line commands were provided to put the EUT in corresponding RF test mode.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Diatrend Corp.	Industrial PoE Switching Hub	Model DEH-GTX5AT S/N DEH2013120083
TDK Lambda	Switching Power Supply for PoE Switching Hub	Model HWS100A S/N 08813733
ACER	Support Laptop	Model Aspire V (MS2392) S/N NXMPGSJ007530039F06600
ACER	AC Adapter for support laptop	Model A13-045N2A S/N F258341517013344
Elecom	Serial to USB adapter	Model UC-SGT1 S/N 6813889
-	Serial Cable	1.5 meters, DB9 female to female connector
Harting	PoE Cable	0.9 meter, EUT Data A to PoE Hub

1.4.4 Simplified Test Configuration Diagram



1.5 DEVIATIONS FROM THE STANDARD

All deviations made during testing from the applicable test standards or test plan (if any) are detailed under Section 1.2 of this test report.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number/MAC address #1 a8:13:74:85:bc:18, #2 a8:13:74:85:bc:19, #3 a8:13:74:85:bc:1b and #4 a8:13:74:85:bc:3e		
N/A		

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For conducted and radiated emissions, the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.10-2013. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 Fax: 858 546 0364.

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678-1436/65/67 Fax: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Designation is US1146.

1.9.2 Innovation, Science and Economic Development Canada (IC) Registration No.: 3067A-1 & 22806-1

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Rancho Bernardo) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A-1.

The 3m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 22806-1.

1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.9.4 NCC (National Communications Commission - US0102)

TUV SUD America Inc. (San Diego) is listed as a Foreign Recognized Telecommunication Equipment Testing Laboratory and is accredited to ISO/IEC 17025 (A2LA Certificate No.2955.13) which under APEC TEL MRA Phase 1 was designated as a Conformity Assessment Body competent to perform testing of equipment subject to the Technical Regulations covered under its scope of accreditation including RTTE01, PLMN01 and PLMN08 for TTE type of testing and LP002 for Low-Power RF Device type of testing.

1.9.1 VCCI – Registration No. A-0280 and A-0281

TUV SUD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.

1.9.2 RRA – Identification No. US0102

TUV SUD America Inc. (San Diego) is National Radio Research Agency (RRA) recognized laboratory under Phase I of the APEC Tel MRA.

1.9.3 OFCA – U.S. Identification No. US0102

TUV SUD America Inc. (San Diego) is recognized by Office of the Communications Authority (OFCA) under Appendix B, Phase I of the APEC Tel MRA.

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SECTION 2

TEST DETAILS

Radio Testing of the
Panasonic Corporation
New Generation Inter Carriage Link System

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2.1 TRANSMITTER OUTPUT POWER

2.1.1 Specification Reference

Part 15 Subpart C §15.255(b)(1) and §15.255(e)

2.1.2 Standard Applicable

(b) Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(1) Products other than fixed field disturbance sensors and short-range devices for interactive motion sensing shall comply with one of the following emission limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

2.1.3 Equipment Under Test and Modification State

Serial No: #1 a8:13:74:85:bc:18 / Default Test Configuration

2.1.4 Date of Test/Initial of test personnel who performed the test

December 06, 2017 /IR

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Mira Mesa facility (SR5)

Ambient Temperature	23.1 °C
Relative Humidity	29.7 %
ATM Pressure	100.5 kPa

2.1.7 Additional Observations

- This is a radiated test at 3 meters.
- Test methodology is per Section 9.10 of ANSI C63.10-2013 (Measurement of the fundamental emission using a spectrum analyser).
- RBW was set to 1 MHz
- VBW is 10 MHz.

- Sweep is auto.
- Field strength was calculated first using the formula:

  E = 126.8 – 20 log (λ) + P -G

  Where E is the field strength of the emission at the measurement distance, in dBµV/m
  P is the power measured at the output of the test antenna, in dBm
  Λ is the wavelength of the emission under investigation [300/f_{MHz}], in m
  G is the gain of the test antenna, in dBi

- Calculate EIRP from the measured field strength using the following equation:

  EIRP = E_{Meas} + 20 log (d_{Meas}) -104.7

  Where EIRP is the equivalent isotropically radiated power, in dBm
  E_{Meas} is the field strength of the emission at the measurement distance, in dBµV/m
  d_{Meas} is the measurement distance, in m

- Convert the result to the linear form using the following equation:

  $EIRP_{LINEAR} = 10^{[(EIRP_{Log}-30)/10]}$

  Where $EIRP_{LINEAR}$ is the equivalent isotropically radiated power, in watts
  $EIRP_{Log}$ is the equivalent isotropically radiated power, in dBm

- Finally calculate the conducted output power using the following equation:

  $P_{cond} = EIRP_{Linear} / G_{EUT}$

  Where P_{cond} is the conducted output power, in W
  $EIRP_{Linear}$ is the equivalent isotropically radiated power, in W
  G_{EUT} is numeric gain of the EUT radiating element (antenna)

2.1.8 Sample Calculation (MCS5 Average)

- Field strength was first calculated:

  E = 126.8 – 20 log (λ) + P -G
  = 126.8 – 20 log (300/59,792.2 MHz) + (-79.62 dBm) -0 dBi*
  = 70.17 dBµV/m
  **0 dBi was used since the antenna gain was not initially included on the offset of -33dB (preamp only)*

- EIRP was then calculated:

  EIRP = E_{Meas} + 20 log (d_{Meas}) -104.7
  = 70.17 dBµV/m + 20 log (3 meters) -104.7
  = -24.98 dBm

- Convert the result to linear form:

$EIRP_{LINEAR}$ $= 10^{[(EIRP_{Log}-30)/10]}$
$= 10^{[(-24.98\ dBm\ -30)/10\}}$
$= 31.76 \times 10^{-7}$ watt

- Finally calculate the conducted output power:

P_{cond} $= EIRP_{Linear} / G_{EUT}$
$= 31.76 \times 10^{-7}$ watt / 5.01
$= 6.32 \times 10^{-7}$ watt

2.1.9 Test Data

Channel 2 (60.48 GHz /Peak)					
Modulation	**Measured Level**	**Field Strength**	**EIRP**	**$EIRP_{Linear}$**	**Conducted Power**
MCS5	-70.78 dBm	102.01 dBµV/m	6.85 dBm	0.0048 watt	0.00097 watt
MCS6	-71.49 dBm	101.30 dBµV/m	6.14 dBm	0.0041 watt	0.00082 watt

Channel 2 (60.48 GHz /Average)					
Modulation	**Measured Level**	**Field Strength**	**EIRP**	**$EIRP_{Linear}$**	**Conducted Power**
MCS5	-79.62 dBm	93.17 dBµV/m	-1.99 dBm	0.00063 watt	0.00013 watt
MCS6	-79.79 dBm	93.00 dBµV/m	-2.16 dBm	0.00061 watt	0.00012 watt

2.1.10 Test Results

Channel 2 (60.48 GHz /Peak)		
Modulation	**Conducted Power**	**Limit**
MCS5	-0.15 dBm	43 dBm
MCS6	-0.86 dBm	43 dBm

Channel 2 (60.48 GHz /Average)		
Modulation	**Conducted Power**	**Limit**
MCS5	-8.98 dBm	40 dBm
MCS6	-9.16 dBm	40 dBm

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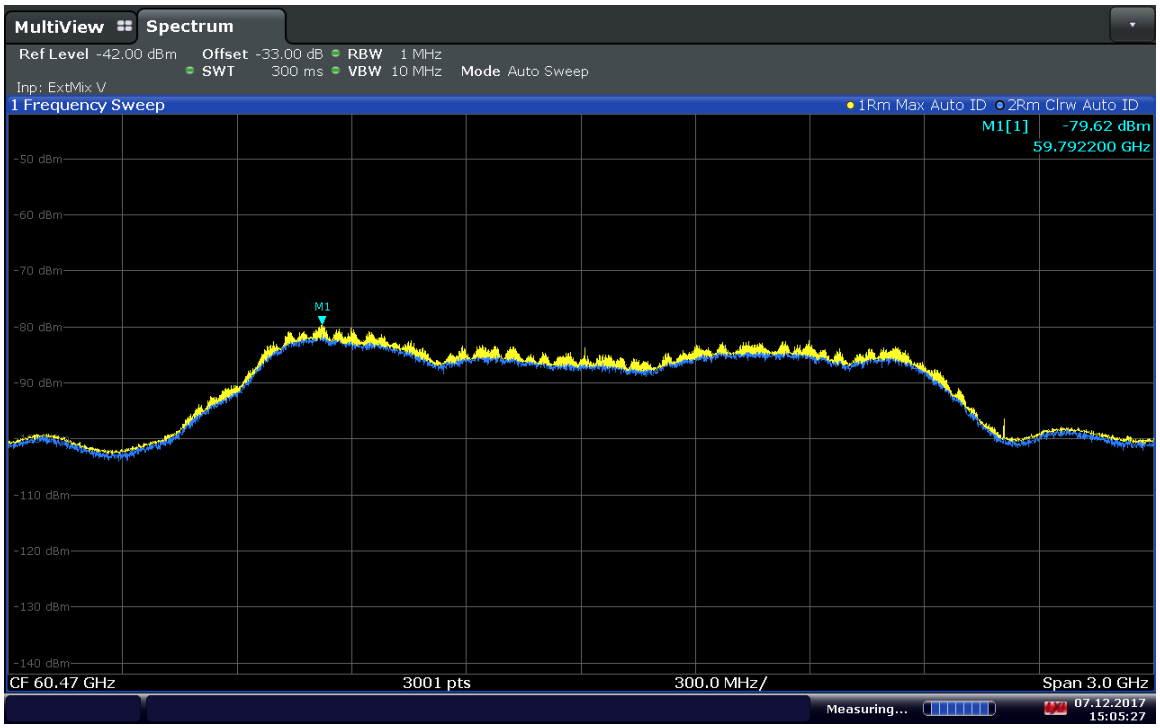
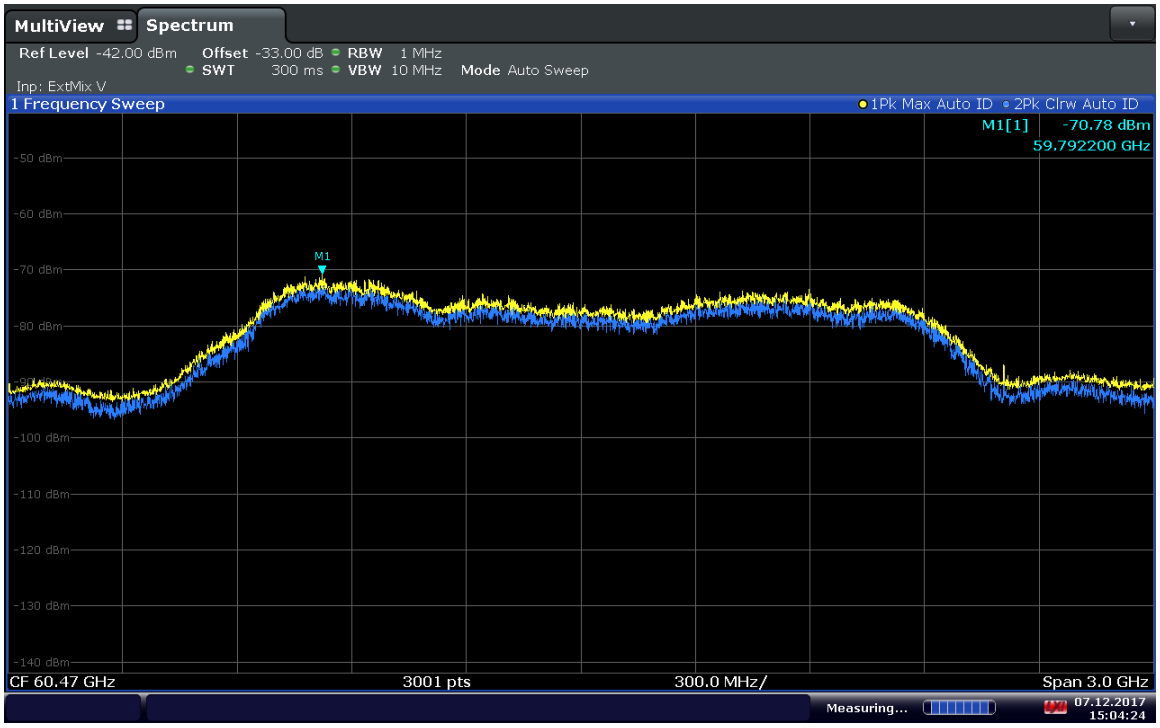


Date: 7.DEC.2017 15:05:28

MCS5 Average

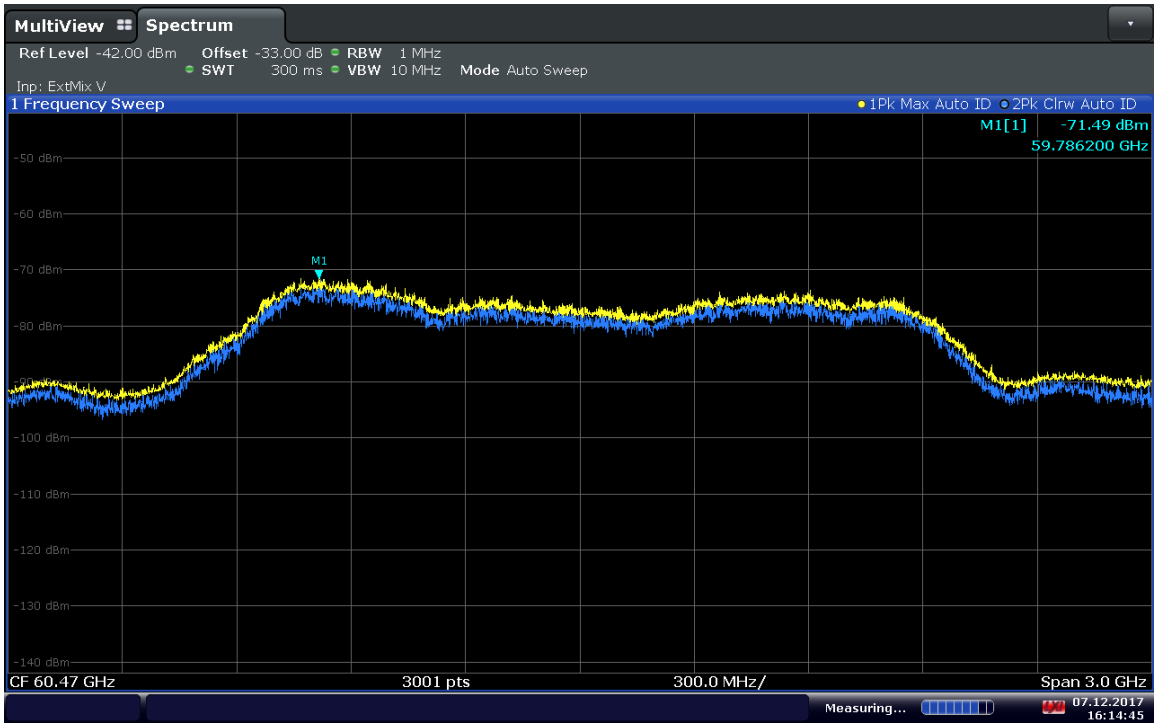


Date: 7.DEC.2017 15:04:25

MCS5 Peak

Date: 7.DEC.2017 16:13:21

MCS6 Average



Date: 7.DEC.2017 16:14:44

MCS6 Peak

2.2 FREQUENCY STABILITY

2.2.1 Specification Reference

Part 15 Subpart C §15.255(e)

2.2.2 Standard Applicable

(e) *Frequency stability.* Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

2.2.3 Equipment Under Test and Modification State

Serial No: #1 a8:13:74:85:bc:18 / Default Test Configuration

2.2.4 Date of Test/Initial of test personnel who performed the test

December 15, 2017 /IR

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Mira Mesa facility.

Ambient Temperature	25.3 °C
Relative Humidity	25.3 %
ATM Pressure	100.2 kPa

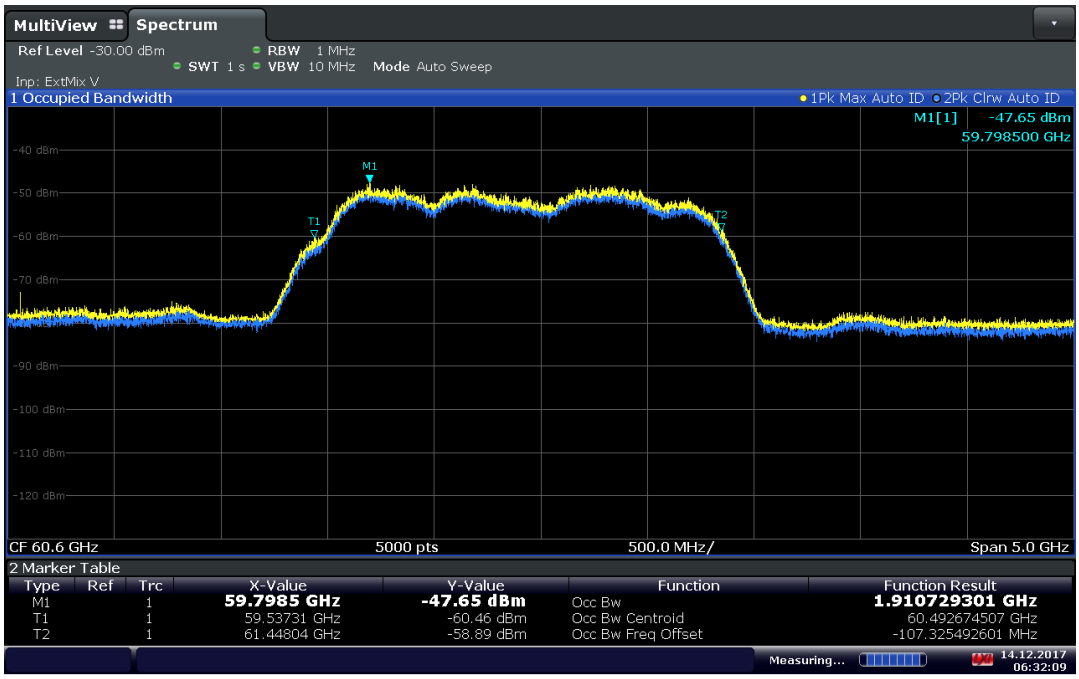
2.2.7 Additional Observations

- This is a radiated test.
- Test methodology is per Section 9.14 of ANSI C63.10-2013 (Frequency stability instrumentation and measurement procedures for millimeter-wave devices).
- Test performed with single channel and worst-case modulation only as per test plan.
- Since PoE is regulated, input voltage variation was performed on the 24VDC input of the PoE HUB.

2.2.8 Test Results

Frequency	Temperature	Voltage	Frequency Low f_L (GHz)	Frequency High f_H (GHz)
60.48 GHz	25°C	100%	59.53731	61.44804
	25°C	85%	59.53598	61.44858
	25°C	115%	59.54332	61.44570
	50°C	100%	59.53153	61.44189
	40°C	100%	59.53398	61.43544
	30°C	100%	59.55052	61.44164
	20°C	100%	59.53667	61.43445
	10°C	100%	59.53913	61.43495
	0°C	100%	59.53731	61.43498
	-10°C	100%	59.54118	61.43804
	-20°C	100%	59.54240	61.45557
f_L = 59.53153 GHz > 57.0 GHz f_H = 61.45557 GHz < 71.0 GHz EUT Complies				

2.2.9 Sample Test plots



06:32:10 14.12.2017

25°C @ 100% Input Voltage

07:56:07 14.12.2017

50°C @ 100% Input Voltage

15:39:24 14.12.2017

-20°C @ 100% Input Voltage

2.3 OCCUPIED BANDWIDTH

2.3.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049 and 2.202(a)

2.3.2 Standard Applicable

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

2.3.3 Equipment Under Test and Modification State

Serial No: #1 a8:13:74:85:bc:18 / Default Test Configuration

2.3.4 Date of Test/Initial of test personnel who performed the test

December 12, 2017 /IR

2.3.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Mira Mesa facility.

Ambient Temperature	24.2 °C
Relative Humidity	24.0 %
ATM Pressure	100.3 kPa

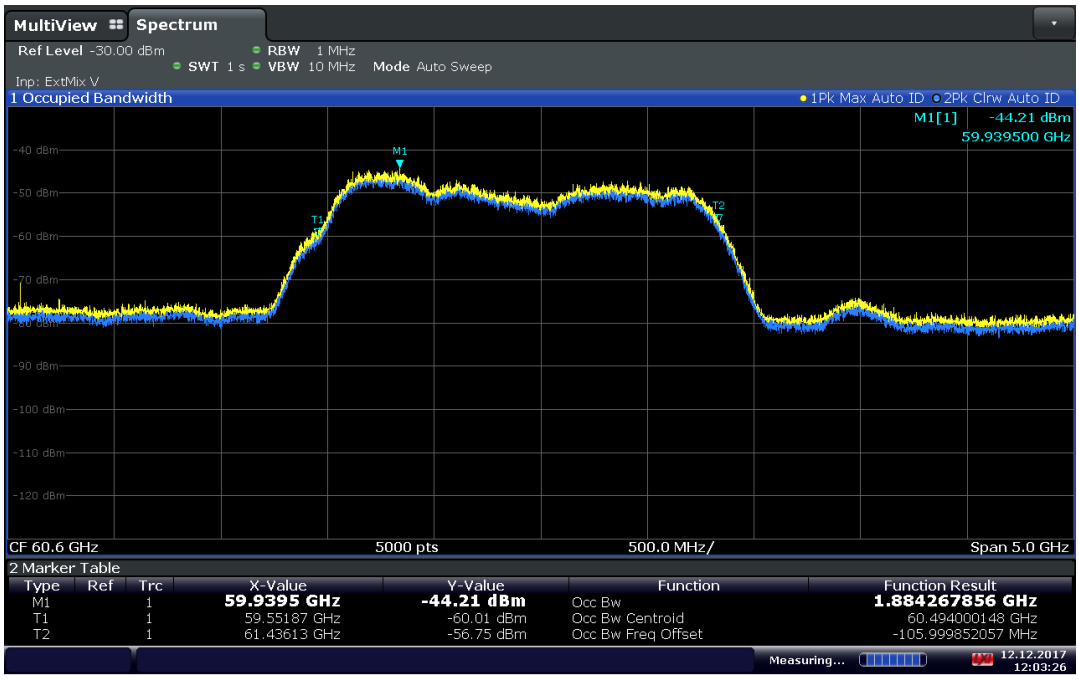
2.3.7 Additional Observations

- This is a radiated test.
- Test methodology is per Section 6.9.3 of ANSI C63.10-2013 (Occupied bandwidth—power bandwidth (99%) measurement procedure).
- Test performed at one channel only (60.48 GHz).
- Span set between 1.5X to 5X of the expected OBW.
- The peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.

2.3.8 Test Results

See attached test plots. For reporting purposes only.

2.3.9 Test Plots



12:03:26 12.12.2017

99% OBW MCS5 (1.88 GHz)

12:07:27 12.12.2017

99% OBW MCS6 (1.89 GHz)

2.4 FIELD STRENGTH OF SPURIOUS RADIATION

2.4.1 Specification Reference

Part 15 Subpart C §15.255(c)

2.4.2 Standard Applicable

(c) Limits on spurious emissions:

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

2.4.3 Equipment Under Test and Modification State

Serial No: #1 a8:13:74:85:bc:18 / Default Test Configuration

2.4.4 Date of Test/Initial of test personnel who performed the test

December 08, January 02 2017 /IR

2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Mira Mesa / Rancho Bernardo facility

Ambient Temperature	24.0 – 25.4°C
Relative Humidity	38.3 – 25.1%
ATM Pressure	99.2 – 100.9 kPa

2.4.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30 MHz to 200 GHz. There are no significant spurious emissions observed.
- Spurious emissions (if any) will be verified per Section 9.12 and 9.13 of ANSI C63.10-2013 (Measurement of harmonic and spurious emissions above 40 GHz / Measurement of harmonic and spurious emissions at or below 40 GHz).
- Test performed at one channel only (60.48 GHz) and worst-case modulation.

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- Test distance of 3 m was used for the spurious emissions measurement below 60 GHz. The emissions in the range from 60 GHz to 160 GHz were evaluated at 1.0 m distance. For the measurements in the ranges from 160 GHz to 200 GHz, the test distance was reduced to 0.5 m to assure that the noise floor is at least 10 dB below the applicable limit.
- Corrections factors of 9.54 dB and 15.56 dB were used to extrapolate the field strengths measured at 1.0 metres and 0.5 meters to the 3 meters measurement distance specified by the standard.
- All the emissions below 40 GHz comply with the general radiated emission limits of §15.209.
- Measurements below 40 GHz were done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.4.8 for sample computation.

2.4.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.4.9 Limits Used

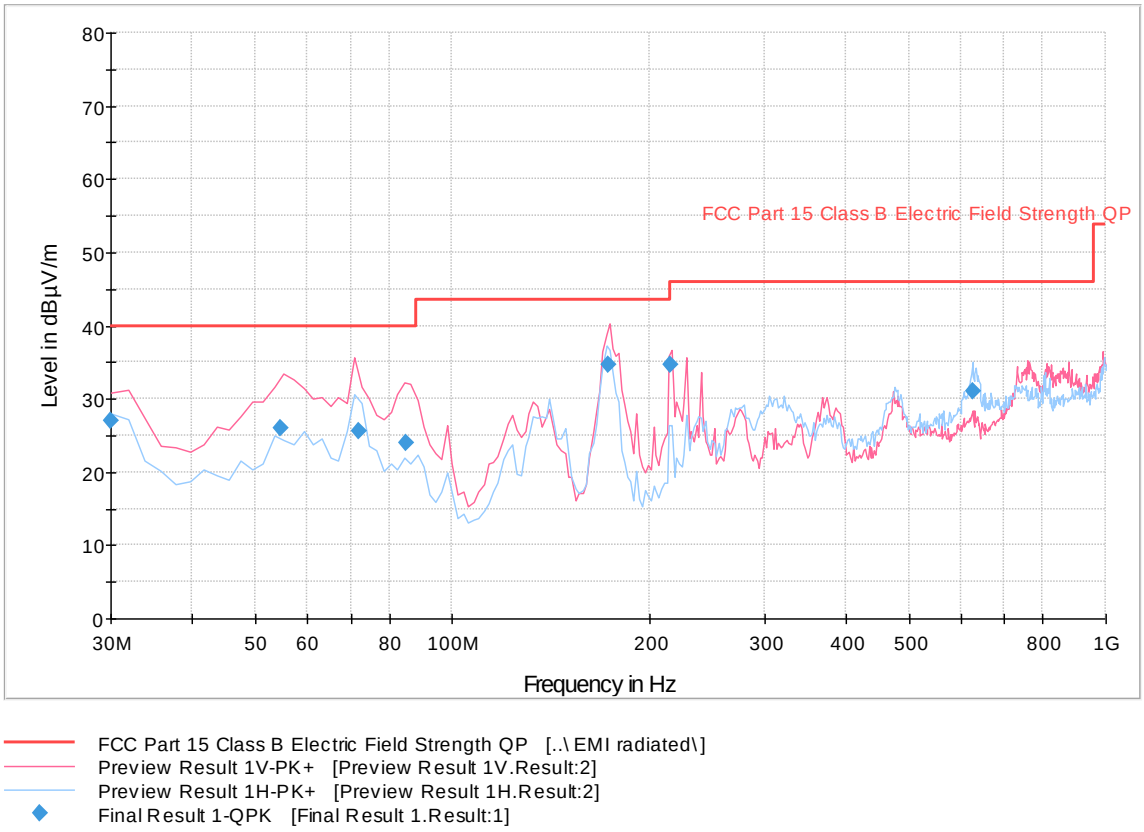
Frequency Range	Measurement Distance	Limits Requirement	Limit Used
Below 40GHz	3 meters	§15.209 Limits @ 3 meters	§15.209 Limits
40 GHz to 60 GHz	3 meters	90 pW/cm^2 @ 3 meters	94.85 dBµV/m
60 GHz to 75 GHz	1 meter		94.85 dBµV/m
75 GHz to 110 GHz	1 meter		94.85 dBµV/m
110 GHz to 160 GHz	1 meter		94.85 dBµV/m
160 GHz to 200 GHz	0.5 meter		100.87 dBµV/m

90 pW/cm^2 @ 3 meters = 85.31 dBµV/m (based on free space condition / impedance of 377 ohm)

2.4.10 Test Results

Compliant. See attached plots and tables.

2.4.11 Test Results Below 1GHz

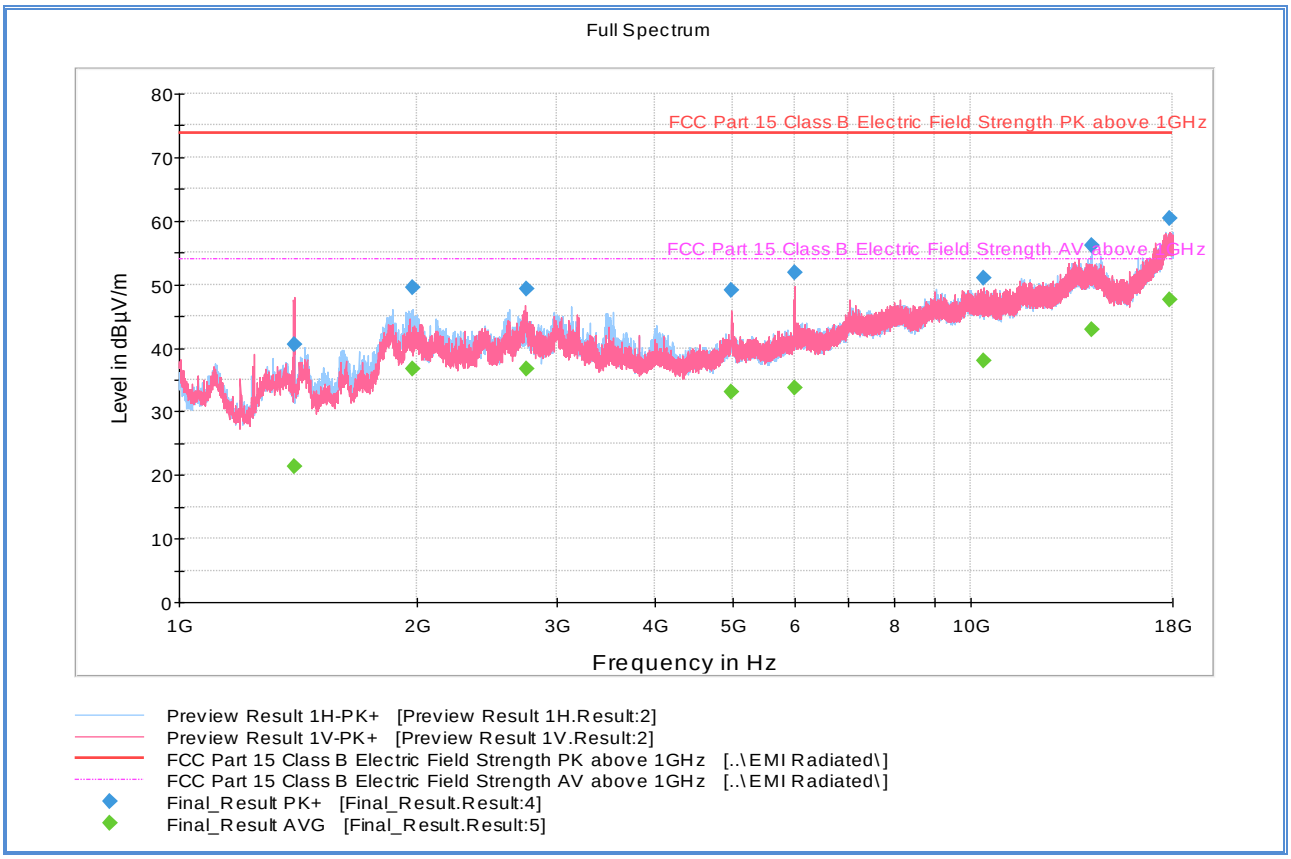


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.040000	27.0	1000.0	120.000	100.0	V	272.0	-5.9	13.0	40.0
54.510541	26.0	1000.0	120.000	100.0	V	15.0	-15.5	14.0	40.0
71.861643	25.7	1000.0	120.000	100.0	V	186.0	-16.9	14.3	40.0
85.012745	24.0	1000.0	120.000	200.0	V	229.0	-16.8	16.0	40.0
173.423808	34.7	1000.0	120.000	100.0	V	106.0	-12.4	8.8	43.5
215.973226	34.7	1000.0	120.000	100.0	V	67.0	-11.0	8.8	43.5
627.589659	31.1	1000.0	120.000	100.0	H	41.0	1.4	14.9	46.0

Test Note: To comply with the requirement, the test laptop was removed. EUT remains transmitting at that point.

2.4.12 Test Results 1 GHz to 18 GHz



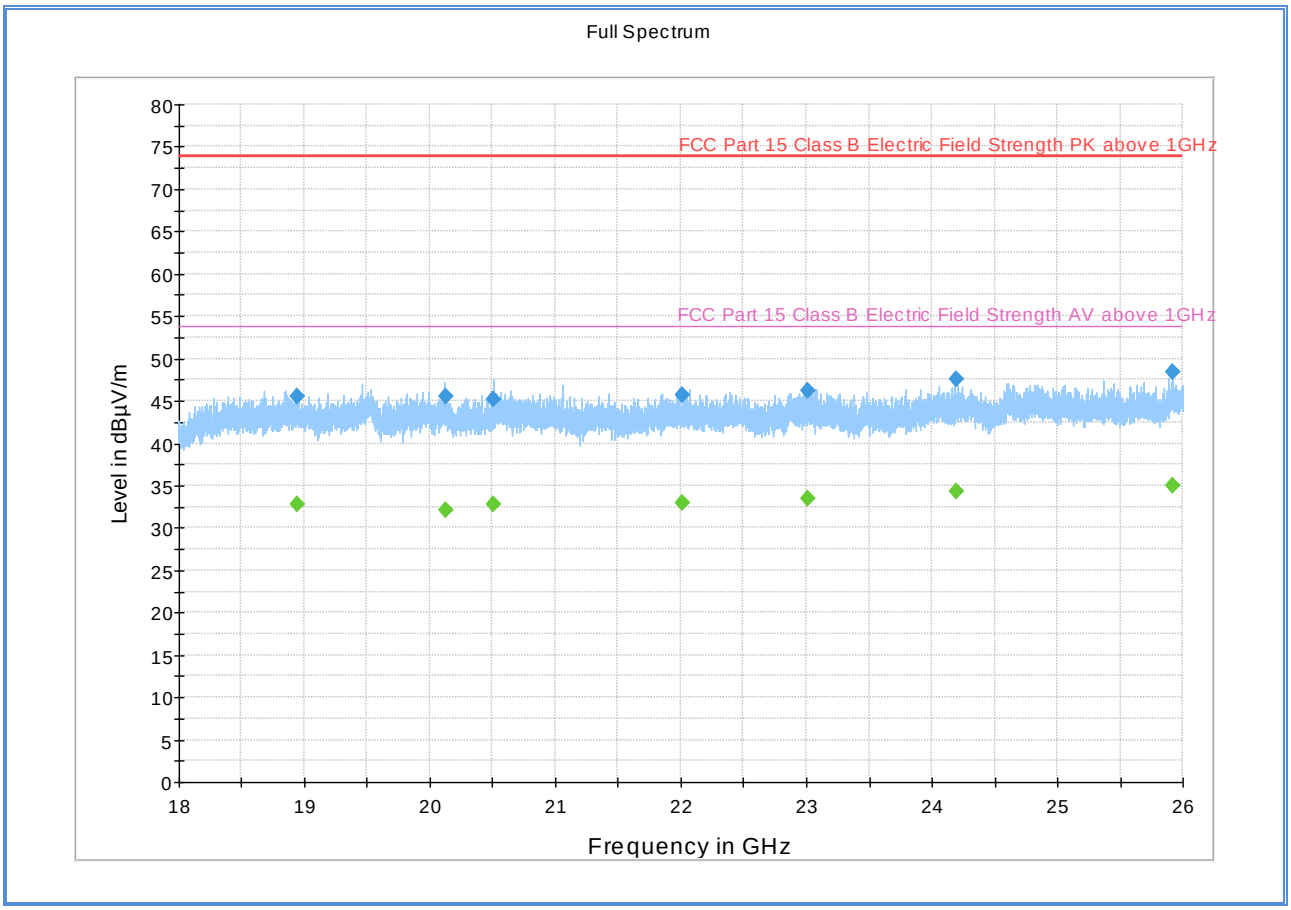
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV /m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1398.00000	40.50	73.90	33.40	1000.0	1000.000	384.5	V	211.0	-3.6
1970.30000	49.53	73.90	24.37	1000.0	1000.000	252.3	H	11.0	-0.2
2746.56666	49.18	73.90	24.72	1000.0	1000.000	410.3	V	13.0	1.7
4978.43333	49.02	73.90	24.88	1000.0	1000.000	237.1	V	189.0	10.0
5999.20000	51.75	73.90	22.15	1000.0	1000.000	101.7	V	266.0	12.6
10386.4333	50.99	73.90	22.91	1000.0	1000.000	99.9	V	328.0	19.7
14253.1666	56.08	73.90	17.82	1000.0	1000.000	361.6	H	246.0	25.0
17830.8000	60.47	73.90	13.43	1000.0	1000.000	297.9	V	125.0	29.4

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV /m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1398.00000	21.26	53.90	32.64	1000.0	1000.000	384.5	V	211.0	-3.6
1970.30000	36.63	53.90	17.27	1000.0	1000.000	252.3	H	11.0	-0.2
2746.56666	36.59	53.90	17.31	1000.0	1000.000	410.3	V	13.0	1.7
4978.43333	32.99	53.90	20.91	1000.0	1000.000	237.1	V	189.0	10.0
5999.20000	33.61	53.90	20.29	1000.0	1000.000	101.7	V	266.0	12.6
10386.4333	37.89	53.90	16.01	1000.0	1000.000	99.9	V	328.0	19.7
14253.1666	42.92	53.90	10.98	1000.0	1000.000	361.6	H	246.0	25.0
17830.8000	47.51	53.90	6.39	1000.0	1000.000	297.9	V	125.0	29.4

2.4.13 Test Results from 18 GHz to 26 GHz



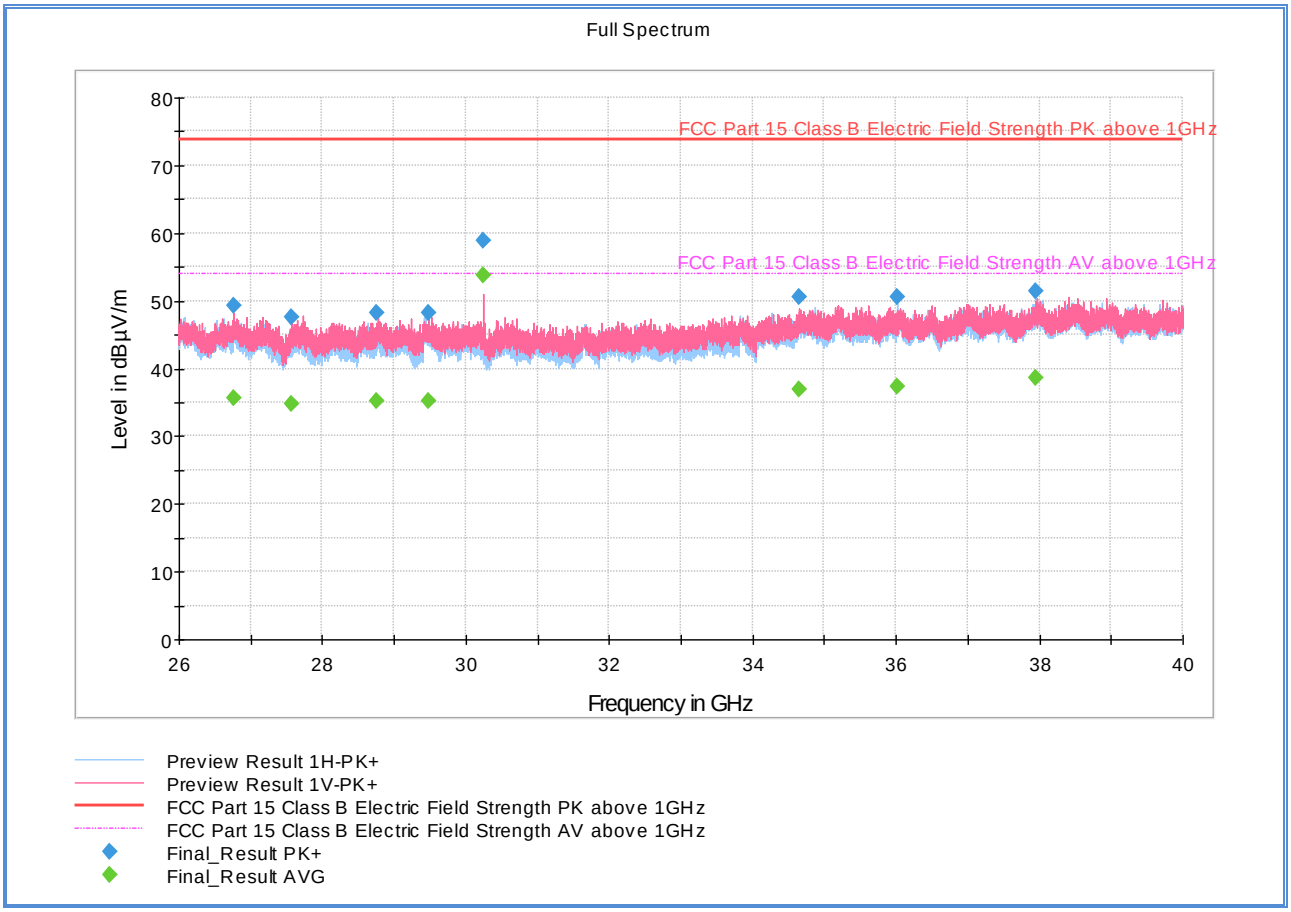
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
18938.600	45.52	73.90	28.38	1000.0	1000.000	H	302.0	-0.7
20122.200	45.48	73.90	28.42	1000.0	1000.000	H	18.0	-0.7
20509.000	45.22	73.90	28.68	1000.0	1000.000	H	242.0	-0.6
22007.800	45.74	73.90	28.16	1000.0	1000.000	H	214.0	0.4
23010.200	46.13	73.90	27.77	1000.0	1000.000	H	173.0	0.9
24198.200	47.48	73.90	26.42	1000.0	1000.000	H	144.0	1.3
25922.200	48.40	73.90	25.50	1000.0	1000.000	H	306.0	1.8

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
18938.600	32.77	73.90	41.13	1000.0	1000.000	H	302.0	-0.7
20122.200	32.10	73.90	41.80	1000.0	1000.000	H	18.0	-0.7
20509.000	32.73	73.90	41.17	1000.0	1000.000	H	242.0	-0.6
22007.800	32.96	73.90	40.94	1000.0	1000.000	H	214.0	0.4
23010.200	33.44	73.90	40.46	1000.0	1000.000	H	173.0	0.9
24198.200	34.26	73.90	39.64	1000.0	1000.000	H	144.0	1.3
25922.200	35.02	73.90	38.88	1000.0	1000.000	H	306.0	1.8

2.4.14 Test Results from 26 GHz to 40 GHz



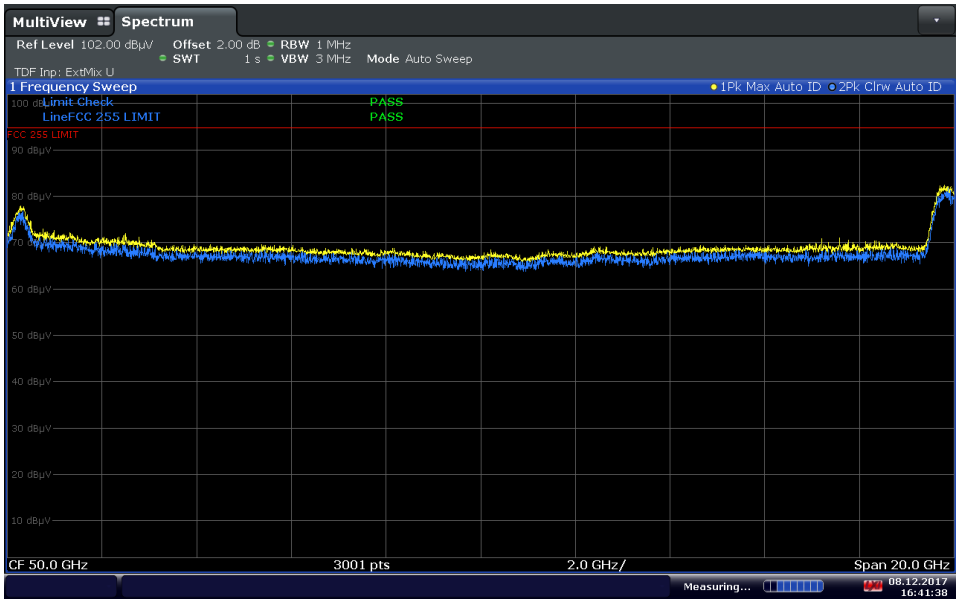
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV /m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
26770.0923	49.26	73.90	24.64	1000.0	1000.000	104.9	V	157.0	2.4
27566.2769	47.58	73.90	26.32	1000.0	1000.000	125.3	V	109.0	3.0
28765.2923	48.23	73.90	25.67	1000.0	1000.000	104.9	V	121.0	3.5
29481.2923	48.31	73.90	25.59	1000.0	1000.000	125.2	V	40.0	3.4
30240.0461	58.88	73.90	15.02	1000.0	1000.000	116.5	V	101.0	3.9
34657.0615	50.50	73.90	23.40	1000.0	1000.000	125.2	V	70.0	6.3
36020.7846	50.62	73.90	23.28	1000.0	1000.000	175.1	H	190.0	6.7
37951.1538	51.45	73.90	22.45	1000.0	1000.000	128.4	H	62.0	7.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV /m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
26770.0923	35.55	53.90	18.35	1000.0	1000.000	104.9	V	157.0	2.4
27566.2769	34.75	53.90	19.15	1000.0	1000.000	125.3	V	109.0	3.0
28765.2923	35.11	53.90	18.79	1000.0	1000.000	104.9	V	121.0	3.5
29481.2923	35.13	53.90	18.77	1000.0	1000.000	125.2	V	40.0	3.4
30240.0461	53.67	53.90	0.23	1000.0	1000.000	116.5	V	101.0	3.9
34657.0615	36.98	53.90	16.92	1000.0	1000.000	125.2	V	70.0	6.3
36020.7846	37.39	53.90	16.51	1000.0	1000.000	175.1	H	190.0	6.7
37951.1538	38.71	53.90	15.19	1000.0	1000.000	128.4	H	62.0	7.9

2.4.15 Test Results 40 GHz to 300 GHz



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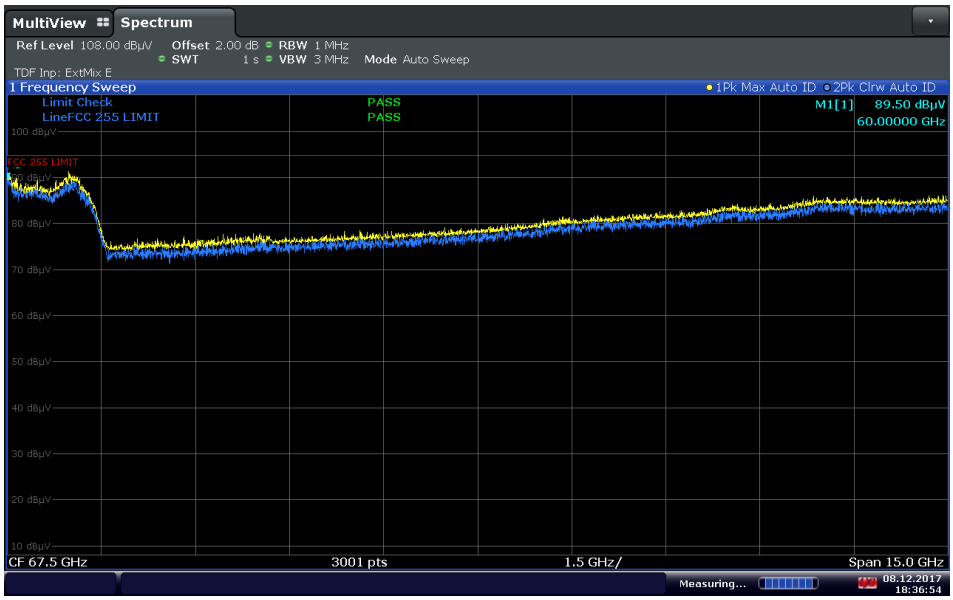
40 to 60 GHz



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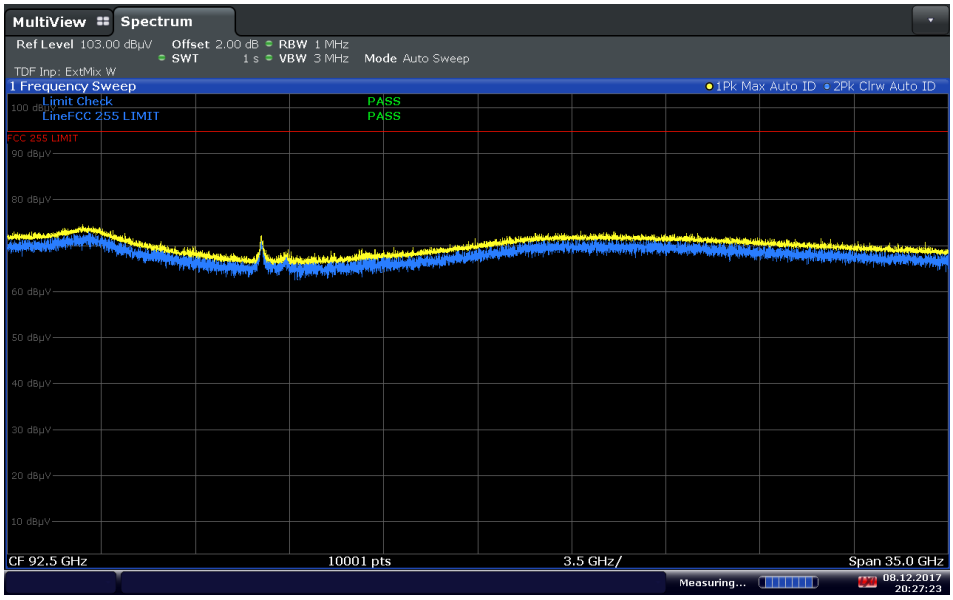
60 to 75 GHz



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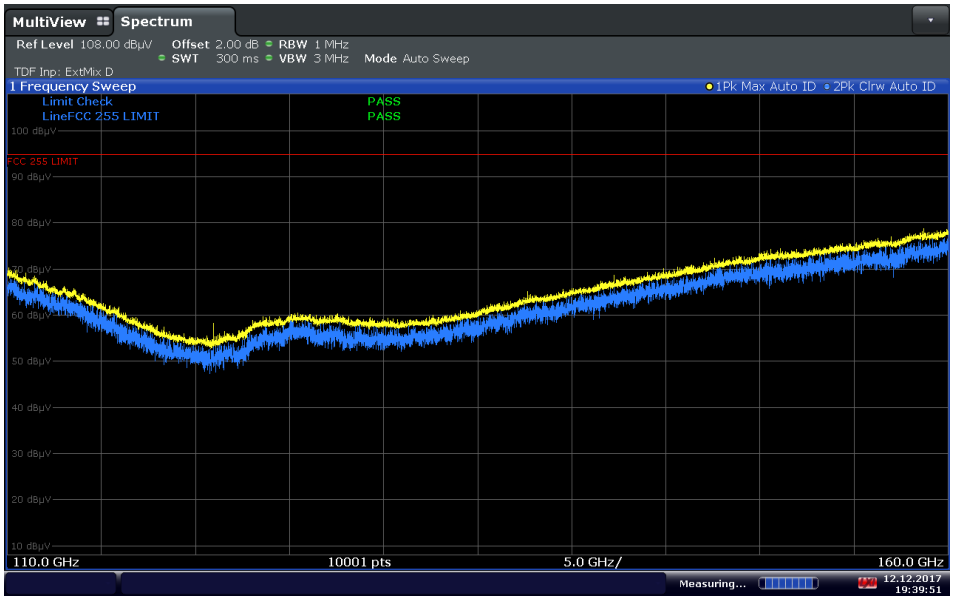
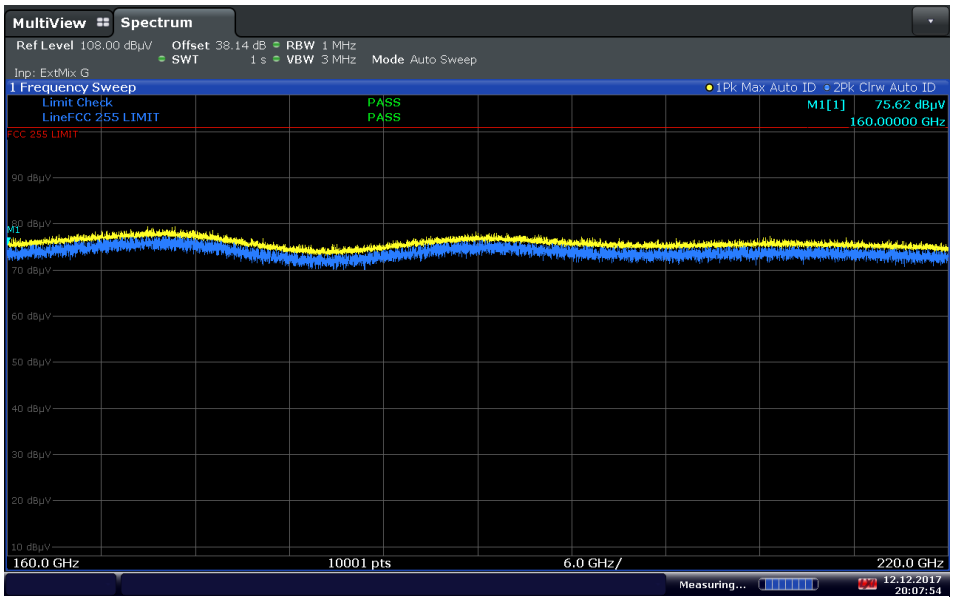
75 to 110 GHz



Date: 12.DEC.2017 19:39:51

110 to 160 GHz



Date: 12.DEC.2017 20:07:54

160 to 200 GHz

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment. treshold

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Radiated Test Setup						
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/16/17	05/16/18
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	04/25/17	04/25/18
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/20/17	11/20/19
8891	Pre-Amplifier	PE15A3262	1012	TUV SUD America	06/15/17	06/15/18
7631	Double-ridged waveguide horn antenna	3117	00205418	ETS-Lindgren	08/03/17	08/03/18
9001	Horn antenna (18-26 GHz)	HO42S	101	Custom Microwaves	08/18/17	08/18/19
9002	Horn antenna (26-40 GHz)	HO28S	102	Custom Microwaves	07/14/17	07/14/19
9003	Horn antenna (40-60 GHz)	HO19R	103	Custom Microwaves	07/19/17	07/19/19
9004	Horn antenna (50-75 GHz)	HO15R	104	Custom Microwaves	07/19/17	07/19/19
7628	Horn antenna (75-110 GHz)	SAR-2309-10-S2	13481-01	Sage Millimeter, Inc.	08/16/17	08/16/19
9081	Horn antenna (110-170 GHz)	HO6R	N/A	Custom Microwaves	Verified	
9082	Horn antenna (140-220 GHz)	HO5R	N/A	Custom Microwaves	Verified	
9080	Horn antenna (220-325 GHz)	HO3R	N/A	Custom Microwaves	Verified	
7620	EMI Test Receiver	ESU40	100399	Rhode & Schwarz	10/17/17	10/17/18
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/09/17	02/09/18
8893	Pre-amplifier (18-40 GHz)	SLKKa-30-6	15G27	Spacek Labs	Verified by 1003 and 7611	
7637	Harmonics mixer (40-60 GHz)	FS-Z60	100009	Rhode & Schwarz	01/26/16	01/26/18
1647192E	Harmonics mixer (50-75 GHz)	FS-Z75	100983	Rhode & Schwarz	05/11/17	05/11/18
7636	Harmonics mixer (60-90 GHz)	FS-Z90	100092	Rhode & Schwarz	Verified	
7633	Harmonics mixer (75-110 GHz)	HM-110-7	101000	Radiometer Physics	Verified	
7634	Harmonics mixer (110-170 GHz)	HM-170	0062	Radiometer Physics	05/10/16	05/10/18
7635	Harmonics mixer (170-220 GHz)	HM-220	020022	Radiometer Physics	06/10/16	06/10/18
7632	Harmonics mixer (220-325 GHz)	HM-325	020075	Radiometer Physics	06/14/16	06/14/18
8872	Direct Reading Attenuator	STA-60-19-D1	11875-01	Sage Millimeter, Inc.	Verified	
8860	Direct Reading Attenuator	STA-60-15-D1	11466-01	Sage Millimeter, Inc.	Verified	
8861	Direct Reading Attenuator	STA-60-10-D1	11466-01	Sage Millimeter, Inc.	Verified	
8873	Active Multiplier (40-60 GHz)	AMC-19-RFH00	124	Millitech, Inc.	Verified	
8914	Active Multiplier (50-75 GHz)	AMC-15-RFH00	283	Millitech, Inc.	Verified	
8915	Active Multiplier (75-110 GHz)	AMC-10-RFH00	606	Millitech, Inc.	Verified	
8922	High-frequency cable	R90-088-200	N/A	Teledyne	02/10/17	02/10/18
1026	High-frequency cable	3M-7/C2	N/A	MicroCoax	04/26/17	04/26/18
8849	High-frequency cable (1-18 GHz)	SAC-26G-6.1	363	A.H.Systems	04/23/17	04/23/18
8771	6dB attenuator	606-06-1F4/DR	N/A	MECA	10/11/17	10/11/18
Miscellaneous						
6708	Multimeter	34401A	US36086974	Hewlett Packard	07/05/17	07/05/18
7554	Barometer/Temperature/Humidity Transmitter	iBTHX-W	0400706	Omega	01/17/17	01/17/18
7579	Temperature Chamber	115	151617	TestQuity	08/22/17	08/22/18

118208	DC Power Supply	Pad 250-4.5L	29051058	Kikusui Electronics Corp.	Verified by 6708
9076	DC Power Supply	18020M	P802039	Protek	Verified by 6708
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Radiated Emission Measurements (Below 1 GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Triangular	3.55	1.45	2.10
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.69
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.38

3.2.2 Radiated Emission Measurements (1 GHz to 18 GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Triangular	3.55	1.45	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	2.40
				Coverage Factor (k):	2
				Expanded Uncertainty:	4.81

3.2.3 Radiated Emission Measurements (Above 18 GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Spectrum Analyzer/External Mixer	Rectangular	3.34	1.93	3.72
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.50	0.87	0.75
				Combined Uncertainty (u_c):	2.67
				Coverage Factor (k):	2
				Expanded Uncertainty:	5.35

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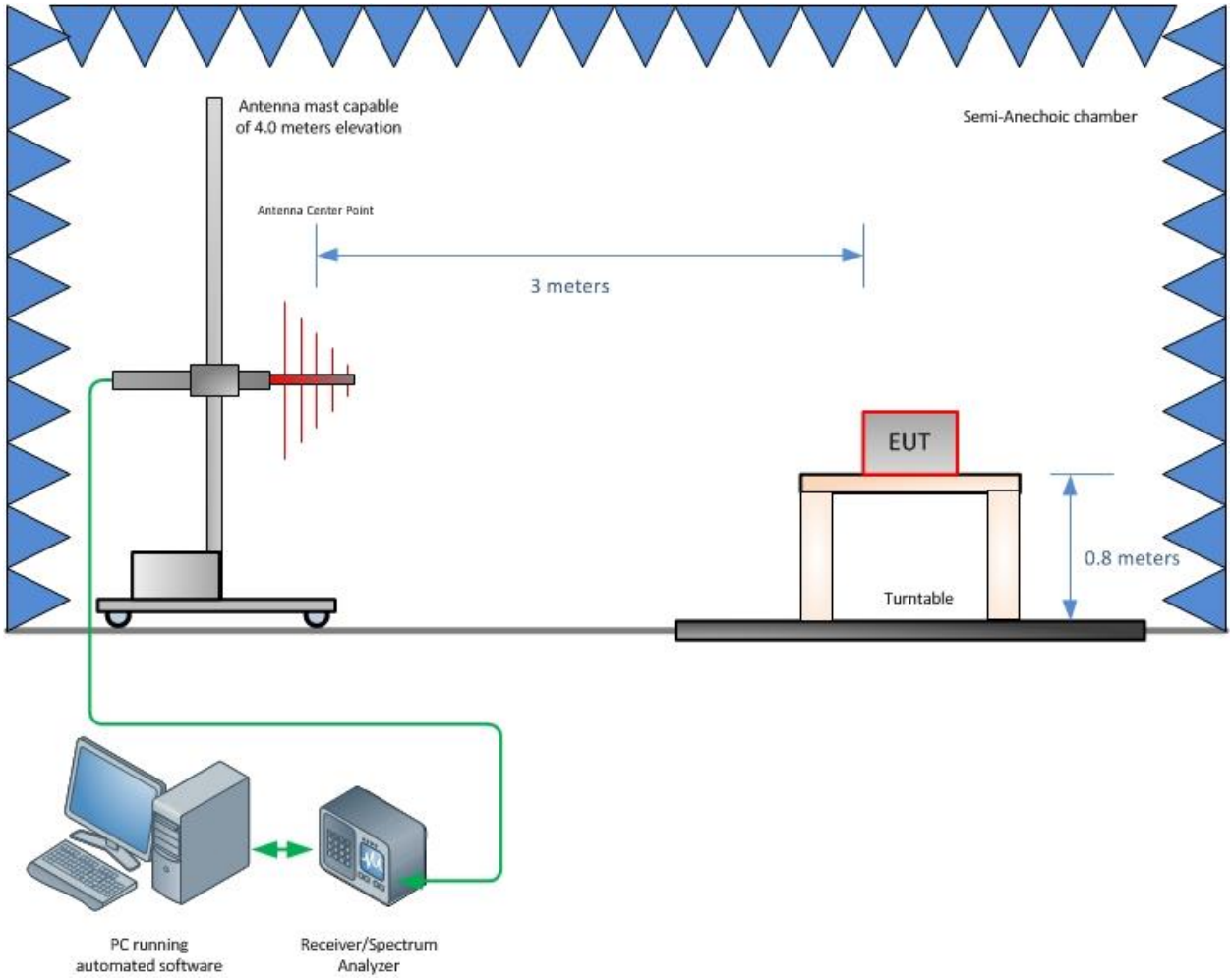
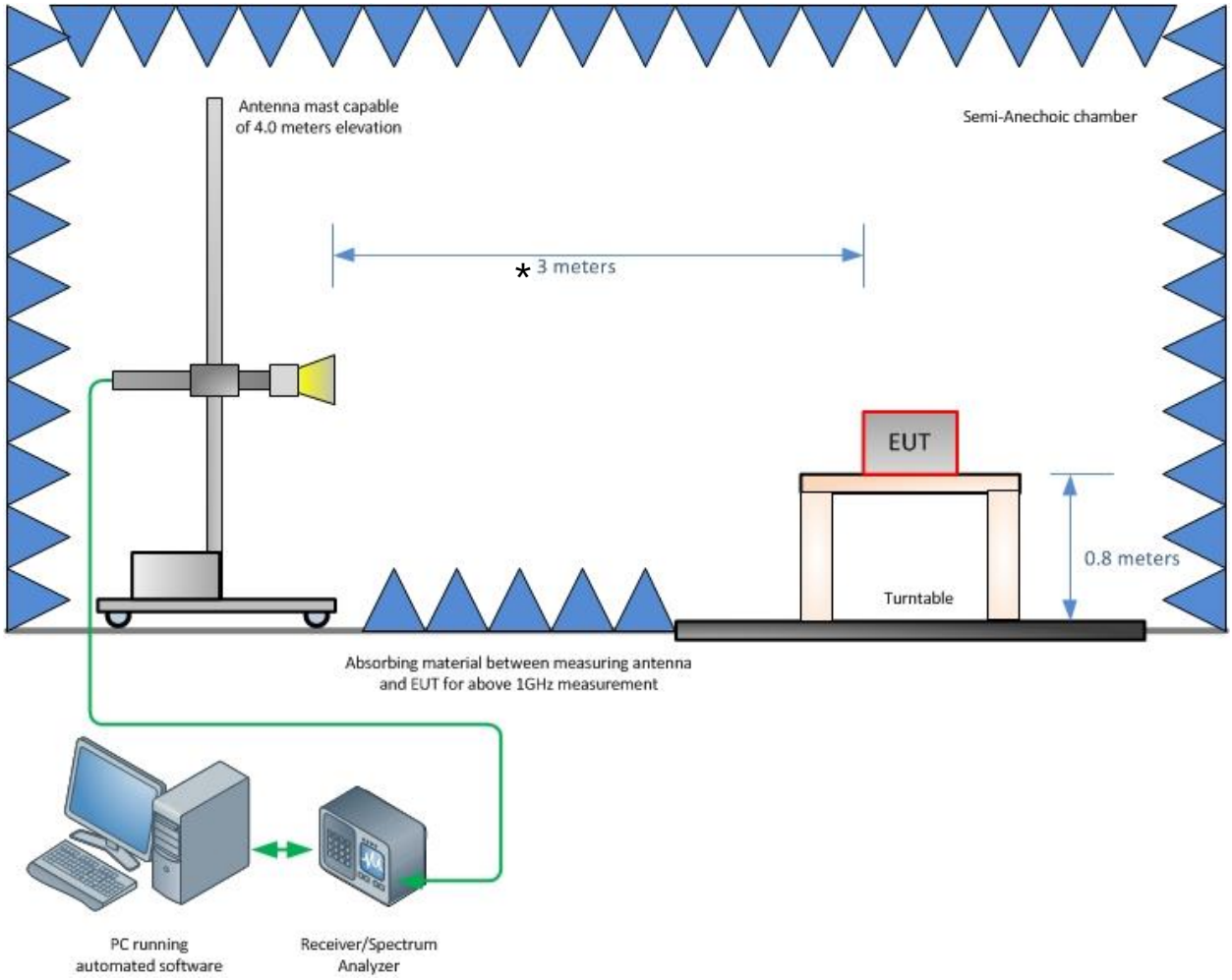
SECTION 4

DIAGRAM OF TEST SETUP

4.1 RADIATED EMISSION TEST SETUP (BELOW 1 GHZ)



4.2 RADIATED EMISSION TEST SETUP (ABOVE 1 GHZ)



*A test distance of 3 m was used for measurements below 60 GHz. The emissions in the range from 60 GHz to 160 GHz were evaluated at 1.0 m distance. For the measurements from 160 GHz to 220 GHz, the test distance was reduced to 0.5 m to assure that the noise floor is at least 10 dB below the applicable limit.

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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