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Report On

Application for Grant of Equipment Authorization of the
Nextivity Inc.

Cel-Fi DUO RAINIER Smart Cellular Signal Booster

FCC CFR 47 Part 2 and 27
IC RSS-Gen and RSS-130

Report No. SD72116210-0416E

May 2016



REPORT ON EMC Evaluation of the
Nextivity Inc.
Cel-Fi DUO RAINIER Smart Cellular Signal Booster

TEST REPORT NUMBER SD72116210-0416E

TEST REPORT DATE May 2016

PREPARED FOR Nextivity Inc.
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DATED

May 10, 2016



Revision History

SD72116210-0416E Nextivity Inc. M/N D32-2/12/66 Cel-Fi DUO RAINIER Smart Cellular Signal Booster					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
05/10/16	Initial Release				Chip Fleury



CONTENTS

Section	Page No
1	REPORT SUMMARY 5
1.1	Introduction 6
1.2	Brief Summary Of Results 7
1.3	Product Information 8
1.4	EUT Test Configuration 10
1.6	Modification Record 14
1.7	Test Methodology 14
1.8	Test Facility Location..... 14
1.9	Test Facility Registration 14
1.10	Sample Calculations 16
2	TEST DETAILS 17
2.1	Transmitter Conducted Output Power 18
2.2	Effective Radiated Power 21
2.3	Occupied Bandwidth..... 23
2.4	Peak-Average Ratio 29
2.5	Band Edge 33
2.6	Conducted Spurious Emissions 39
2.7	Field Strength Of Spurious Radiation..... 47
2.8	Frequency Stability 56
2.9	Power Line Conducted Emissions 62
3	TEST EQUIPMENT USED 68
3.1	Test Equipment Used 69
3.2	Measurement Uncertainty 71
4	DIAGRAM OF TEST SETUP 73
4.1	Test Setup Diagram..... 74
5	ACCREDITATION, DISCLAIMERS AND COPYRIGHT 79
5.1	Accreditation, Disclaimers and Copyright..... 80



SECTION 1

REPORT SUMMARY

Radio Testing of the
Nextivity Inc.
Cel-Fi DUO RAINIER Smart Cellular Signal Booster



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Nextivity Inc. Smart Cellular Signal Booster to the requirements of FCC CFR 47 Part 2 and 27 and IC RSS-Gen and RSS-130.

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	Nextivity Inc.
Model Number(s)	Cel-Fi DUO RAINIER
FCC ID	YETD32-21266NU and YETD32-21266CU
IC Number	9298A-D3221266NU and 9298A-D3221266CU
Serial Number(s)	296546000554 (NU) and 29754000407 (CU) – Conducted Samples 296546000509 (NU) and 297546000285 (CU) – Radiated Samples
Number of Samples Tested	4
Test Specification/Issue/Date	- FCC CFR 47 Part 2 and 27 (October 1, 2015). - RSS-130 – Mobile Broadband Services (MBS) Equipment Operating in the Frequency Bands 698-756 MHz and 777-787 MHz (Issue 1, October 2013). - RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 4, November 2014).
Start of Test	May 04, 2016
Finish of Test	May 10, 2016
Name of Engineer(s)	Xiaoying Zhang Ferdinand Custodio
Related Document(s)	- ANSI/TIA-603-C-2004 – Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards. - KDB971168 (D01 Power Meas License Digital Systems v02r02) Measurement Guidance For Certification Of Licensed Digital Transmitters - KDB412172 D01 Determining ERP and EIRP v0101 (Guidelines for Determining the Effective Radiated Power (ERP) and Equivalent Isotropically Radiated Power (EIRP) of a RF Transmitting System. - Supporting documents for EUT certification are separate exhibits.



1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 2 and 27 with cross-reference to the corresponding IC RSS standard is shown below.

Section	Spec Clause			Test Description	Result
	FCC Part 2	FCC Part 27	RSS-130		
3.1	2.1046	27.50 (c)(9)	4.4	Transmitter Conducted Output Power	Compliant
3.2			4.4	Equivalent Isotropic Radiated Power	Compliant
	2.1046	27.50 (c)(9)	4.4	Equivalent Radiated Power	Compliant
3.3	2.1049	27.53 (h)(3)	RSS-Gen 6.6	Occupied Bandwidth	Compliant
3.4	-	27.50 (d)(5)	4.4	Peak-Average Ratio	Compliant
3.5	2.1051	27.53 (g)	4.6.1	Band Edge	Compliant
3.6	2.1051	27.53 (g)	4.6.1	Conducted Spurious Emissions	Compliant
3.7	2.1053	27.53 (g)	4.6	Field Strength Of Spurious Radiation	Compliant
3.8	2.1055	27.54	4.3	Frequency Stability	Compliant
-	-	-	RSS-Gen 7.1	Receiver Spurious Emissions	N/A
3.9	-	-	RSS-Gen 8.8	Power Line Conducted Emission	Compliant

N/A Not required as per RSS-Gen 5.3. The EUT however already shows compliance to FCC Subpart B/ICES-003.



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) is a Nextivity Inc. Cel-Fi DUO RAINIER Smart Cellular Signal Booster. The EUT is a WCDMA/LTE Signal Booster to improve voice and data cellular performance for indoor residential, small business and small enterprise environments. RAINIER consists of two separate units: the Network Unit (NU), and the Coverage Unit (CU). The NU transmits and receives Cellular signals from the base station and operates similar to a cellular handset. The CU transmits and receives signals with the cellular handset and operates on frequencies similar to the cellular base station. The NU and CU are connected wirelessly over a full-duplex wireless link in the UNII band using a mixed OFDM and muxed cellular signal over a 30 or 40 MHz channel in each direction. The CU also includes Bluetooth LE connectivity. With the use of smart phone application, it allows user to register the product, update software, and capture/display details metrics of the system. NU does not support Bluetooth LE. The LTE Band 12 function of the EUT were verified in this test report.

1.3.2 EUT General Description

EUT Description	Smart Cellular Signal Booster
Model Name	Cel-Fi DUO RAINIER
Model Number(s)	D32-2/12/66
Rated Voltage	12VDC via external AC/DC adaptor
Mode Verified	LTE Band 12

Frequency Range	NU	CU
TX (MHz)	698-716	728-746
RX (MHz)	728-746	698-716

Capability LTE (Band 2, 12 and 4)/UNII and BT LE

Primary Unit (EUT)

☐ Production

☒ Pre-Production

☐ Engineering

Manufacturer Declared Temperature Range 0°C to 40°C

Antenna Type PCB PIFA

Manufacturer Nextivity Inc.

Antenna Model N/A



Maximum Antenna Gain

NU	CU
0 dBi	0 dBi

1.3.3 Transmit Frequency Table

Mode	Channel Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	ERP(Part 27)	
				Max. Power (dBm)	Max. Power (W)
LTE Band 12 Downlink	5	731.5 - 743.5	4M29F9W	9.21	0.0083
	10	737.5	8M75F9W	11.65	0.0146
LTE Band 12 Uplink	5	701.5 - 713.5	4M34F9W	21.58	0.1439
	10	707.5	8M64F9W	20.95	0.1245

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Downlink (CU TX). Input signal is applied to B12 antenna port of NU. Output is monitored from B12 Top antenna port of CU.
B	Uplink (NU TX). Input signal is applied to B12 antenna port of CU. Output is monitored from B12 Top antenna port of NU.
C	Radiated test setup. Downlink (CU TX). Input signal is applied to B12 antenna port of NU. B12 Top antenna port of CU is terminated with a 50Ω load.
D	Radiated test setup. Uplink (NU TX). Input signal is applied to B12 antenna port of CU. B12 Top antenna port of NU is terminated with a 50Ω load.
E	Radiated test setup using the radiated samples. Support base station simulator transmitting Band 12 LTE signal. 100 dB gain on CU maintained (Downlink) during testing.

1.4.2 EUT Exercise Software

Manufacturer provided a configuration software (ConformanceTest.exe) running from a support laptop where both EUT are connected via USB.

1.4.3 Support Equipment and I/O cables

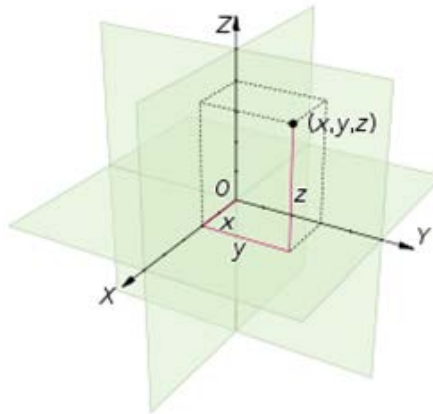
Manufacturer	Equipment/Cable	Description
Hon-Kwang	I.T.E Power Supply (2X)	Model HK-AX-120A167-US S/N: FB0000101 and FB0000075
-	Support USB cable	1.75 meters, shielded Type A to Micro B connector
Nextivity	Support USB cable	Custom 1.0 meter shielded USB Type A to DB9 for the Shielded Test Enclosure
Sony	Support Laptop	M/N PCG-31311L S/N 27545534 3006488
Sony	Support Laptop AC Adapter	M/N PCGA-AC19V9 S/N 147839091 0023259
Rhode & Schwarz	Support Wideband Radio Communication Tester	M/N CMW500 S/N 1201.0002k50/103829
Mini-Circuits	Support Coaxial SMA Fixed Attenuator (x4)	M/N VAT-30W2 30dB DC-6GHz
Ramsey	Support Shielded Test Enclosure	M/N STE3300 S/N 3676 with custom USB cable and AC/DC Adapter

1.4.4 Worst Case Configuration

Worst-case configuration used in this test report per Transmitter Conducted Output Power (Section 2.1 of this test report):

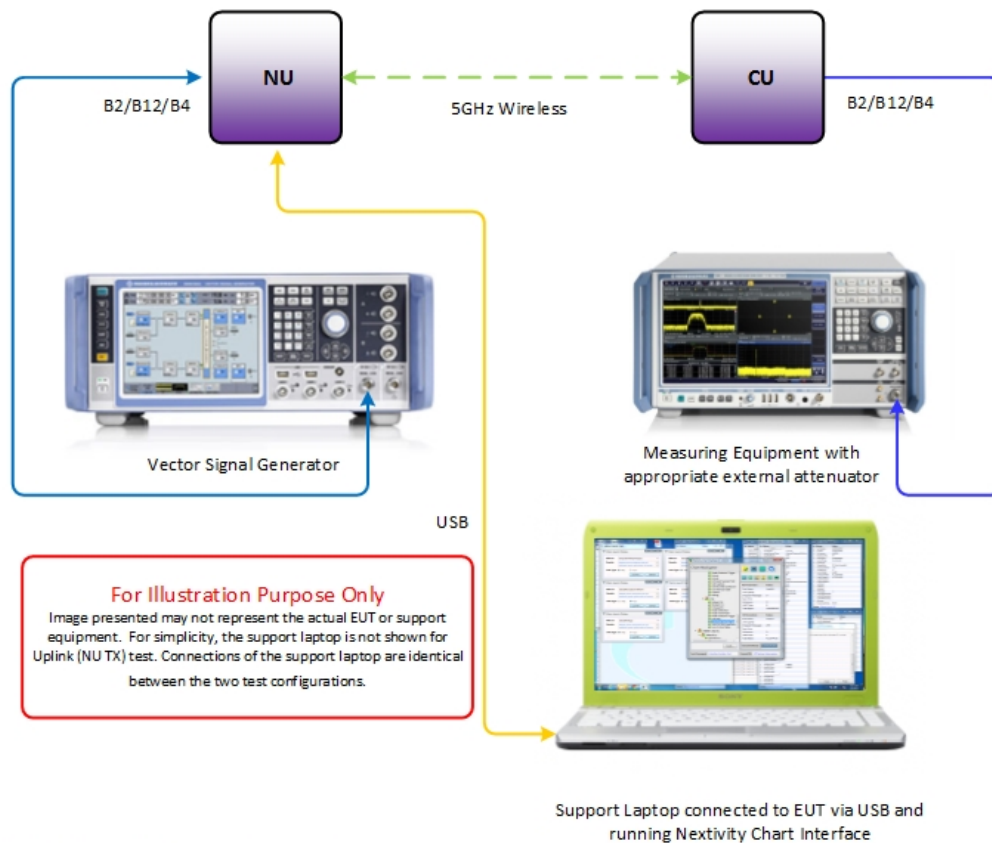
Mode	Bandwidth	Cellular	Frequency
LTE Band 12 Downlink	10MHz	Channel 5060	734 MHz
LTE Band 12 Uplink	5MHz	Channel 23035	701.5 MHz

EUT is a mobile device. Final installation position is unknown at the time of verification. For radiated measurements X, Y and Z orientations were verified. No major variation in emissions observed between the three (3) orientations. Verifications performed using "Z" configuration.

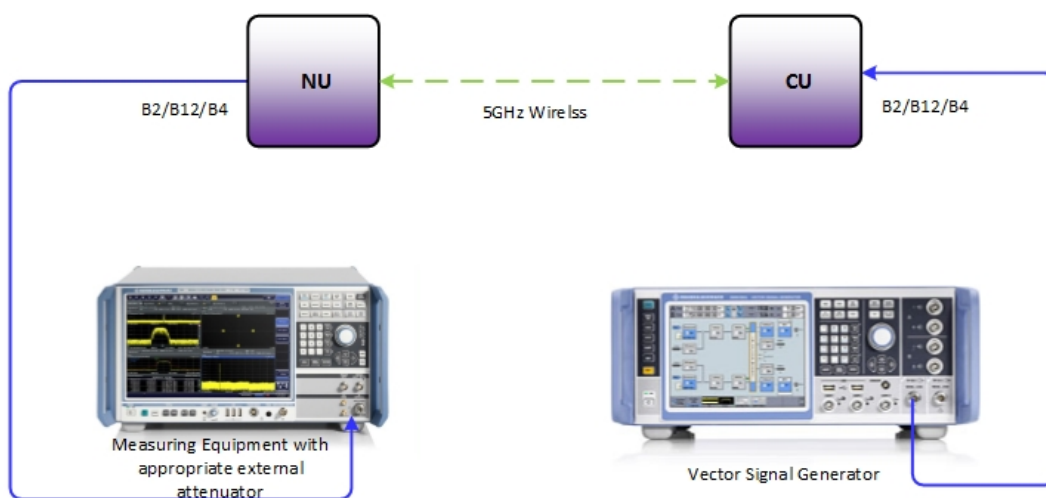


1.4.5 Simplified Test Configuration Diagram

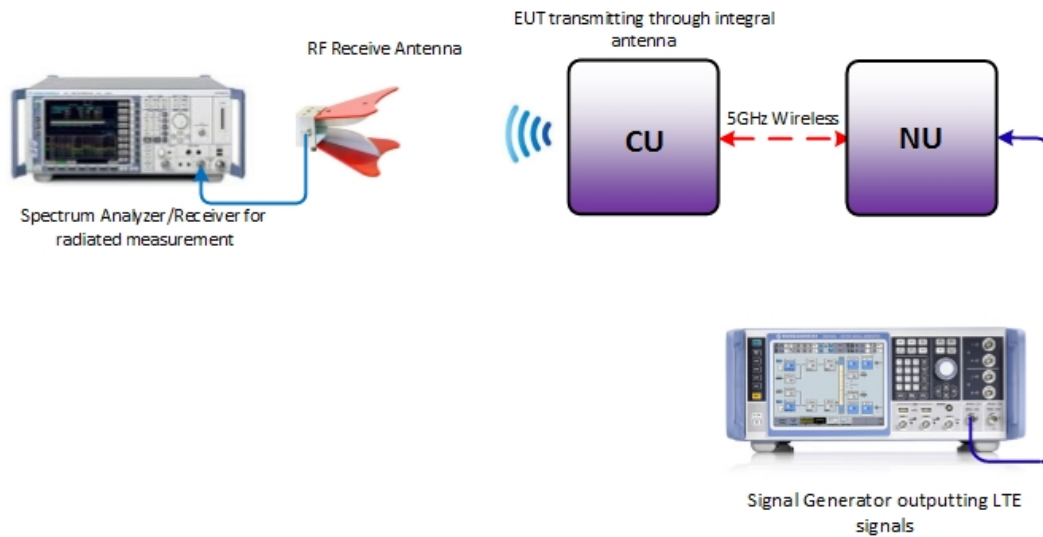
Downlink (CU Tx) Conducted Test



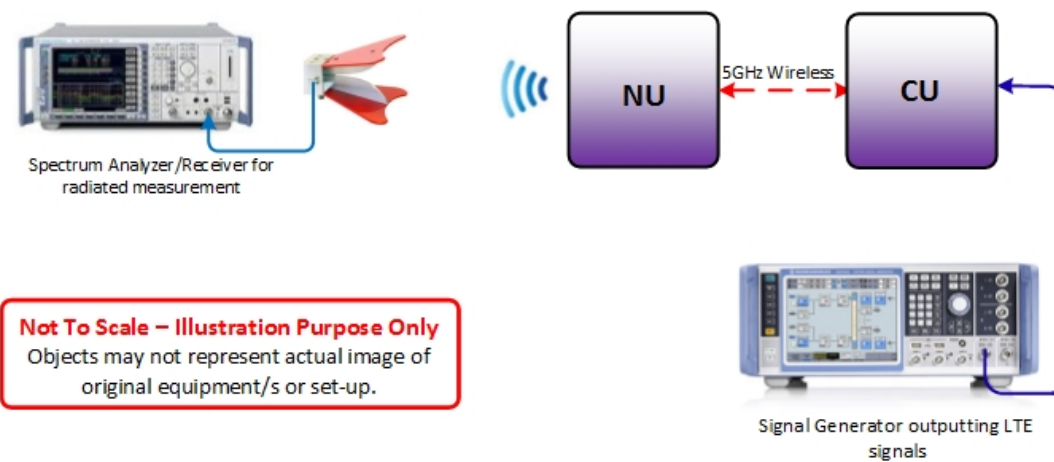
Uplink (NU Tx) Conducted Test



Radiated Testing (Downlink)



Radiated Testing (Uplink)



Not To Scale – Illustration Purpose Only
 Objects may not represent actual image of
 original equipment/s or set-up.



1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number 296546000554 (NU) and 29754000407 (CU) / 296546000509 (NU) and 297546000285 (CU)		
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 C63.26 2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.

For conducted (if applicable) 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 C63.26-2015. 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)

16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 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 Registration is US1146.



1.9.2 Innovation, Science and Economic Development Canada Registration No.: 3067A

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

1.10 SAMPLE CALCULATIONS

1.10.1 LTE Emission Designator

Emission Designator = 4M29F9W

F = Frequency Modulation

9= Composite Digital Info

W = Combination (Audio/Data)

1.10.2 Spurious Radiated Emission (below 1GHz)

Measuring equipment raw measurement (dBμV/m) @ 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

1.10.3 Spurious Radiated Emission – Substitution Method

Example = 84dBμV/m @ 1413 MHz (numerical sample only)

The field strength reading of 84dBμV/m @ 1413 MHz (2nd Harmonic of 706.5 MHz) is the maximized measurement when the EUT is on the turntable measured at 3 meters. The gain of the substituted antenna is 7.8dBi while the transmit cable loss is 1.0 dB (cable between signal generator and the substituted antenna). The signal generator level is adjusted until the 84dBμV/m level at the receiving end is replicated (identical test setup, i.e. same antenna, cable/s and preamp). If the adjusted signal generator level is -18dBm, then we have the following for both EIRP and ERP as required:

$$\begin{aligned}
 P_{\text{EIRP}} &= -18 \text{ dBm} + 7.8 \text{ dBi} - 1 \text{ dB} \\
 &= 11.2 \text{ dBm} \\
 P_{\text{ERP}} &= P_{\text{EIRP}} - 2.15 \text{ dB} \\
 &= 11.2 \text{ dBm} - 2.15 \text{ dB} \\
 &= 9.05 \text{ dBm}
 \end{aligned}$$



SECTION 2

TEST DETAILS

Radio Testing of the
Nextivity Inc.
Cel-Fi DUO RAINIER Smart Cellular Signal Booster



2.1 TRANSMITTER CONDUCTED OUTPUT POWER

2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046 (a) and (c)
FCC 47 CFR Part 27, Clause 27.50 (c)(9)
RSS-130, Clause 4.4

2.1.2 Standard Applicable

FCC 47 CFR Part 2, Clause 2.1046:

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

FCC 47 CFR Part 27, Clause 27.50 (c)(9):

(9) Control and mobile stations in the 698-746 MHz band are limited to 30 watts ERP.

2.1.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU) / Test Configuration A and B

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

May 06 and 10, 2016/FSC

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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	25.7 - 26.1 °C
Relative Humidity	42.0 - 45.6 %
ATM Pressure	98.8 – 99.1 kPa

2.1.7 Additional Observations

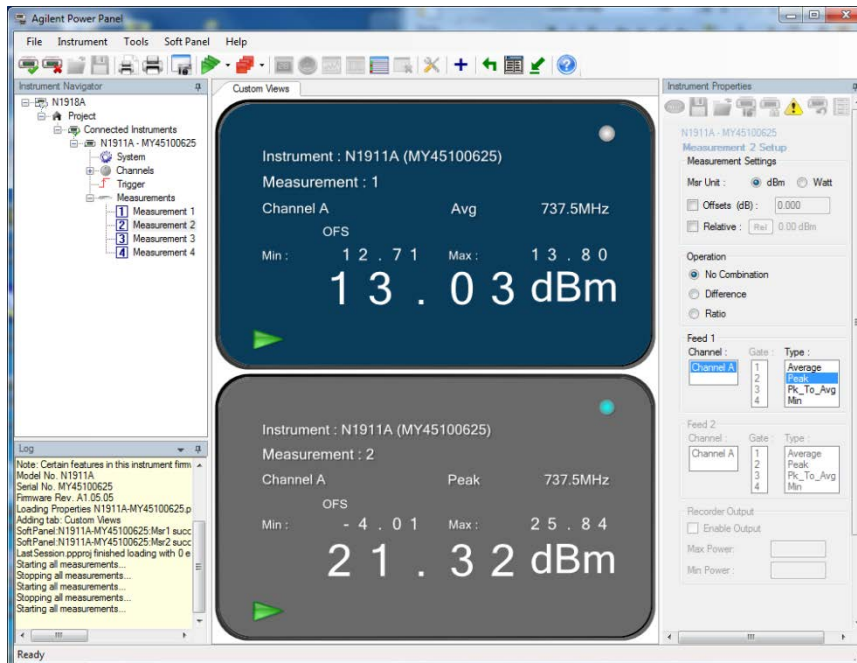
- This is a conducted test using an average power meter.
- The path loss was measured and entered as a level offset (20.5dB).
- Both Peak and Average measurements presented.

2.1.8 Test Results

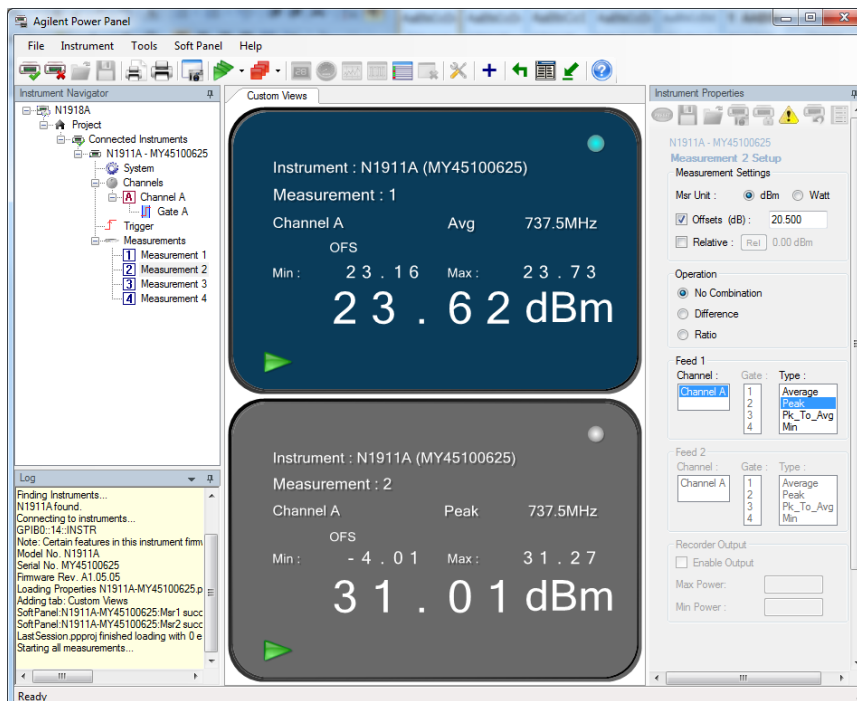
<i>Downlink (CU B12 Output)</i>					
Band	Bandwidth	Channel	Frequency (MHz)	Average Power (dBm)	Peak Power (dBm)
LTE Band 12	5MHz	5035	731.50	11.00	21.71
		5095	737.50	11.36	21.46
		5155	743.50	11.16	21.76
	10MHz	5060	734.00	13.80	25.84
		5095	737.50	13.36	21.77
		5130	741.00	13.20	21.81

<i>Uplink (NU B12 Output)</i>					
Band	Bandwidth	Channel	Frequency (MHz)	Average Power (dBm)	Peak Power (dBm)
LTE Band 12	5MHz	23035	701.50	23.73	31.27
		23095	707.50	23.14	31.25
		23155	713.50	21.86	29.08
	10MHz	23060	704.00	23.10	30.15
		23095	707.50	22.67	29.49
		23130	711.00	21.80	29.49

2.1.9 Sample Test Plot



LTE Band 12 DL 10MHz Bandwidth Low Channel



LTE Band 12 UL 5MHz Bandwidth Low Channel

2.2 EFFECTIVE RADIATED POWER

2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046 (a) and (c)
FCC 47 CFR Part 27, Clause 27.50 (c)(9)
RSS-130, Clause 4.4

2.2.2 Standard Applicable

FCC 47 CFR Part 27, Clause 27.50 (c)(9):
(9) Control and mobile stations in the 698-746 MHz band are limited to 30 watts ERP

RSS-130, Clause 4.4:
The e.i.r.p. shall not exceed 50 watts for mobile equipment or for outdoor fixed subscriber equipment, nor shall it exceed 5 watts for portable equipment or for indoor fixed subscriber equipment.

2.2.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU)

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

May 06, 2016/FSC

2.2.5 Additional Observations

- ERP was calculated as per Section 1.3.2 of KDB412172 D01 (Determining ERP and EIRP v01).
- Calculation formula in logarithmic terms:

$$ERP = P_T + G_T - L_C - 2.15dB$$

Where:

P_T = transmitter conducted output power dBm (Section 3.1 of this test report)
 G_T = gain of the transmitting antenna, in dBi (EIRP: the -2.15 in the formula is to convert EIRP to ERP);
 L_C = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

2.2.6 Sample Computation

ERP = $P_T + G_T - L_C - 2.15dB$
= 13.80 (Conducted Power) + 0 dBi (max. gain) – 0 (cable loss negligible @ 734MHz) -2.15
= 11.65 dBm



2.2.7 Test Results

Band 12 Downlink							
Bandwidth	Channel	Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	ERP (dBm)	EIRP (dBm)	Limit (dBm)
5.0MHz	5035	731.50	11.00	0	8.85	11.00	44.78
	5095	737.50	11.36	0	9.21	11.36	44.78
	5155	743.50	11.16	0	9.01	11.16	44.78
10MHz	5060	734.00	13.80	0	11.65	13.80	44.78
	5095	737.50	13.36	0	11.21	13.36	44.78
	5130	741.00	13.20	0	11.05	13.20	44.78

Band 12 Uplink							
Bandwidth	Channel	Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	ERP (dBm)	EIRP (dBm)	Limit (dBm)
5.0MHz	23035	701.50	23.73	0	21.58	23.73	44.78
	23095	707.50	23.14	0	20.99	23.14	44.78
	23155	713.50	21.86	0	19.71	21.86	44.78
10MHz	23060	704.00	23.10	0	20.95	23.10	44.78
	23095	707.50	22.67	0	20.52	22.67	44.78
	23130	711.00	21.80	0	19.65	21.80	44.78



2.3 OCCUPIED BANDWIDTH

2.3.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049
FCC 47 CFR Part 27, Clause 27.53(h)(3)
RSS-GEN Issue 4, Clause 6.6

2.3.2 Standard Applicable

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

2.3.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU) / Test Configuration A and B

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

May 06 and 10, 2016/FSC

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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	25.7 - 26.1 °C
Relative Humidity	42.0 - 45.6 %
ATM Pressure	98.8 – 99.1 kPa

2.3.7 Additional Observations

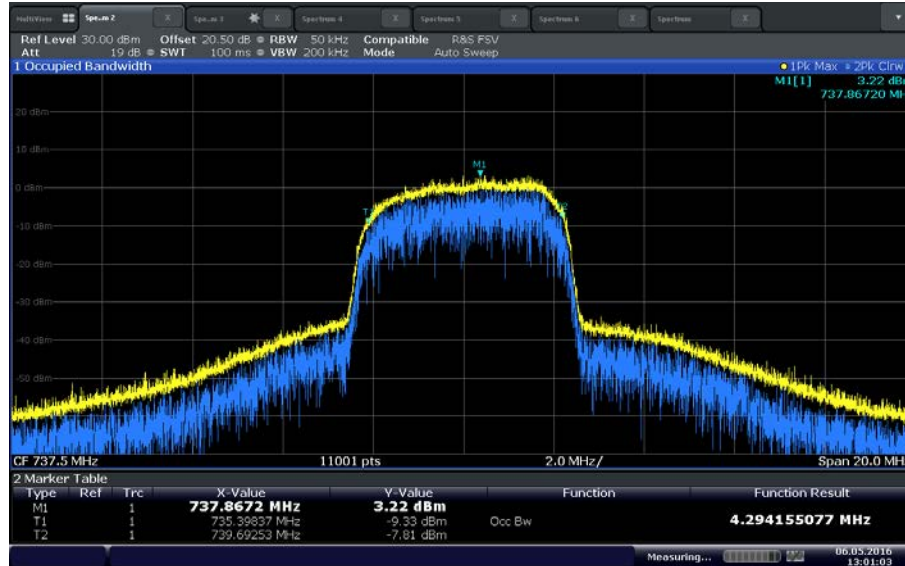
- This is a conducted test. Both 26dB bandwidth and 99% bandwidth presented.
- All channels for emission bandwidth verified.
- The span is between two and five times the anticipated OBW.
- The RBW is set to 1% of the OBW while the VBW is $\geq 3X$ RBW.
- The detector is peak and the trace mode is max hold.
- All low, middle and high channels were verified. Only test plots for middle channel presented in this test report as the representative configuration.
- The SA built-in emission bandwidth measurement feature is utilized. The power level setting is set to 99% for OBW measurements while “n dB down” was set to -26 for 26dB BW measurements.

2.3.8 Test Results

<i>Downlink</i>					
Band	Bandwidth	Channel	Frequency (MHz)	OBW (MHz)	-26dB BW (MHz)
LTE Band 12	5MHz	5035	731.50	4.34	4.89
		5095	737.50	4.29	4.83
		5155	743.50	4.25	4.74
	10MHz	5060	734.00	8.75	9.32
		5095	737.50	8.70	9.27
		5130	741.00	8.61	9.17

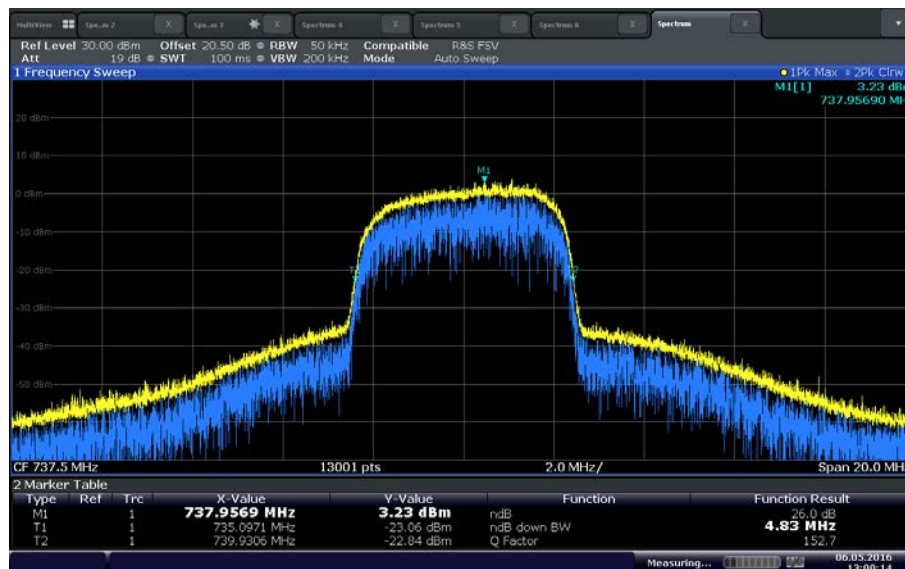
<i>Uplink</i>					
Band	Bandwidth	Channel	Frequency (MHz)	OBW (MHz)	-26dB BW (MHz)
LTE Band 12	5MHz	23035	701.50	4.34	4.65
		23095	707.50	4.24	4.70
		23155	713.50	4.23	4.63
	10MHz	23060	704.00	8.64	9.24
		23095	707.50	8.70	9.22
		23130	711.00	8.78	9.23

LTE Band 12 Downlink 5MHz Bandwidth Mid Channel 99% OBW



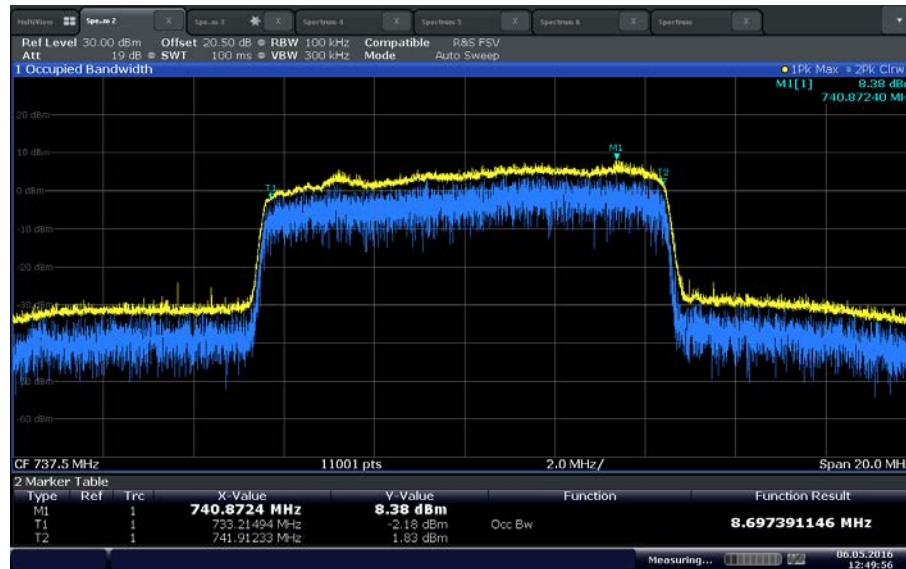
Date: 6 MAY 2016 13:01:03

LTE Band 12 Downlink 5MHz Bandwidth Mid Channel -26dB BW



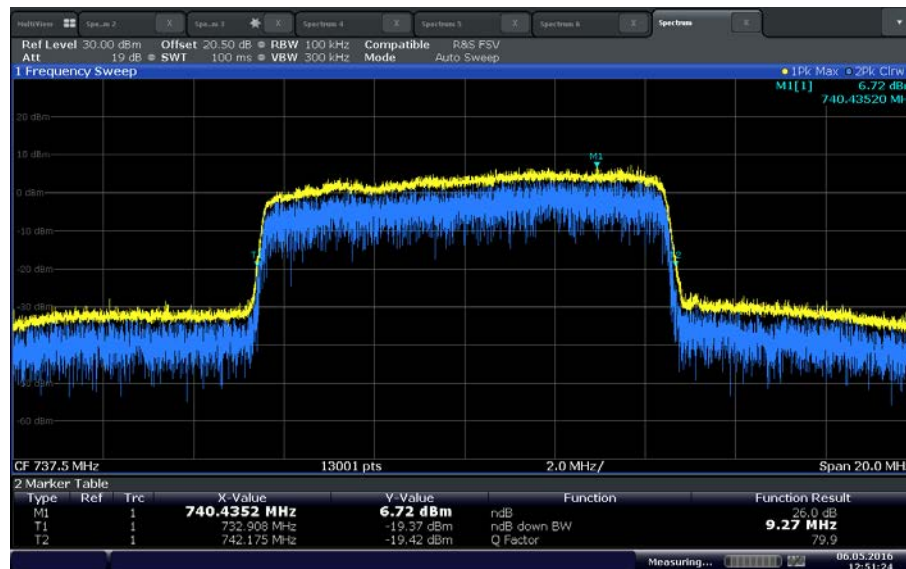
Date: 6 MAY 2016 13:00:15

LTE Band 12 Downlink 10MHz Bandwidth Mid Channel 99% OBW



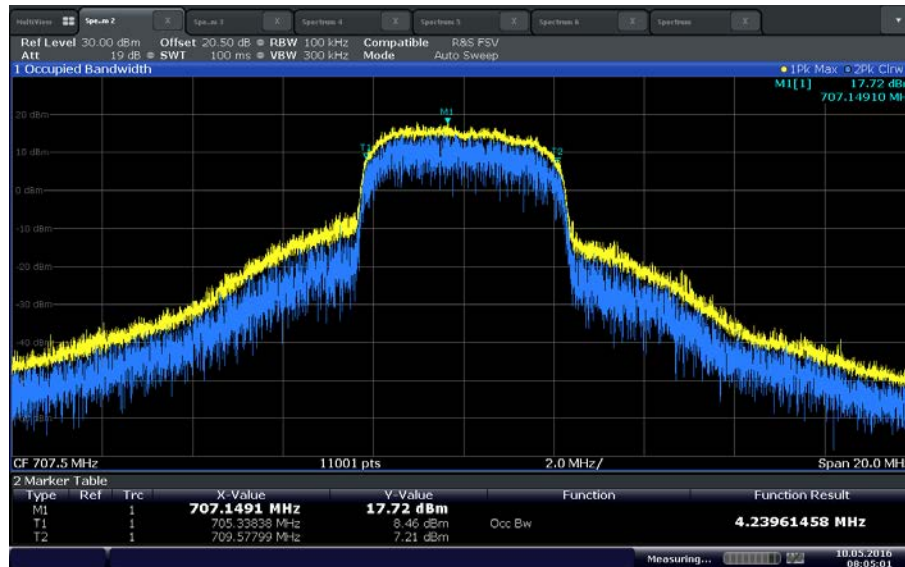
Date: 6 MAY 2016 12:49:56

LTE Band 12 Downlink 10MHz Bandwidth Mid Channel -26dB BW



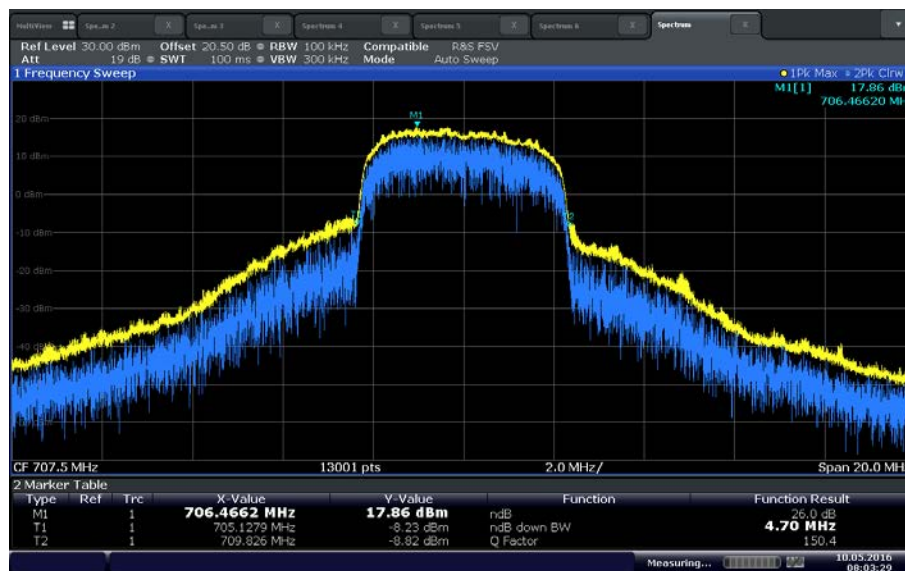
Date: 6 MAY 2016 12:51:24

LTE Band 12 Uplink 5MHz Bandwidth Mid Channel 99% OBW



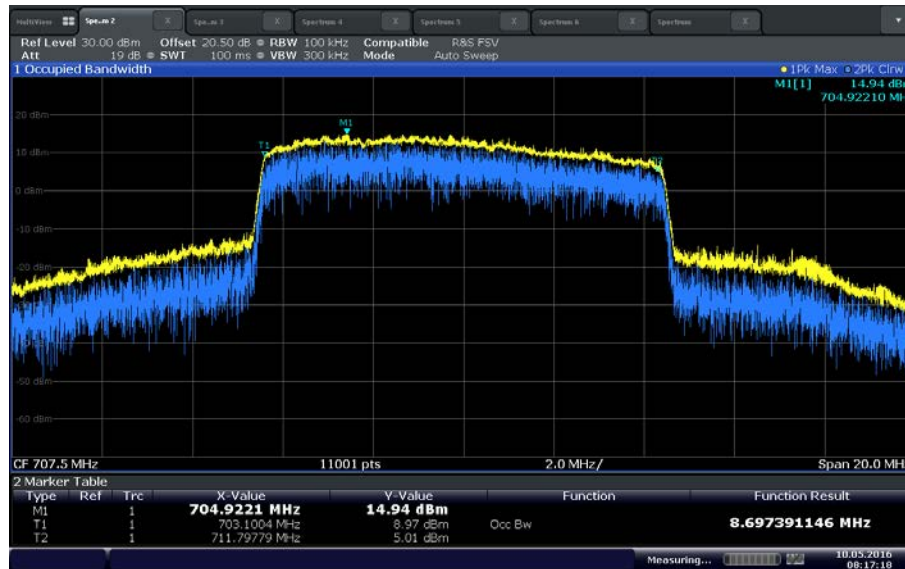
Date: 10 MAY 2016 08:05:01

LTE Band 12 Uplink 5MHz Bandwidth Mid Channel -26dB BW



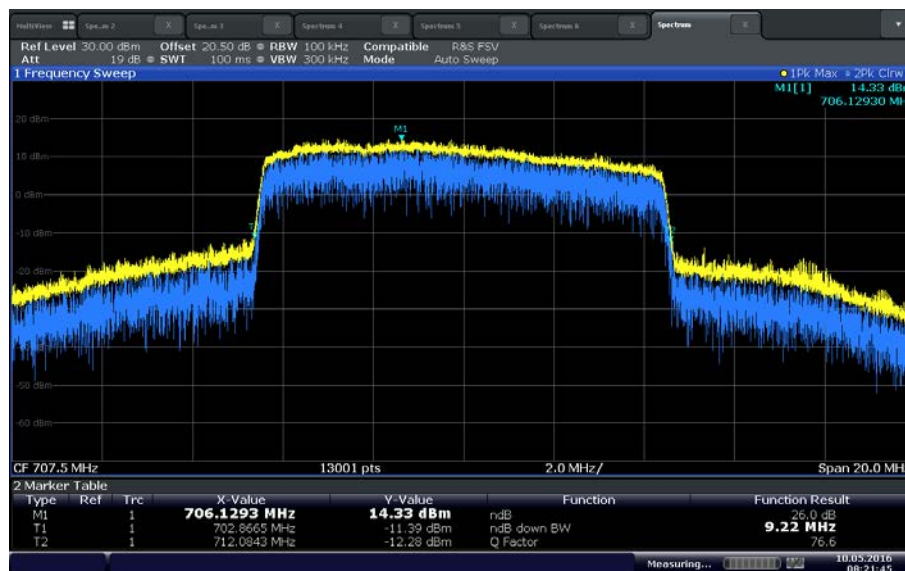
Date: 10 MAY 2016 08:03:29

LTE Band 12 Uplink 10MHz Bandwidth Mid Channel 99% OBW



Date: 10 MAY 2016 08:17:17

LTE Band 12 Uplink 10MHz Bandwidth Mid Channel -26dB BW



Date: 10 MAY 2016 08:21:46



2.4 PEAK-AVERAGE RATIO

2.4.1 Specification Reference

RSS-130, Clause 4.4

2.4.2 Standard Applicable

The peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

2.4.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU) / Test Configuration A and B

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

May 06 and 10, 2016/FSC

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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	25.7 - 26.1 °C
Relative Humidity	42.0 -45.6 %
ATM Pressure	98.8 – 99.1 kPa

2.4.7 Additional Observations

- This is a conducted test. Test procedure is per Section 5.7 of KDB971168 (D01 Power Meas License Digital Systems v02r02). Appropriate offset (line losses) applied.
- Measurement was done using the Spectrum Analyzer's Complementary Cumulative Distribution Function (CCDF) measurement profile. The built-in function is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth (crest factor or peak-to-average ratio) The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signals spends at or above the level defines the probability for that particular power level.
- RBW was set to maximum the SA can support.
- The maximum PAPR level associated with a probability of 0.1% was recorded.
- All low, middle and high channels were verified. Only test plots for middle channel presented in this test report as the representative configuration.
- There were no measured PAR levels greater than 13dB. EUT complies.

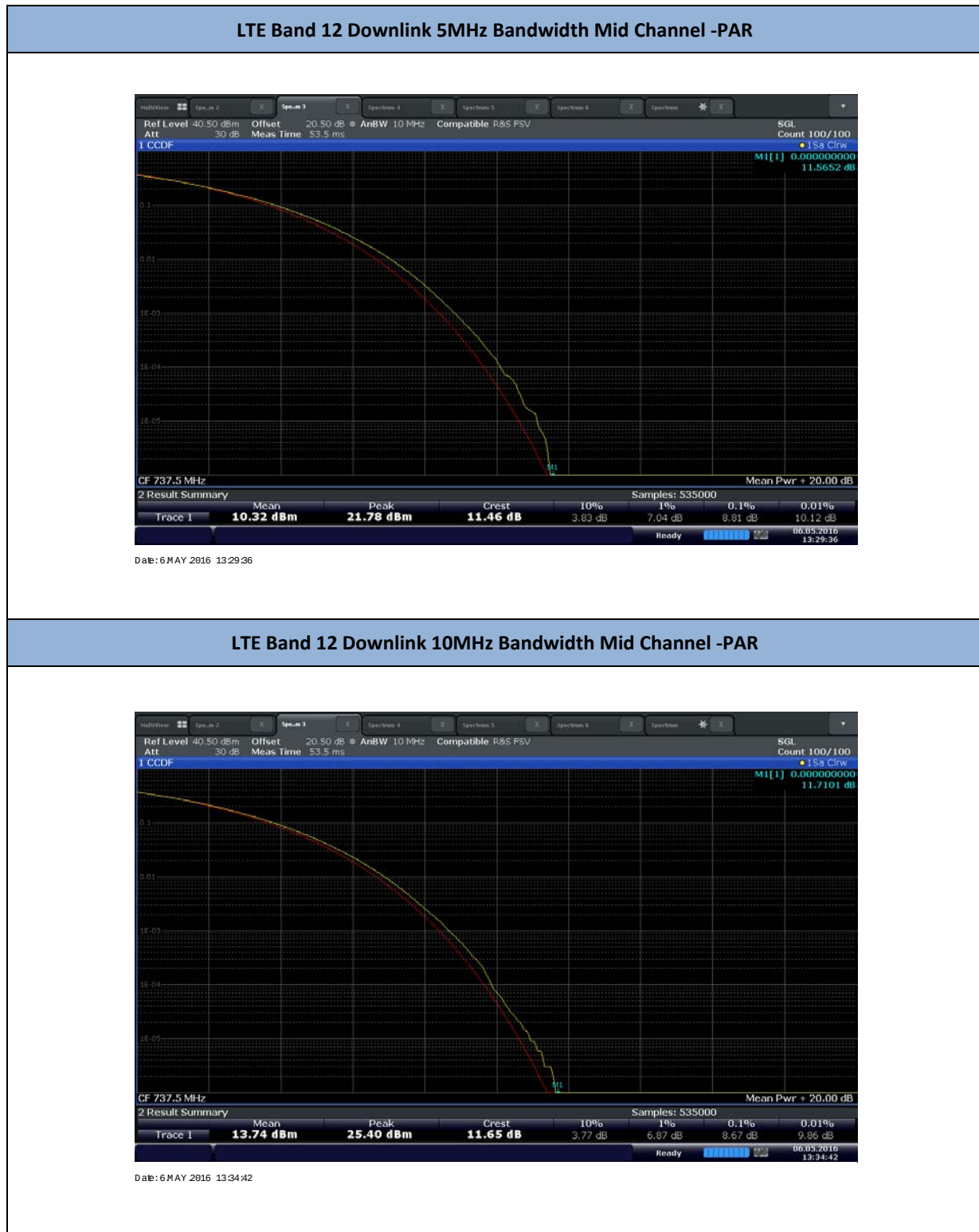


2.4.8 Test Results

<i>Downlink</i>				
Band	Bandwidth	Channel	Frequency (MHz)	PAR (dB)
LTE Band 12	5MHz	5035	731.50	9.01
		5095	737.50	8.81
		5155	743.50	9.30
	10MHz	5060	734.00	8.81
		5095	737.50	8.67
		5130	741.00	8.84

<i>Uplink</i>				
Band	Bandwidth	Channel	Frequency (MHz)	PAR (dB)
LTE Band 12	5MHz	23035	701.50	6.75
		23095	707.50	6.26
		23155	713.50	6.84
	10MHz	23060	704.00	7.28
		23095	707.50	7.22
		23130	711.00	7.22

2.4.9 Sample Test Plot

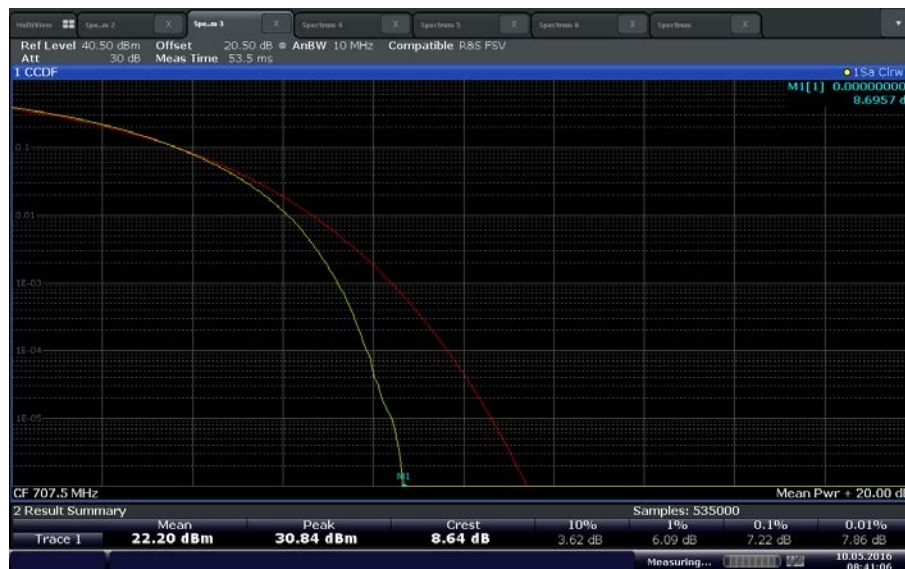


LTE Band 12 Uplink 5MHz Bandwidth Mid Channel -PAR



Date: 10 MAY 2016 08:58:01

LTE Band 12 Uplink 10MHz Bandwidth Mid Channel -PAR



Date: 10 MAY 2016 08:41:06



2.5 BAND EDGE

2.5.1 Specification Reference

FCC 47 CFR Part 27, Clause 27.53(g)
RSS-130, Clause 4.6.

2.5.2 Standard Applicable

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

The power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside the frequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside the equipment's operating frequency range, a resolution bandwidth of 30 kHz may be employed.

2.5.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU) / Test Configuration A and B

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

May 06 and 10, 2016/FSC

2.5.5 Test Equipment Used

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

2.5.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

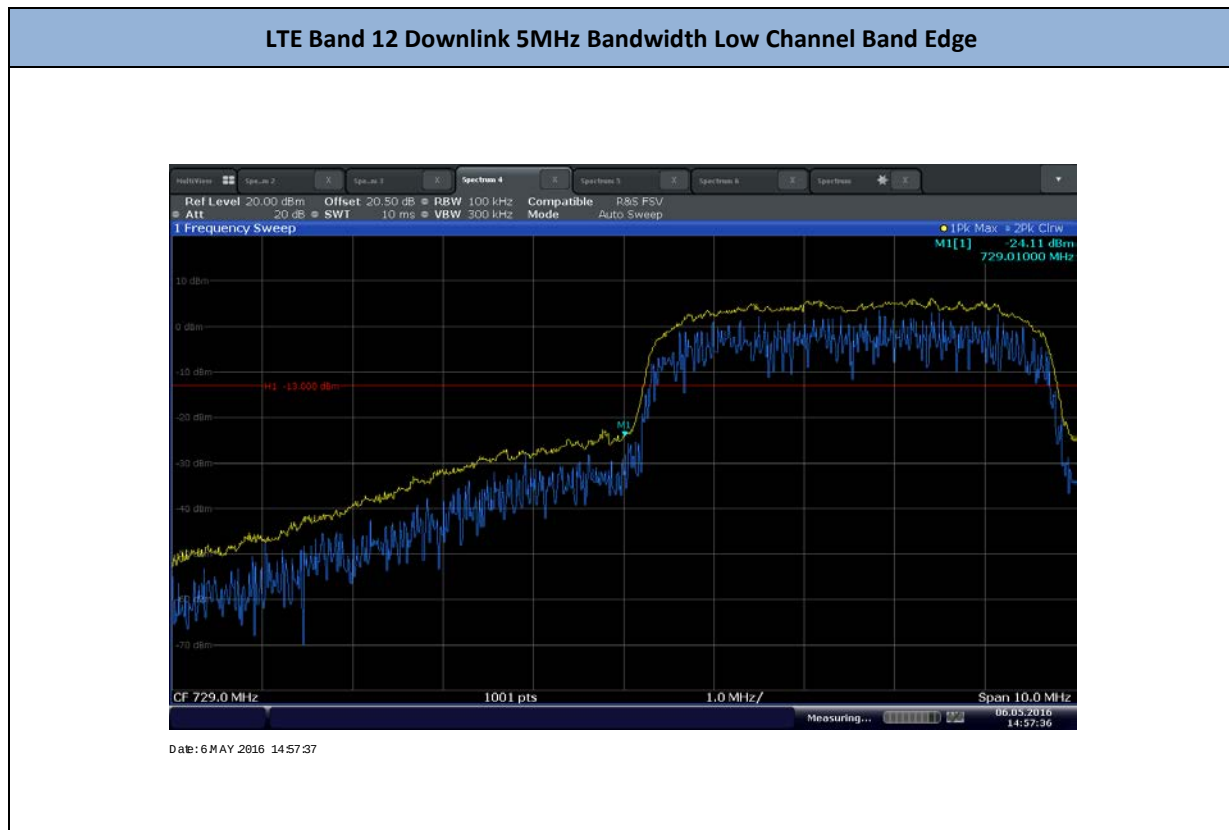
Ambient Temperature	25.7 - 26.1 °C
Relative Humidity	42.0 - 45.6 %
ATM Pressure	98.8 – 99.1 kPa

2.5.7 Additional Observations

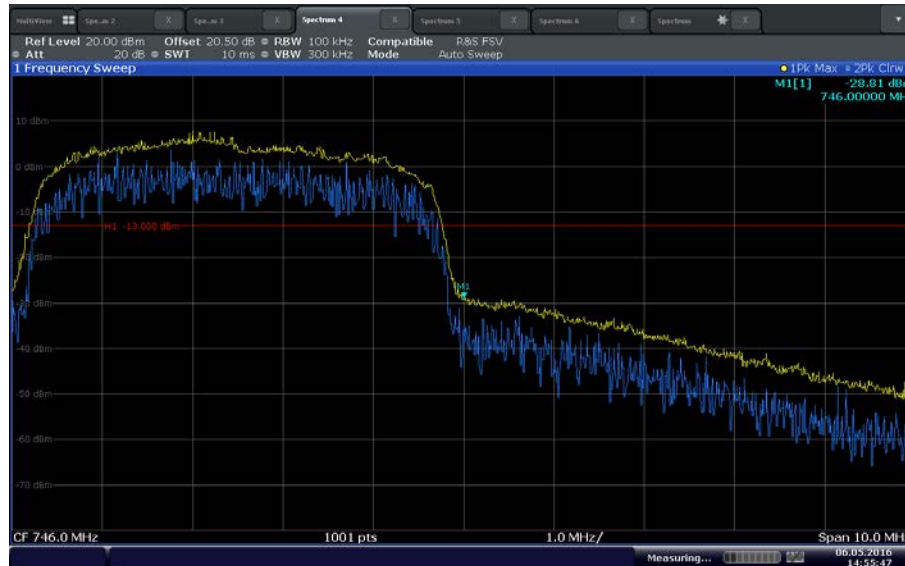
- This is a conducted test. Test guidance is per Section 6.0 of KDB971168 (D01 Power Meas License Digital Systems v02r01).

- The path loss was measured and entered as a level offset.
- The center frequency of the spectrum is the band edge frequency (729-746 MHz and 698-716 MHz).
- Using a span of 10MHz for Band 12, RBW is set to 100 kHz (minimum of 30kHz limited to 1% of EBW) and VBW is set to 3x RBW.

2.5.8 Test Results

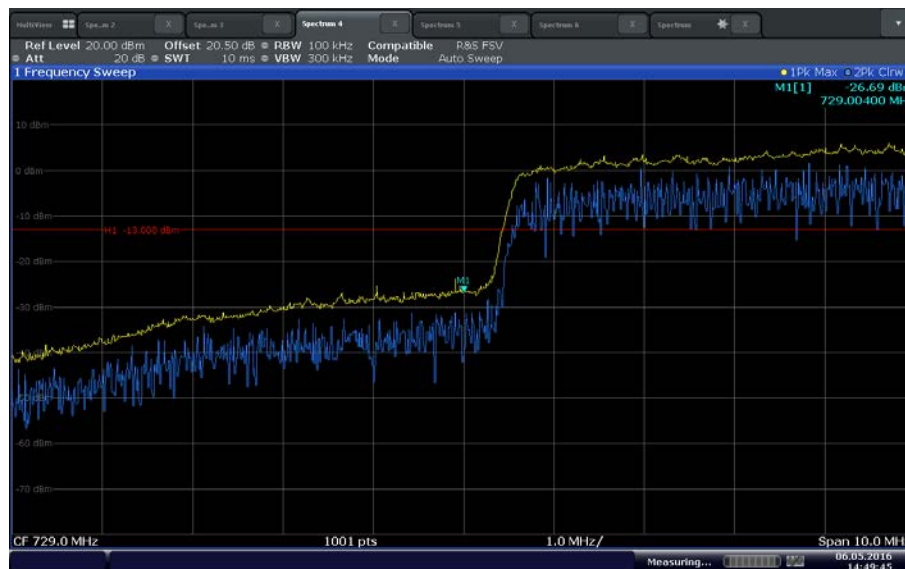


LTE Band 12 Downlink 5MHz Bandwidth High Channel Band Edge



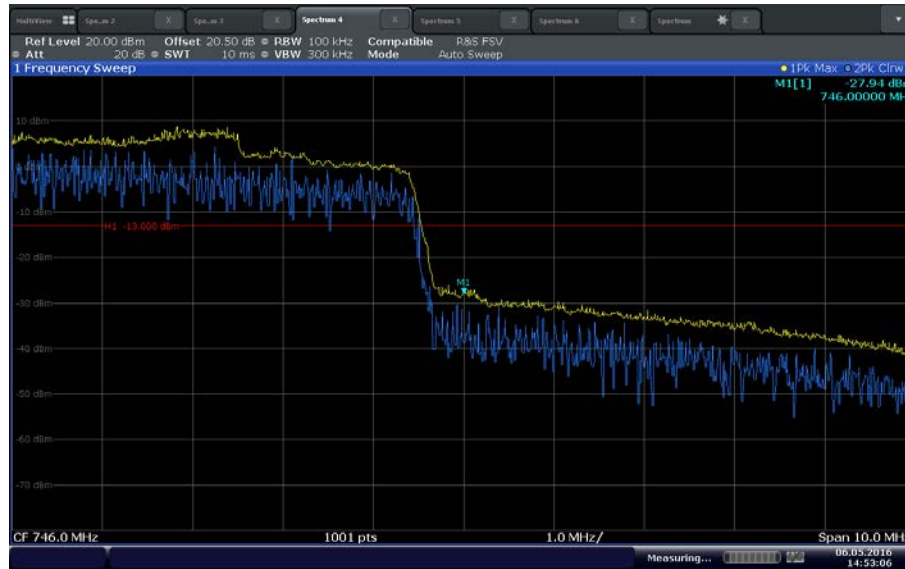
Date: 6 MAY 2016 14:55:47

LTE Band 12 Downlink 10MHz Bandwidth Low Channel Band Edge



Date: 6 MAY 2016 14:49:45

LTE Band 12 Downlink 10MHz Bandwidth High Channel Band Edge



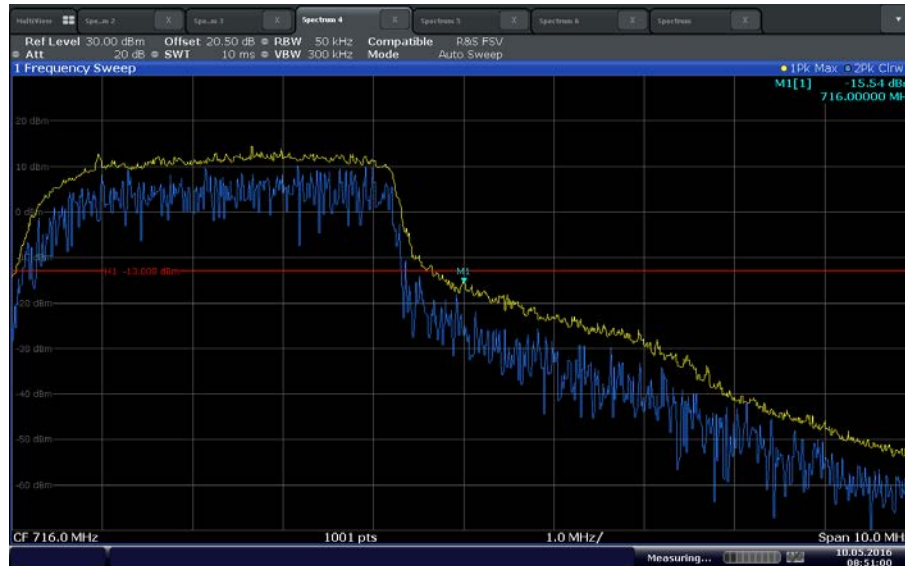
Date: 6 MAY 2016 14:53:06

LTE Band 12 Uplink 5MHz Bandwidth Low Channel Band Edge



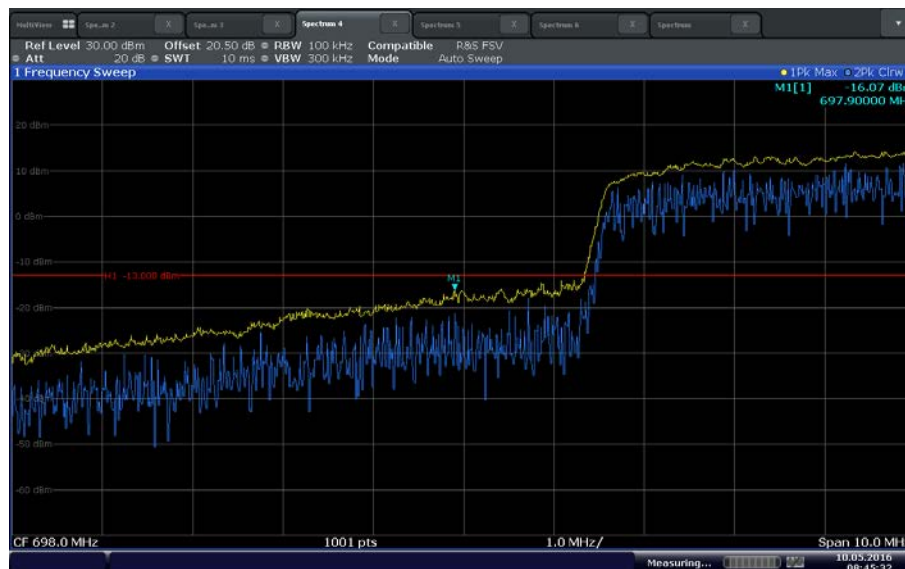
Date: 10 MAY 2016 09:00:47

LTE Band 12 Uplink 5MHz Bandwidth High Channel Band Edge



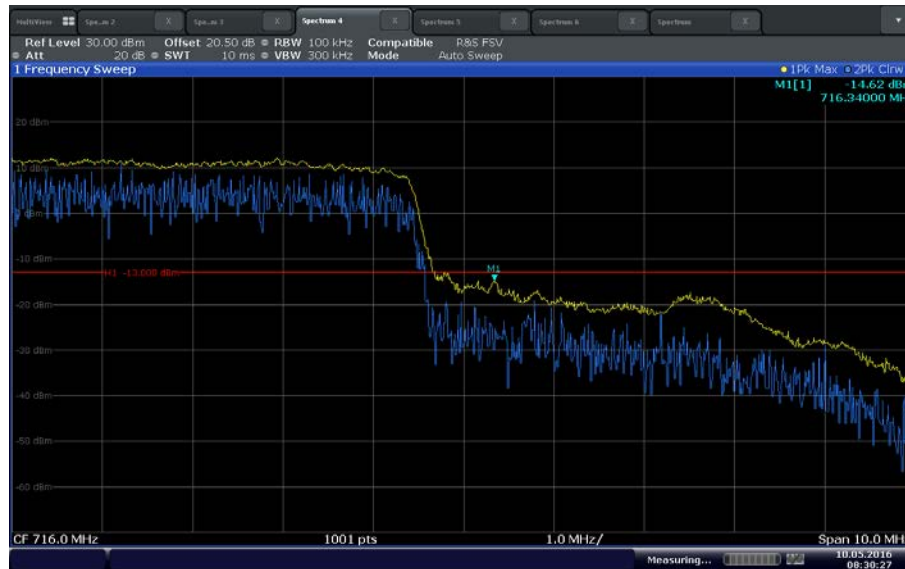
Date: 10 MAY 2016 08:51:01

LTE Band 12 Uplink 10MHz Bandwidth Low Channel Band Edge



Date: 10 MAY 2016 08:45:32

LTE Band 12 Uplink 10MHz Bandwidth High Channel Band Edge





2.6 CONDUCTED SPURIOUS EMISSIONS

2.6.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1051
FCC 47 CFR Part 27, Clause 27.53(g)
RSS-130, Clause 4.6.1

2.6.2 Standard Applicable

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

4.6.1 The power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside the frequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside the equipment's operating frequency range, a resolution bandwidth of 30 kHz may be employed.

2.6.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU) / Test Configuration A and B

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

May 06 and 10, 2016/FSC

2.6.5 Test Equipment Used

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

2.6.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

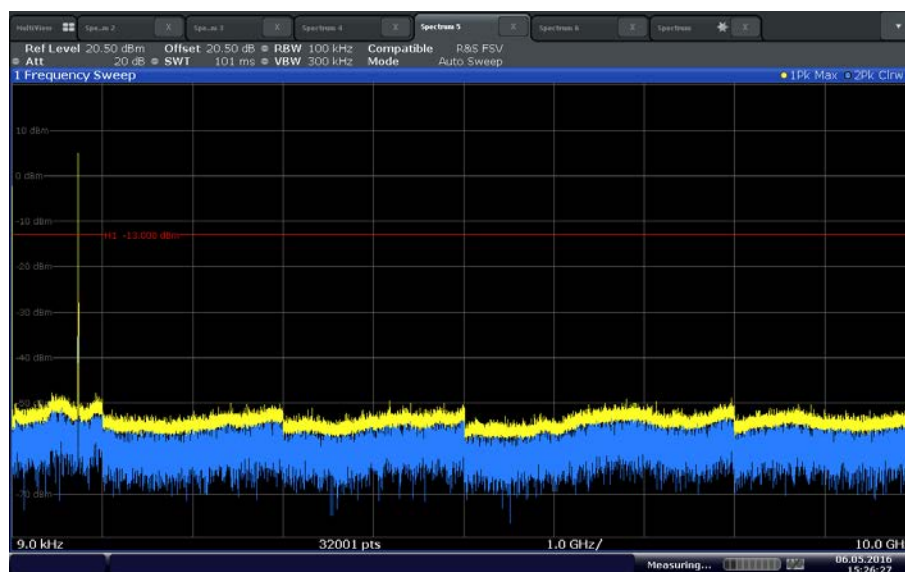
Ambient Temperature	25.7 - 26.1 °C
Relative Humidity	42.0 -45.6 %
ATM Pressure	98.8 – 99.1 kPa

2.6.7 Additional Observations

- This is a conducted test.
- The transducer factor (TDF) used is from the external attenuators and cables used.
- Sweep points set to maximum the SA can support.
- Sweep time set to auto.
- The spectrum was searched from 9 kHz to 10GHz (requirement is up to the 10th harmonic ($\leq 8\text{GHz}$)).

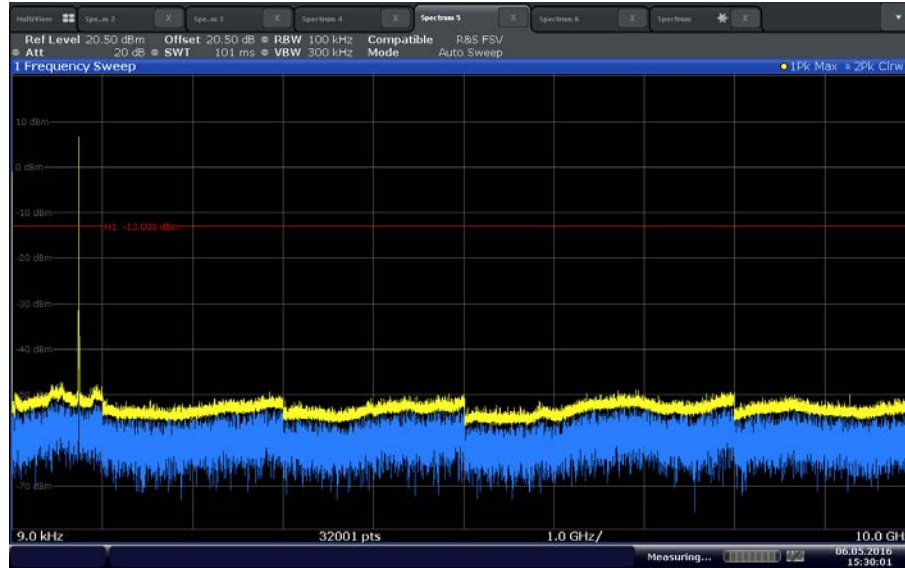
2.6.8 Test Results

LTE Band 12 Downlink 5MHz Bandwidth Low Channel Conducted Spurious Emissions



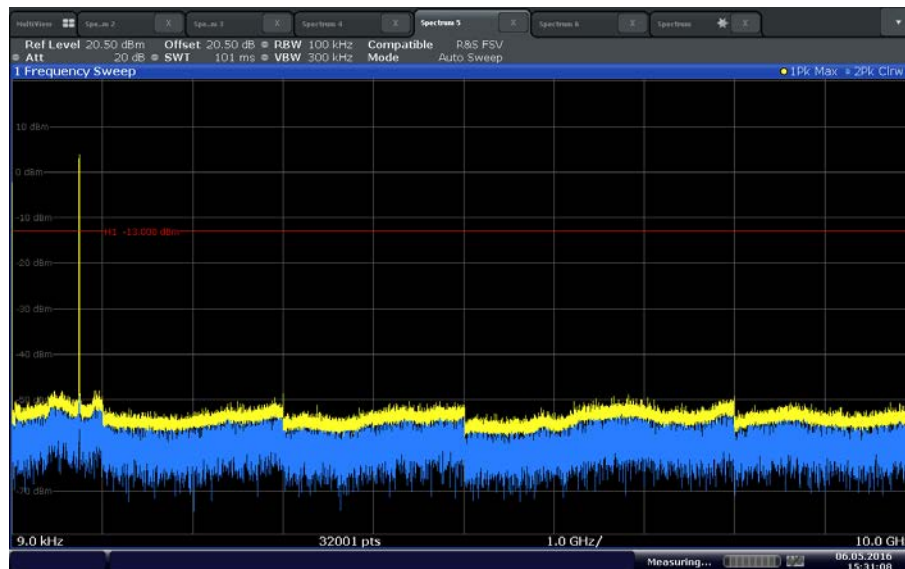
Date: 6 MAY 2016 15:26:28

LTE Band 12 Downlink 5MHz Bandwidth Mid Channel Conducted Spurious Emissions



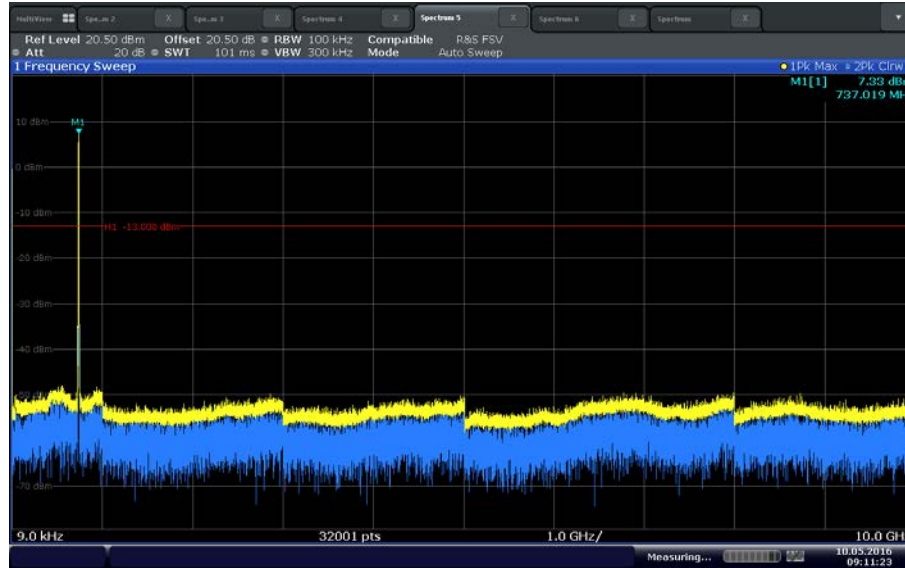
Date: 6 MAY 2016 15:30:01

LTE Band 12 Downlink 5MHz Bandwidth High Channel Conducted Spurious Emissions



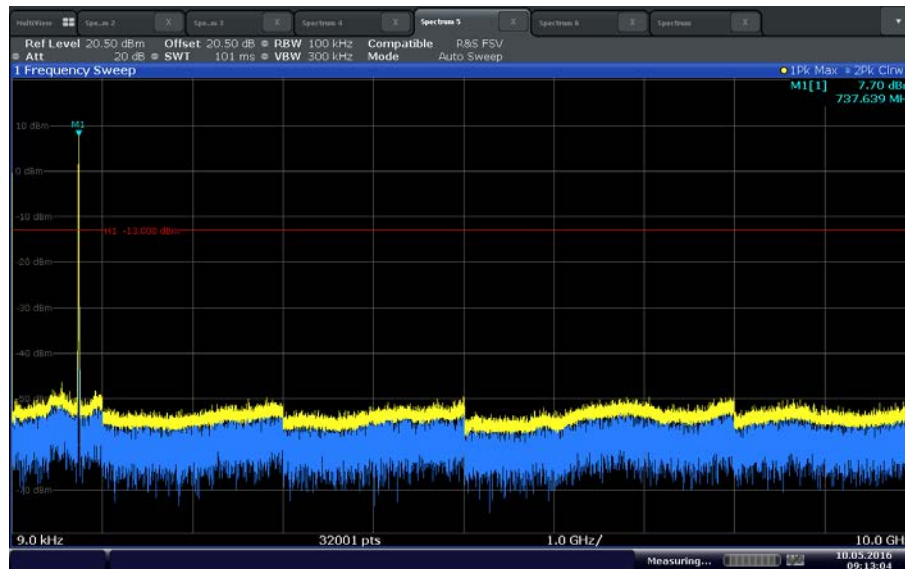
Date: 6 MAY 2016 15:31:09

LTE Band 12 Downlink 10MHz Bandwidth Low Channel Conducted Spurious Emissions



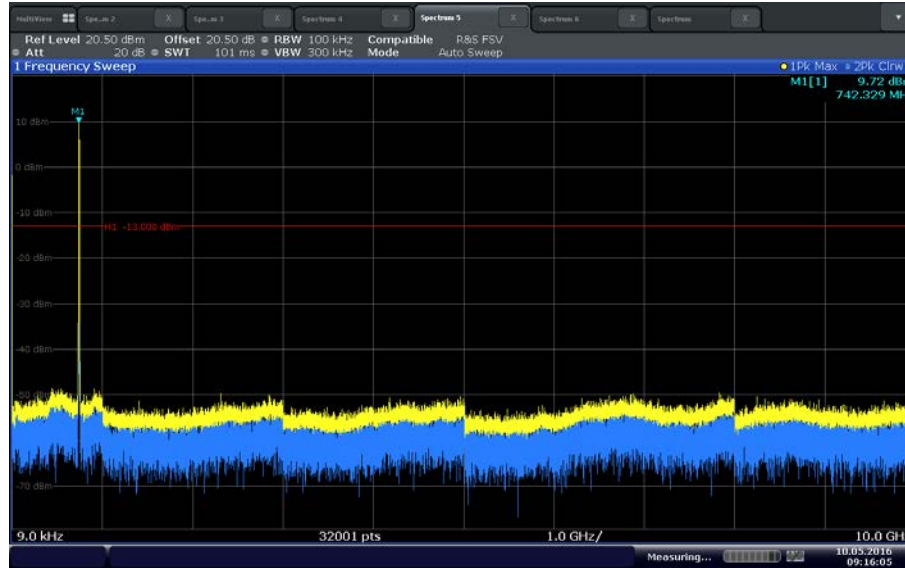
Date: 10 MAY 2016 09:11:23

LTE Band 12 Downlink 10MHz Bandwidth Mid Channel Conducted Spurious Emissions



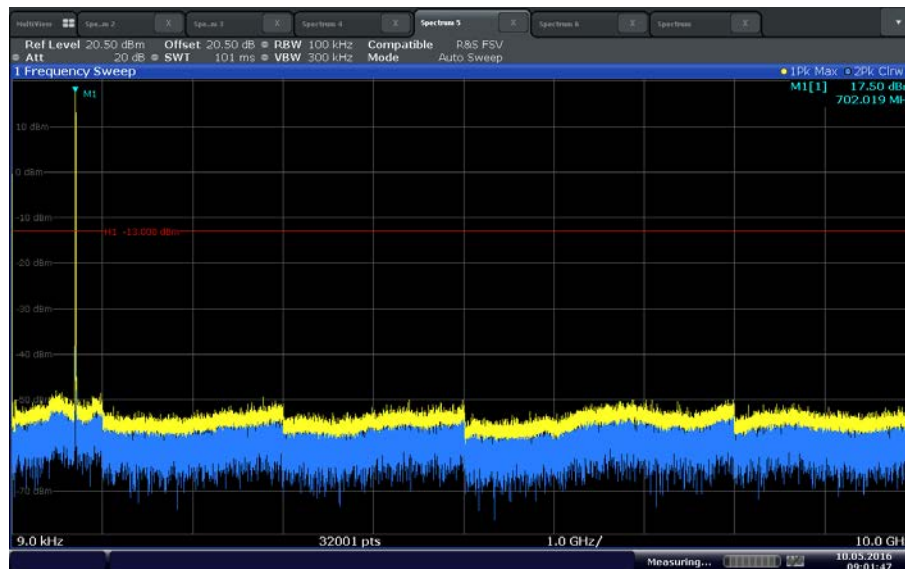
Date: 10 MAY 2016 09:13:04

LTE Band 12 Downlink 10MHz Bandwidth High Channel Conducted Spurious Emissions



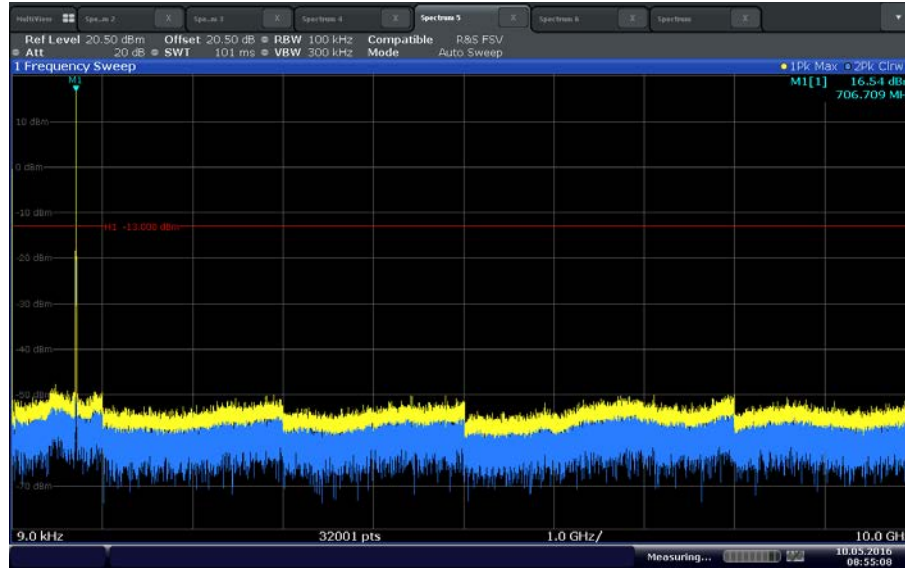
Date: 10 MAY 2016 09:16:06

LTE Band 12 Uplink 5MHz Bandwidth Low Channel Conducted Spurious Emissions

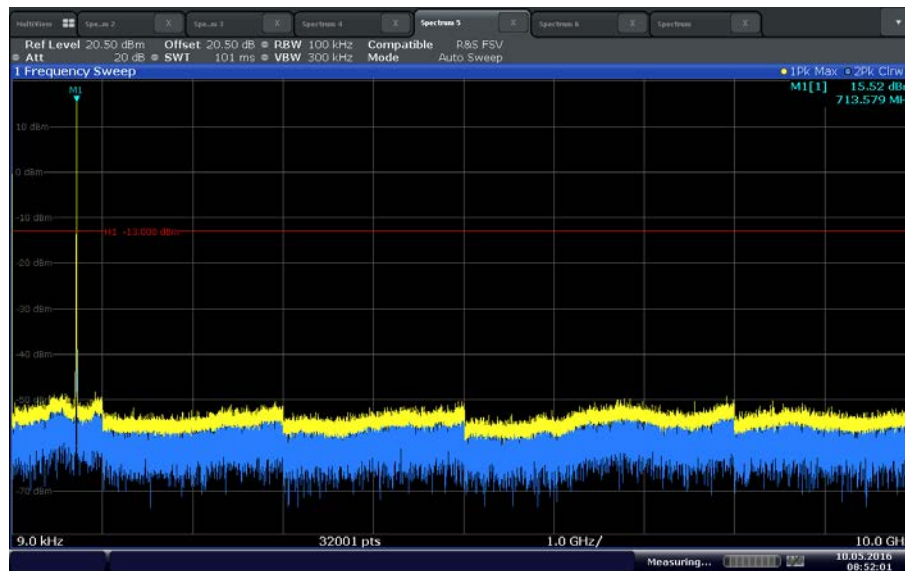


Date: 10 MAY 2016 09:01:47

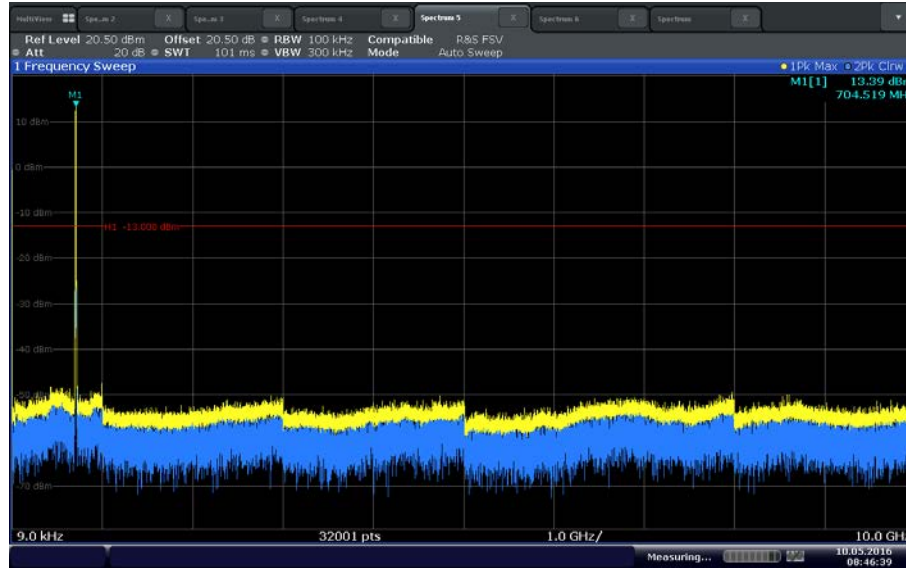
LTE Band 12 Uplink 5MHz Bandwidth Mid Channel Conducted Spurious Emissions



LTE Band 12 Uplink 5MHz Bandwidth High Channel Conducted Spurious Emissions

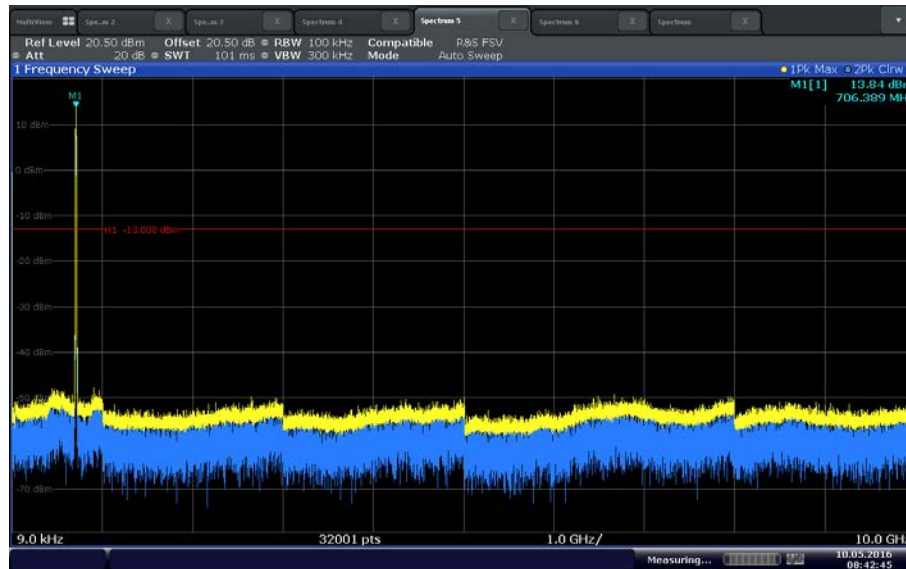


LTE Band 12 Uplink 10MHz Bandwidth Low Channel Conducted Spurious Emissions



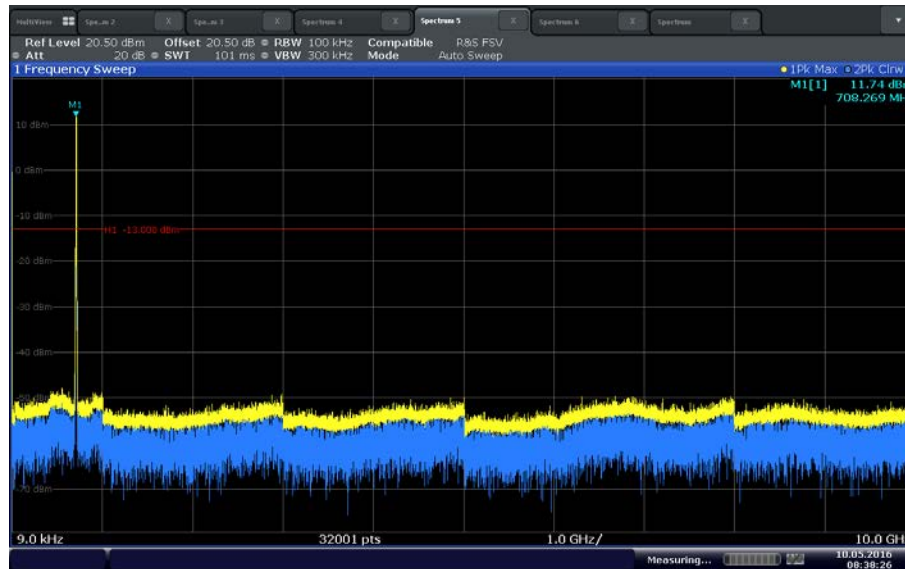
Date:10 MAY 2016 08:46:39

LTE Band 12 Uplink 10MHz Bandwidth Mid Channel Conducted Spurious Emissions



Date:10 MAY 2016 08:42:44

LTE Band 12 Uplink 10MHz Bandwidth High Channel Conducted Spurious Emissions



Date: 10 MAY 2016 08:38:27



2.7 FIELD STRENGTH OF SPURIOUS RADIATION

2.7.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1053
FCC 47 CFR Part 27, Clause 27.53(g)
RSS-130, Clause 4.6

2.7.2 Standard Applicable

Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

2.7.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU) / Test Configuration C and D

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

May 09, 2016/FSC

2.7.2 Test Equipment Used

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

2.7.3 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	27.4 °C
Relative Humidity	42.4 %
ATM Pressure	99.0 kPa

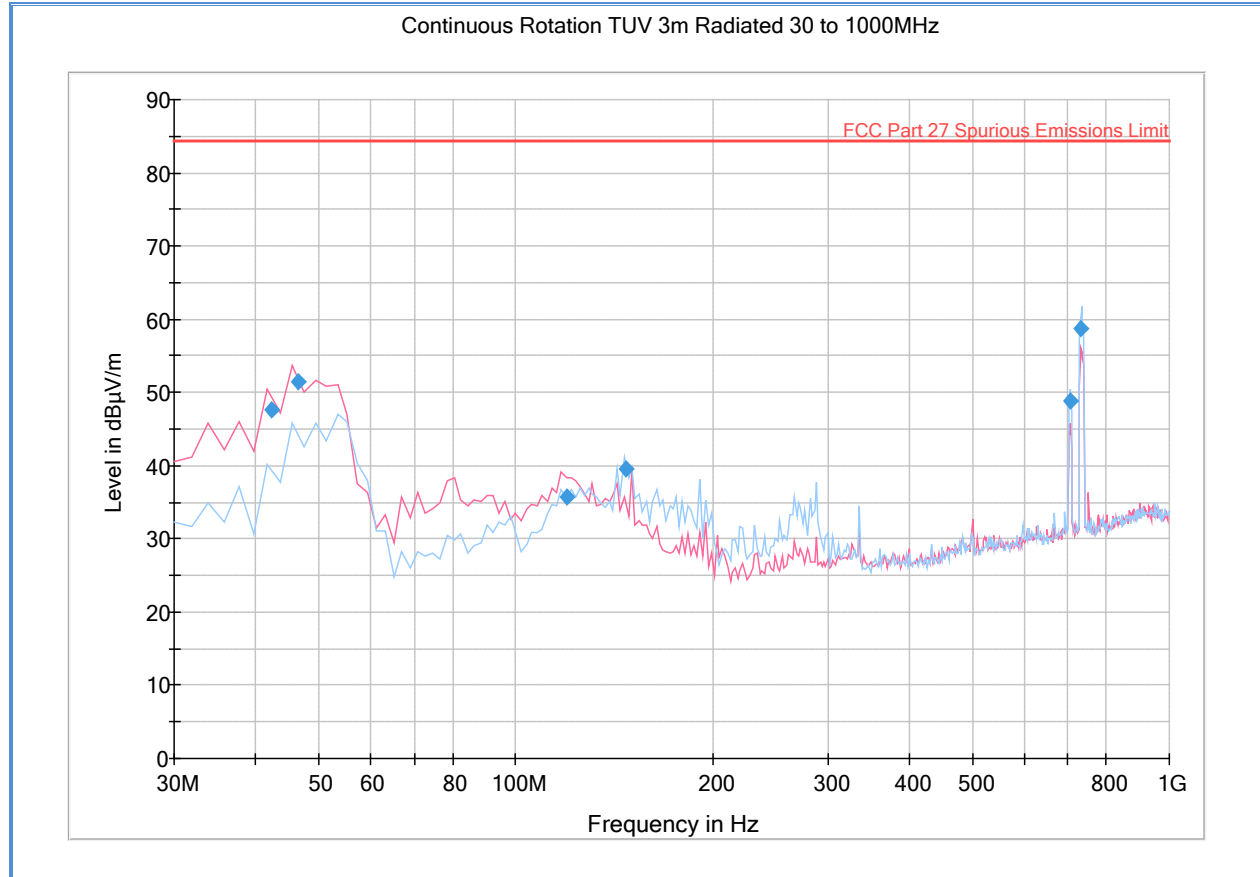
2.7.4 Additional Observations

- This is a radiated test using substitution method as per Unwanted Emissions: Radiated Spurious method of measurement of ANSI/TIA/EIA-603-C 2004, August 17, 2004.
- Only the worst case configuration presented in this test report.
- Measurement was 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.

2.7.5 Test Results

See attached plots.

2.7.6 Test Results Below 1GHz (Downlink Worst Case Configuration)

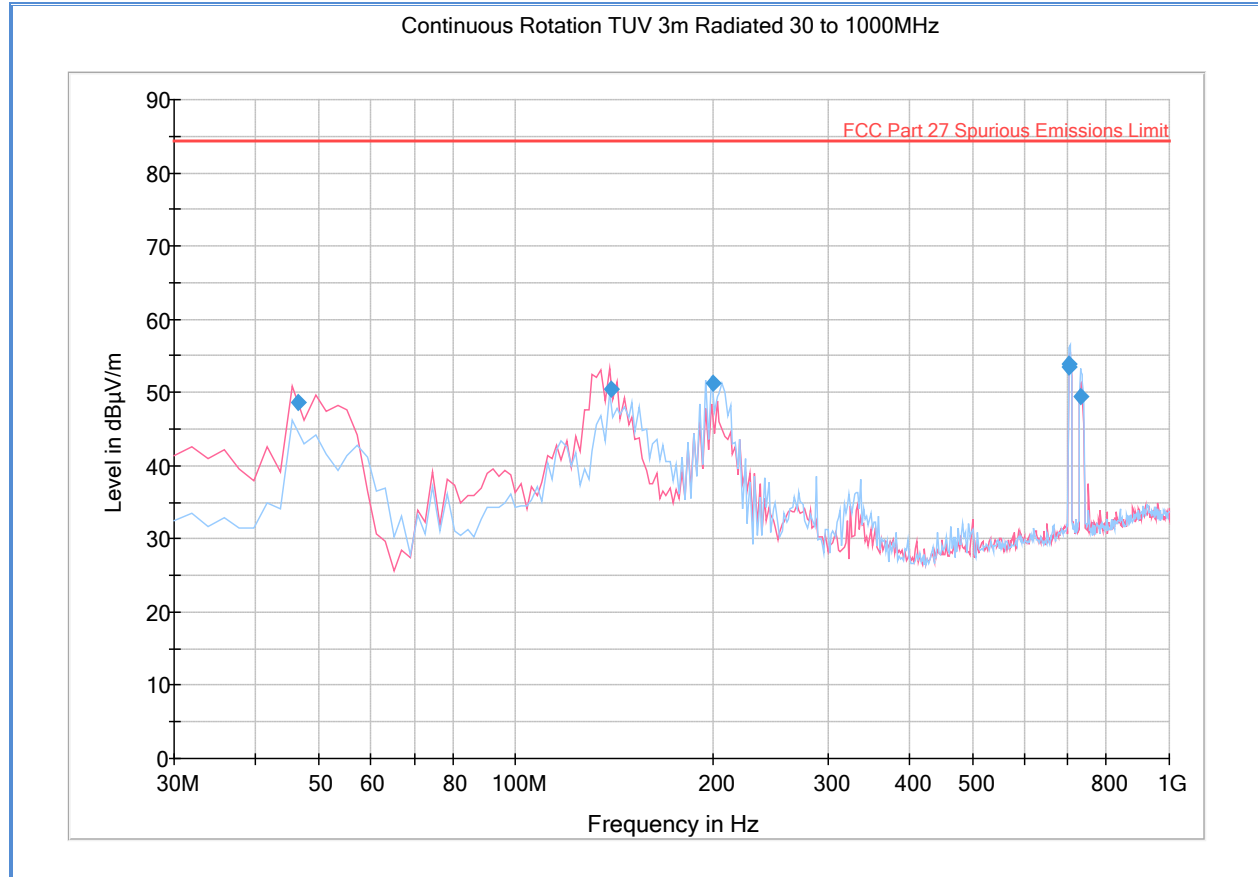


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.383327	47.7	1000.0	120.000	105.0	V	49.0	-12.0	34.5	82.2
46.391102	51.4	1000.0	120.000	100.0	V	67.0	-13.4	30.8	82.2
119.954950	35.7	1000.0	120.000	109.0	V	263.0	-15.2	46.5	82.2
147.593267	39.5	1000.0	120.000	150.0	H	304.0	-13.5	42.7	82.2
705.465170	48.8	1000.0	120.000	100.0	H	10.0	3.0	33.4	82.2
733.711263	58.6	1000.0	120.000	100.0	H	198.0	2.8	23.6	82.2

Test Notes: Only worst case channel presented for spurious emissions below 1GHz. Only case spurious emissions within 20dB of the calculated limit will be proven by substitution method.

2.7.7 Test Results Below 1GHz (Uplink Worst Case Configuration)

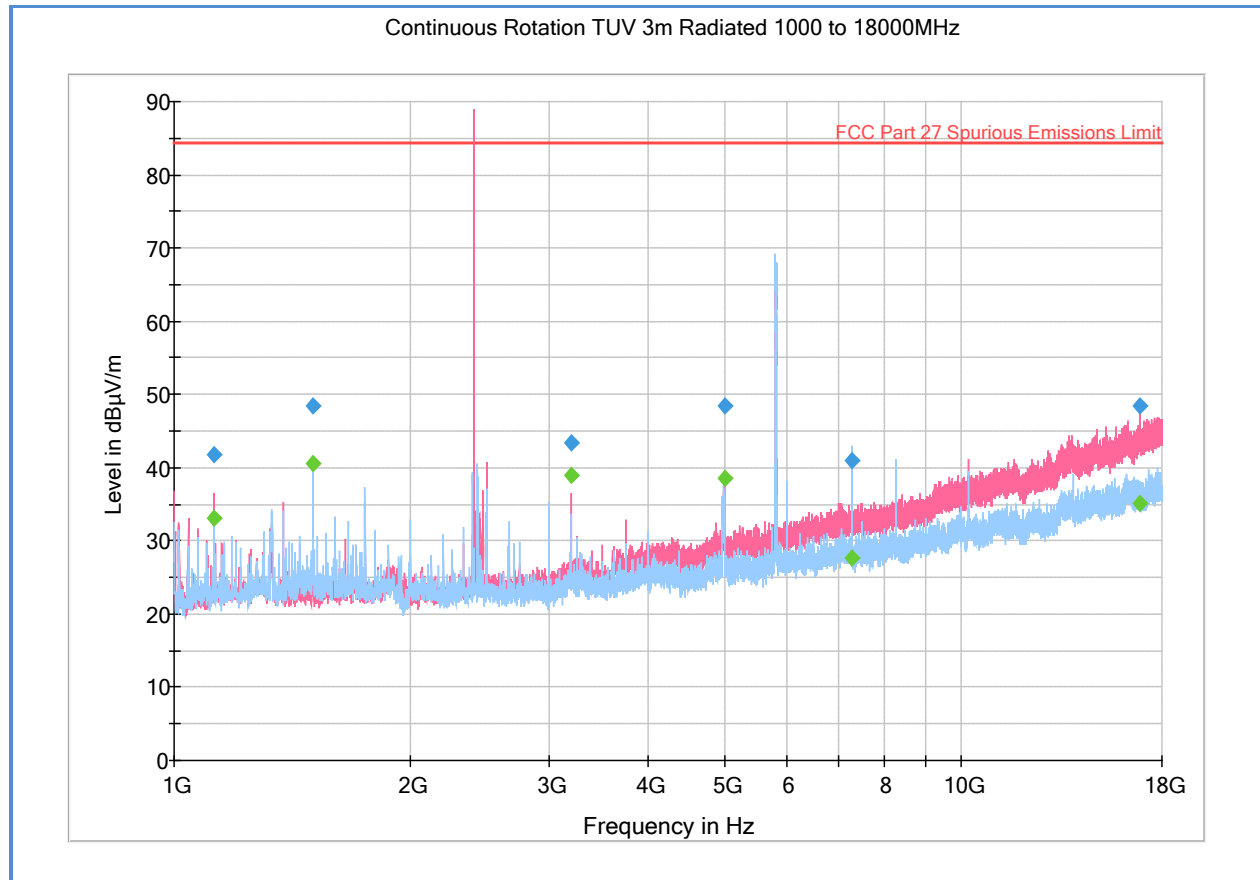


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
46.391102	48.6	1000.0	120.000	100.0	V	118.0	-13.4	33.6	82.2
139.617715	50.5	1000.0	120.000	100.0	V	32.0	-14.6	31.7	82.2
199.998236	51.3	1000.0	120.000	105.0	H	312.0	-11.5	30.9	82.2
703.705170	53.5	1000.0	120.000	100.0	H	334.0	3.0	28.8	82.2
703.729058	53.8	1000.0	120.000	100.0	H	336.0	3.0	28.4	82.2
730.463487	49.5	1000.0	120.000	100.0	H	156.0	2.9	32.7	82.2

Test Notes: Only worst case channel presented for spurious emissions below 1GHz. Only case spurious emissions within 20dB of the calculated limit will be proven by substitution method.

2.7.8 Test Results Above 1GHz - Downlink 10MHz Low Channel



Peak Data

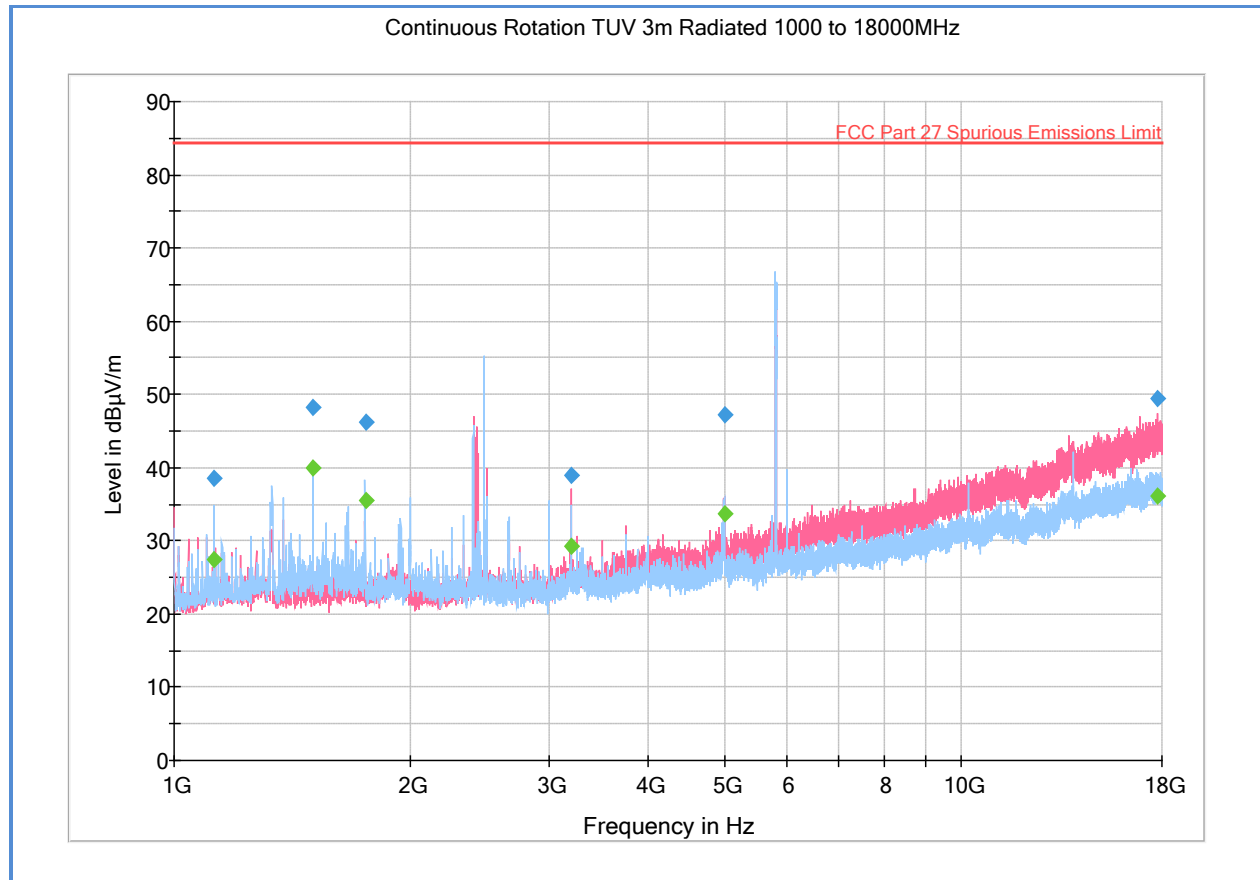
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1124.866667	41.8	1000.0	1000.000	163.6	V	270.0	-10.6	40.4	82.2
1500.000000	48.3	1000.0	1000.000	189.5	H	-20.0	-8.9	33.9	82.2
3200.000000	43.3	1000.0	1000.000	216.4	V	105.0	-4.3	38.9	82.2
4999.900000	48.4	1000.0	1000.000	190.5	V	247.0	-0.7	33.8	82.2
7268.033333	40.9	1000.0	1000.000	114.7	H	317.0	3.9	41.3	82.2
16879.833333	48.4	1000.0	1000.000	148.7	V	150.0	15.5	33.9	82.2

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1124.866667	33.1	1000.0	1000.000	163.6	V	270.0	-10.6	49.2	82.2
1500.000000	40.6	1000.0	1000.000	189.5	H	-20.0	-8.9	41.6	82.2
3200.000000	38.8	1000.0	1000.000	216.4	V	105.0	-4.3	43.4	82.2
4999.900000	38.5	1000.0	1000.000	190.5	V	247.0	-0.7	43.7	82.2
7268.033333	27.7	1000.0	1000.000	114.7	H	317.0	3.9	54.6	82.2
16879.833333	35.2	1000.0	1000.000	148.7	V	150.0	15.5	47.1	82.2

Test Notes: Emissions within the U-NII band (NU/CU link) and 2.4GHz band (CU Bluetooth LE) will be ignored. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.7.9 Test Results Above 1GHz - Downlink 10MHz Mid Channel



Peak Data

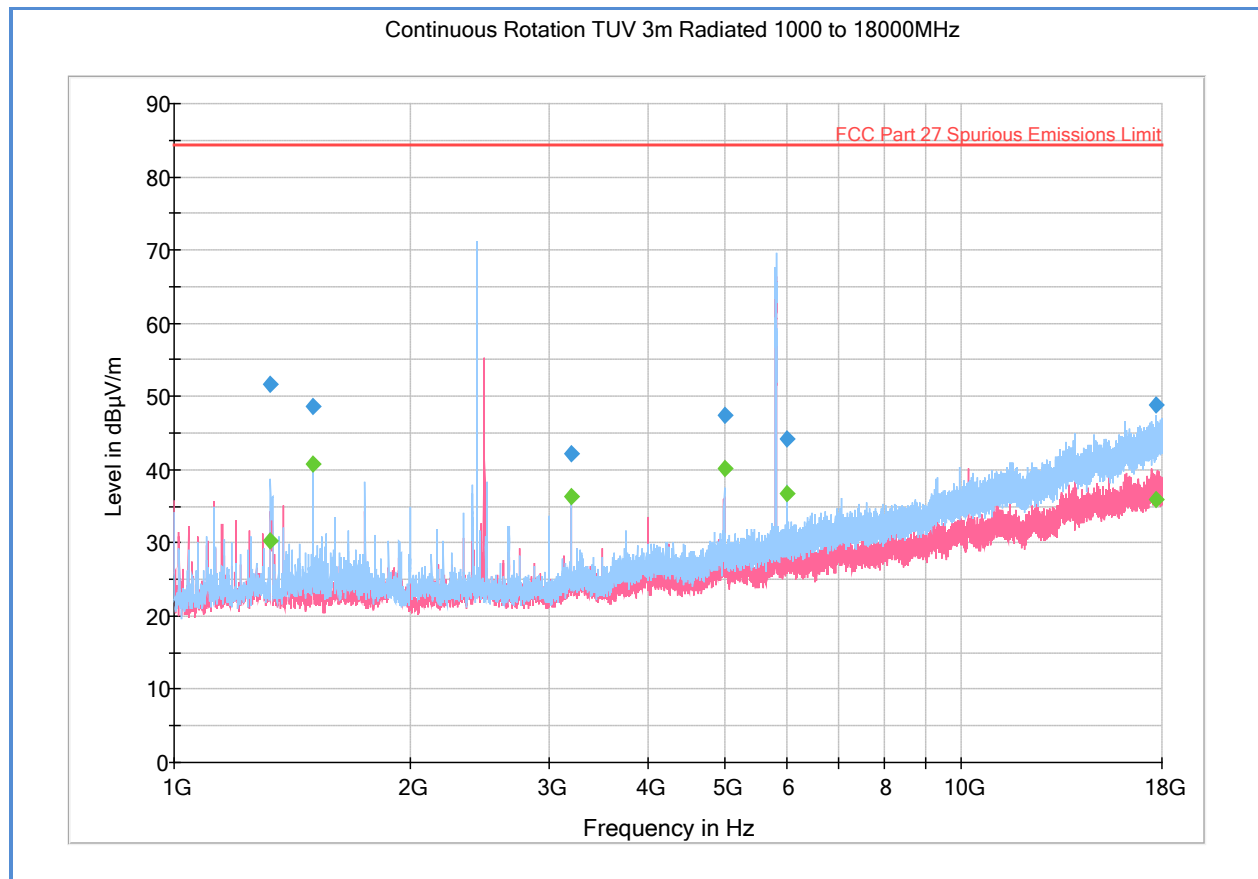
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1124.466667	38.5	1000.0	1000.000	146.7	H	4.0	-10.6	43.8	82.2
1500.000000	48.3	1000.0	1000.000	189.5	H	-16.0	-8.9	33.9	82.2
1749.900000	46.2	1000.0	1000.000	198.5	H	223.0	-7.9	36.0	82.2
3200.000000	39.0	1000.0	1000.000	163.6	V	105.0	-4.3	43.2	82.2
4999.733333	47.1	1000.0	1000.000	198.5	V	87.0	-0.7	35.1	82.2
17748.600000	49.4	1000.0	1000.000	209.4	V	177.0	16.5	32.8	82.2

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1124.466667	27.5	1000.0	1000.000	146.7	H	4.0	-10.6	54.7	82.2
1500.000000	40.0	1000.0	1000.000	189.5	H	-16.0	-8.9	42.2	82.2
1749.900000	35.5	1000.0	1000.000	198.5	H	223.0	-7.9	46.7	82.2
3200.000000	29.2	1000.0	1000.000	163.6	V	105.0	-4.3	53.0	82.2
4999.733333	33.6	1000.0	1000.000	198.5	V	87.0	-0.7	48.6	82.2
17748.600000	36.2	1000.0	1000.000	209.4	V	177.0	16.5	46.0	82.2

Test Notes: Emissions within the U-NII band (NU/CU link) and 2.4GHz band (CU Bluetooth LE) will be ignored. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.7.10 Test Results Above 1GHz - Downlink 10MHz High Channel



Peak Data

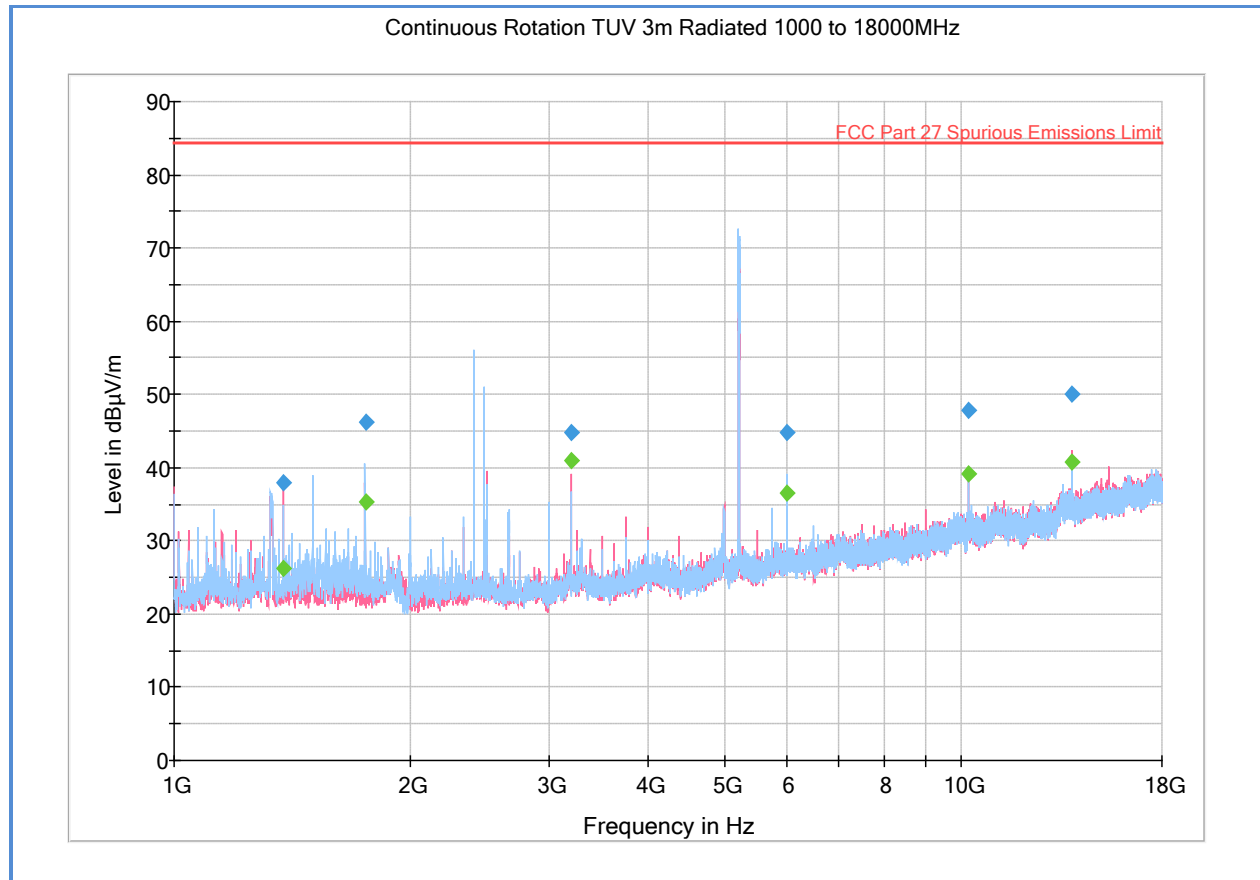
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1326.766667	51.6	1000.0	1000.000	200.5	H	196.0	-8.9	30.7	82.2
1500.000000	48.5	1000.0	1000.000	181.6	H	-20.0	-8.9	33.7	82.2
3200.000000	42.1	1000.0	1000.000	103.7	V	264.0	-4.3	40.1	82.2
4999.900000	47.5	1000.0	1000.000	200.5	H	277.0	-0.7	34.7	82.2
6000.100000	44.2	1000.0	1000.000	257.3	H	122.0	1.3	38.0	82.2
17699.300000	48.7	1000.0	1000.000	117.7	H	178.0	16.4	33.5	82.2

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1326.766667	30.2	1000.0	1000.000	200.5	H	196.0	-8.9	52.1	82.2
1500.000000	40.8	1000.0	1000.000	181.6	H	-20.0	-8.9	41.4	82.2
3200.000000	36.3	1000.0	1000.000	103.7	V	264.0	-4.3	45.9	82.2
4999.900000	40.1	1000.0	1000.000	200.5	H	277.0	-0.7	42.1	82.2
6000.100000	36.8	1000.0	1000.000	257.3	H	122.0	1.3	45.5	82.2
17699.300000	36.0	1000.0	1000.000	117.7	H	178.0	16.4	46.2	82.2

Test Notes: Emissions within the U-NII band (NU/CU link) and 2.4GHz band (CU Bluetooth LE) will be ignored. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.7.11 Test Results Above 1GHz - Uplink 10MHz Low Channel



Peak Data

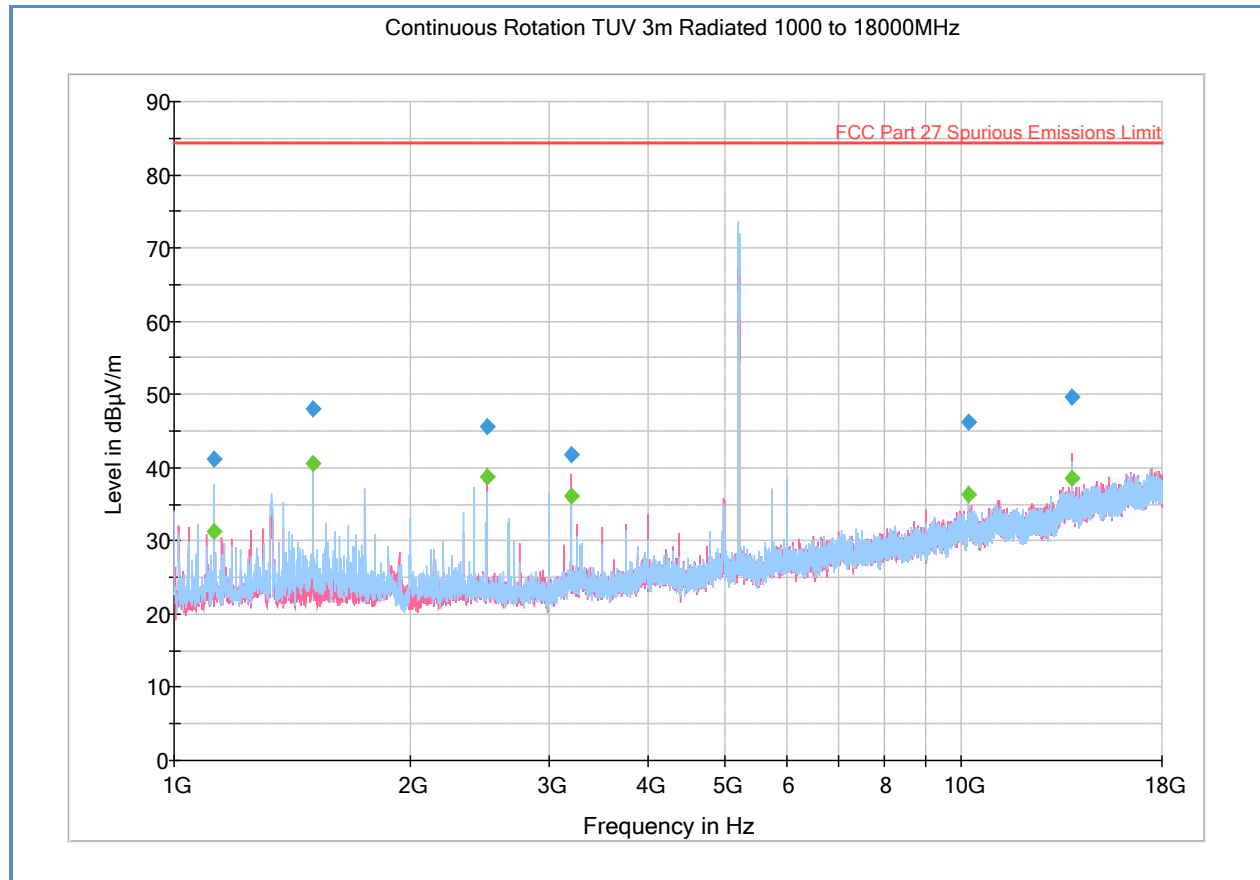
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1374.766667	38.0	1000.0	1000.000	178.6	V	276.0	-9.4	44.2	82.2
1749.900000	46.3	1000.0	1000.000	140.6	H	227.0	-7.9	35.9	82.2
3200.000000	44.8	1000.0	1000.000	199.4	V	110.0	-4.3	37.4	82.2
6000.300000	44.8	1000.0	1000.000	227.4	H	122.0	1.3	37.4	82.2
10200.033333	47.8	1000.0	1000.000	208.4	V	231.0	8.0	34.5	82.2
13812.133333	50.0	1000.0	1000.000	200.5	V	3.0	13.2	32.2	82.2

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1374.766667	26.3	1000.0	1000.000	178.6	V	276.0	-9.4	55.9	82.2
1749.900000	35.3	1000.0	1000.000	140.6	H	227.0	-7.9	46.9	82.2
3200.000000	40.9	1000.0	1000.000	199.4	V	110.0	-4.3	41.3	82.2
6000.300000	36.6	1000.0	1000.000	227.4	H	122.0	1.3	45.6	82.2
10200.033333	39.2	1000.0	1000.000	208.4	V	231.0	8.0	43.0	82.2
13812.133333	40.8	1000.0	1000.000	200.5	V	3.0	13.2	41.4	82.2

Test Notes: Emissions within the U-NII band (NU/CU link) and 2.4GHz band (CU Bluetooth LE) will be ignored. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.7.12 Test Results Above 1GHz - Uplink 10MHz Mid Channel



Peak Data

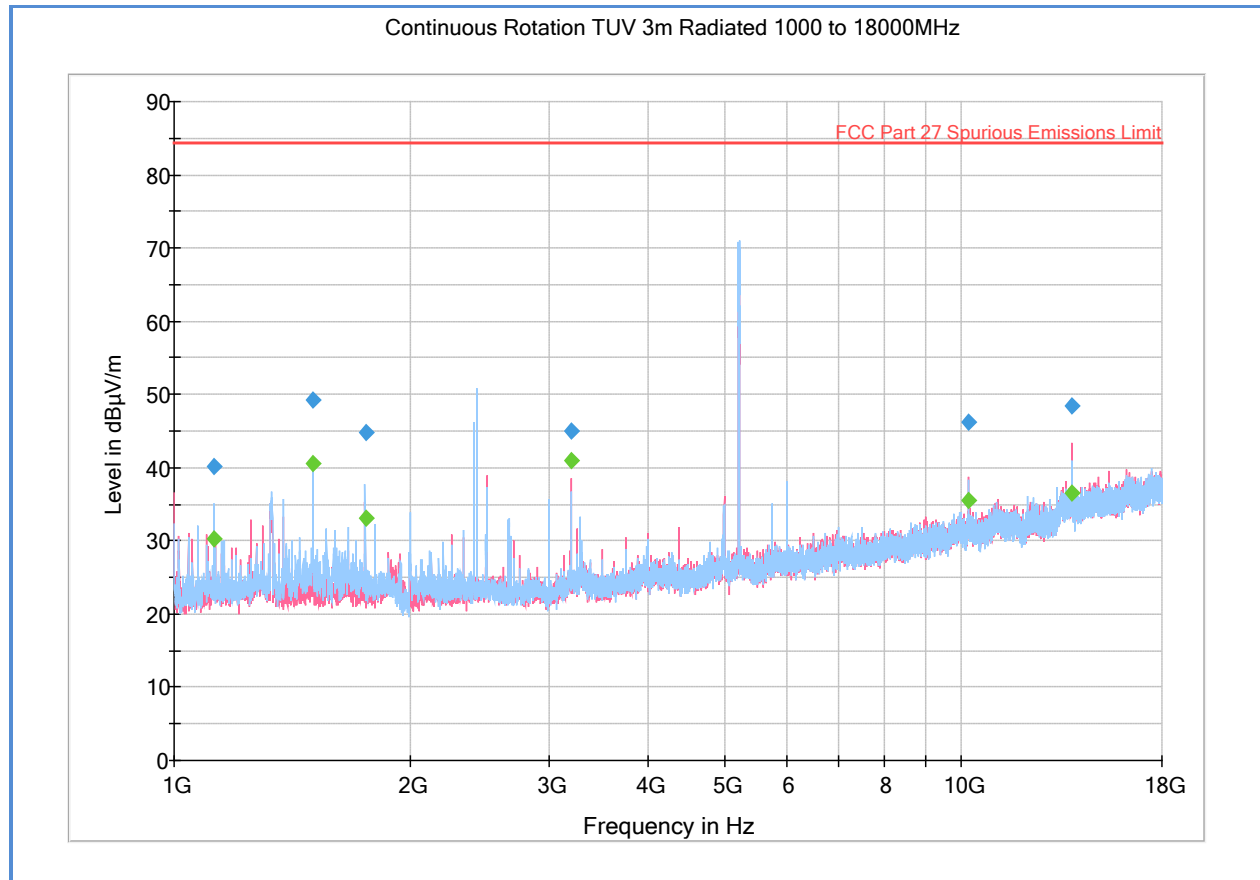
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1124.866667	41.2	1000.0	1000.000	139.7	H	314.0	-10.6	41.0	82.2
1500.200000	48.0	1000.0	1000.000	190.5	H	-20.0	-8.9	34.2	82.2
2499.766667	45.6	1000.0	1000.000	103.7	V	324.0	-6.4	36.6	82.2
3200.000000	41.9	1000.0	1000.000	173.6	V	110.0	-4.3	40.4	82.2
10199.633333	46.2	1000.0	1000.000	200.5	V	256.0	8.0	36.0	82.2
13822.333333	49.6	1000.0	1000.000	199.5	V	4.0	13.1	32.7	82.2

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1124.866667	31.3	1000.0	1000.000	139.7	H	314.0	-10.6	51.0	82.2
1500.200000	40.6	1000.0	1000.000	190.5	H	-20.0	-8.9	41.6	82.2
2499.766667	38.8	1000.0	1000.000	103.7	V	324.0	-6.4	43.5	82.2
3200.000000	36.2	1000.0	1000.000	173.6	V	110.0	-4.3	46.0	82.2
10199.633333	36.3	1000.0	1000.000	200.5	V	256.0	8.0	45.9	82.2
13822.333333	38.5	1000.0	1000.000	199.5	V	4.0	13.1	43.7	82.2

Test Notes: Emissions within the U-NII band (NU/CU link) and 2.4GHz band (CU Bluetooth LE) will be ignored. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.7.13 Test Results Above 1GHz - Uplink 10MHz High Channel



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1125.066667	40.1	1000.0	1000.000	236.4	H	325.0	-10.6	42.1	82.2
1500.000000	49.1	1000.0	1000.000	191.5	H	-20.0	-8.9	33.1	82.2
1750.300000	44.9	1000.0	1000.000	139.7	H	226.0	-7.9	37.4	82.2
3200.000000	44.9	1000.0	1000.000	200.5	V	110.0	-4.3	37.3	82.2
10200.033333	46.2	1000.0	1000.000	163.6	V	248.0	8.0	36.0	82.2
13832.700000	48.4	1000.0	1000.000	288.2	V	4.0	13.1	33.8	82.2

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1125.066667	30.3	1000.0	1000.000	236.4	H	325.0	-10.6	51.9	82.2
1500.000000	40.6	1000.0	1000.000	191.5	H	-20.0	-8.9	41.6	82.2
1750.300000	33.1	1000.0	1000.000	139.7	H	226.0	-7.9	49.1	82.2
3200.000000	40.9	1000.0	1000.000	200.5	V	110.0	-4.3	41.3	82.2
10200.033333	35.5	1000.0	1000.000	163.6	V	248.0	8.0	46.7	82.2
13832.700000	36.5	1000.0	1000.000	288.2	V	4.0	13.1	45.8	82.2

Test Notes: Emissions within the U-NII band (NU/CU link) and 2.4GHz band (CU Bluetooth LE) will be ignored. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



2.8 FREQUENCY STABILITY

2.8.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1055
FCC 47 CFR Part 27, Clause 27.54
RSS-130, Clause 4.3

2.8.2 Standard Applicable

(§27.54) The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

2.8.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU) / Test Configuration A and B

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

May 09 and 10, 2016/FSC

2.8.5 Test Equipment Used

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

2.8.6 Environmental Conditions

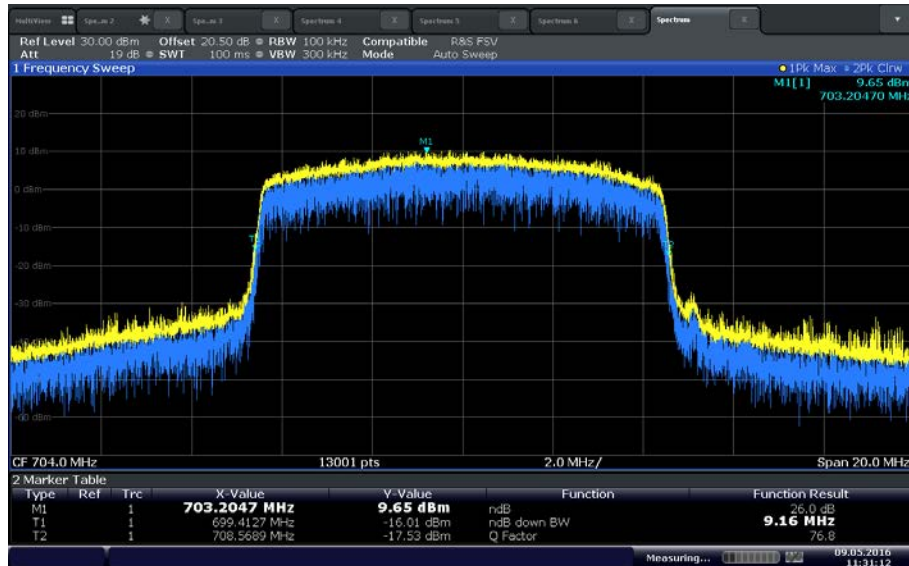
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.6 - 26.1 °C
Relative Humidity	42.0 -48.2 %
ATM Pressure	98.8 – 99.2 kPa

2.8.7 Additional Observations

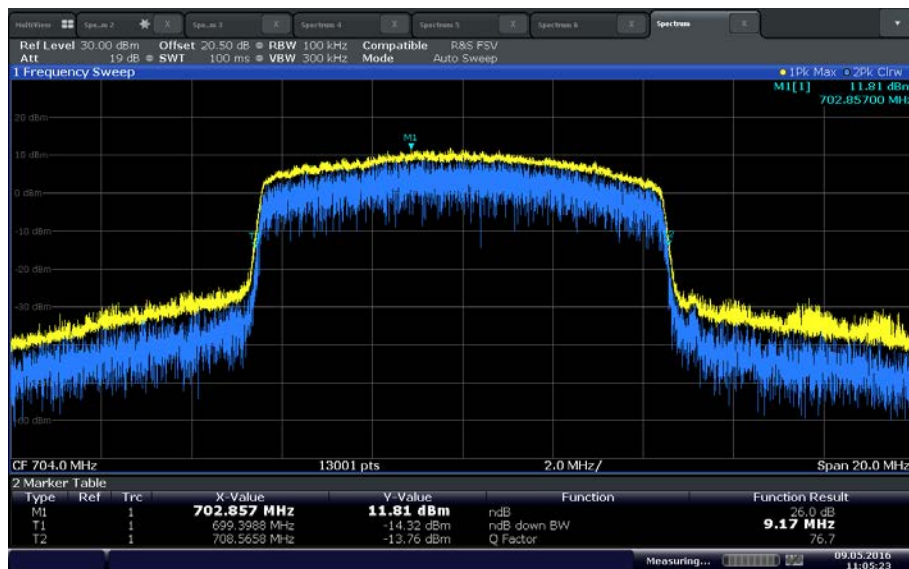
- This is a conducted test.
- The EUT was operated at 120.0VAC nominal voltage and was placed in the temperature chamber for the series of evaluations performed.
- The Temperature was reduced to -30°C and allowed to sit for 1 hour to allow the equipment and chamber temperature to stabilize. The measurements on both downlink and uplink were then performed. The temperature was then increased by 10°C steps and allowed to settle before taking the next set of measurements.
- Voltage variation was also performed at 85% and 115% of the nominal voltage.
- Test procedure as per RSS-130 was also performed.
- 10MHz BW was used for Uplink while 5MHz for Downlink.

2.8.8 Sample Computation and Sample Plots for Uplink



Date: 9 MAY 2016 11:31:12

LTE B12 Uplink Low Channel @ 20°C Nominal Voltage



Date: 9 MAY 2016 11:05:23

LTE B12 Uplink Low Channel @ 50°C Nominal Voltage

Computation of Center Frequency (@ 50°C):

Since T1 = 699.3988MHz and T2 = 708.5658 MHz, therefore $((T2-T1)/2) + T1$ = center frequency (703.9823 MHz)

Calculation of Frequency Deviation (ppm @ 50°C):

Comparing center frequency @ 50°C to center frequency @ 20°C, then calculate ppm.

$$((703.9908 \text{ MHz} - 703.9823 \text{ MHz}) / 703.9908 \text{ MHz}) \times 1000000 = 12.07 \text{ ppm}$$

2.8.9 Test Results Summary

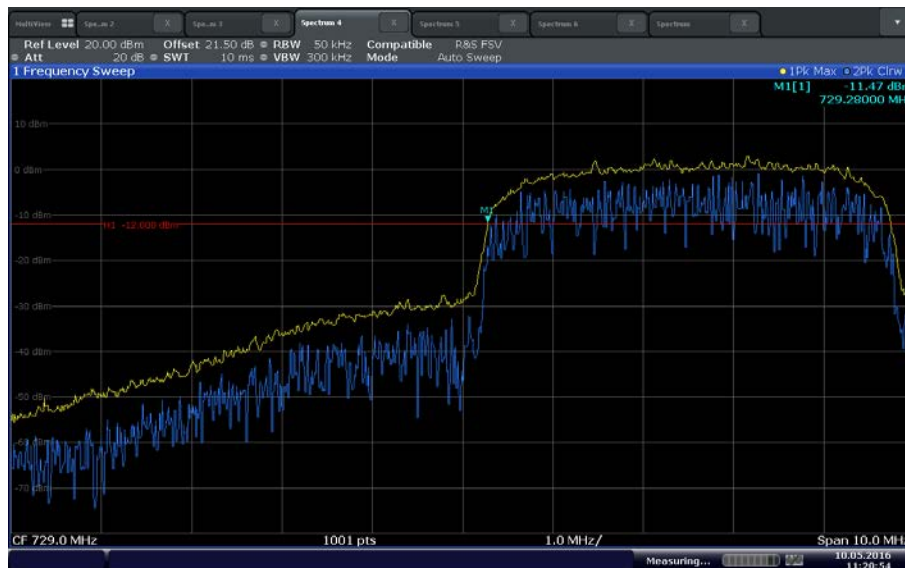
LTE B12 Uplink		
Voltage (VAC)	Temperature (°C)	Frequency Deviation (ppm)
120	-30	-17.47
	-20	-20.67
	-10	-9.80
	0	-2.13
	+10	-0.99
	+20	0
	+30	1.140
	+40	9.870
	+50	12.07

LTE B12 Uplink		
Temperature (°C)	Voltage (VAC)	Frequency Deviation (ppm)
20	102	13.4
	138	0

Given a center frequency of 704 MHz (10MHz BW Low Channel Uplink) and with a BW of 9.24 MHz (Section 3.3.8 of this test report), therefore the -26dB BW low edge of this channel is 699.38 MHz. Since the lower edge of this frequency band is 698 MHz, therefore the theoretical frequency deviation limit would be > 50ppm. **EUT complies.**

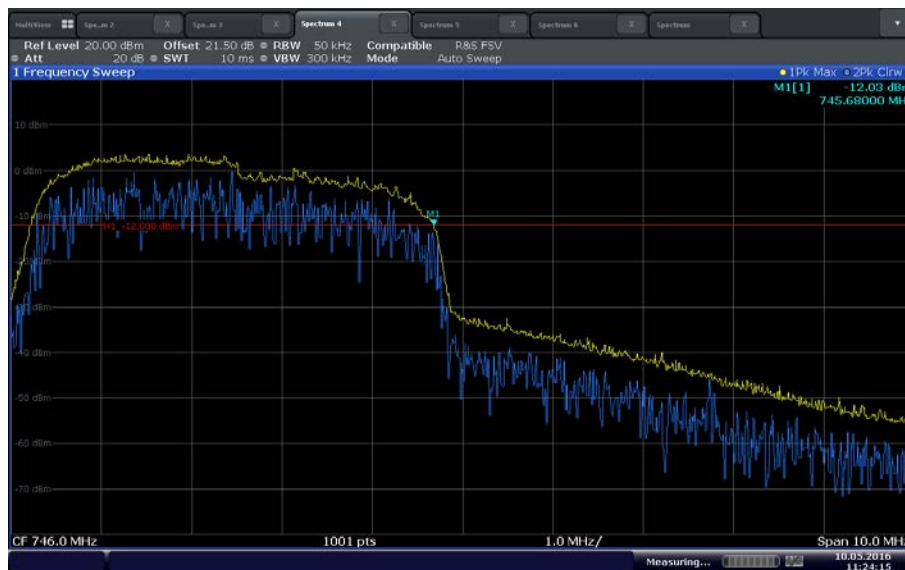
LTE B12 Downlink				
Voltage (VAC)	Temperature (°C)	f _L	f _H	Compliance
120	50	729.28	745.68	Within frequency the range of 729-746 MHz band. EUT complies.
102	20	729.27	745.65	
120	20	729.27	745.65	
138	20	729.27	745.65	
120	-30	729.26	745.70	

2.8.10 Sample Test Plots for Downlink



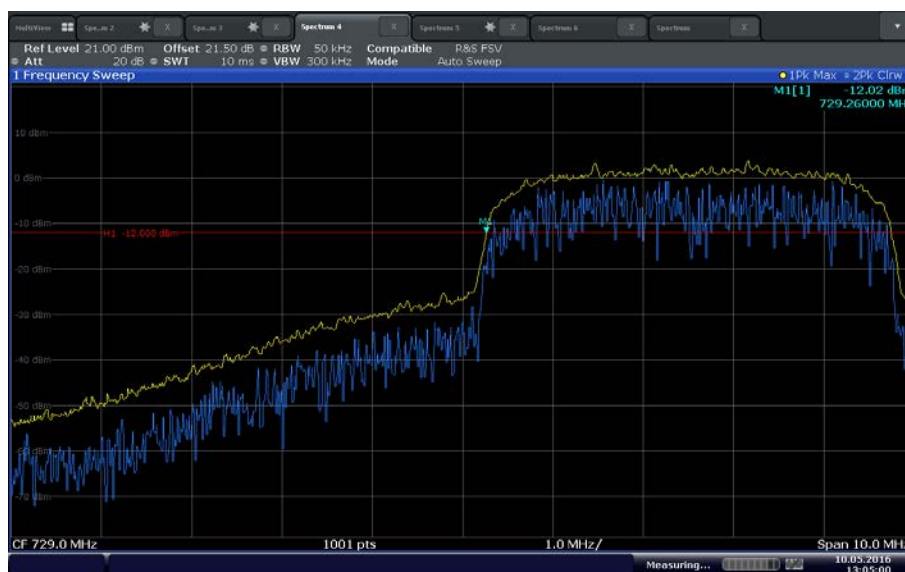
Date: 10 MAY 2016 11:20:54

LTE B12 Downlink Low Channel @ 50°C Nominal Voltage



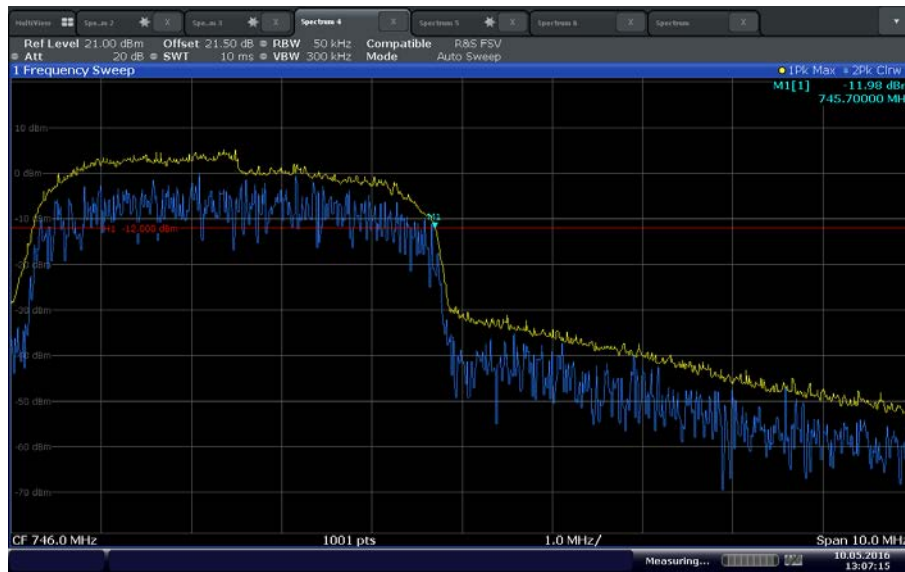
Date: 10 MAY 2016 11:24:16

LTE B12 Downlink High Channel @ 50°C Nominal Voltage



Date: 10 MAY 2016 13:05:00

LTE B12 Downlink Low Channel @ -30°C Nominal Voltage



Date: 10 MAY 2016 13:07:15

LTE B12 Downlink High Channel @ -30°C Nominal Voltage



2.9 POWER LINE CONDUCTED EMISSIONS

2.9.1 Specification Reference

RSS-Gen 8.8

2.9.2 Standard Applicable

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

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

**Decreases with the logarithm of the frequency.*

2.9.3 Equipment Under Test and Modification State

Serial No: 296546000554 (NU) and 29754000407 (CU) / Test Configuration E

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

April 27, 2016/FSC

2.9.5 Test Equipment Used

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

2.9.6 Environmental Conditions

Ambient Temperature 23.6 °C
 Relative Humidity 43.76.%
 ATM Pressure 99.7 kPa



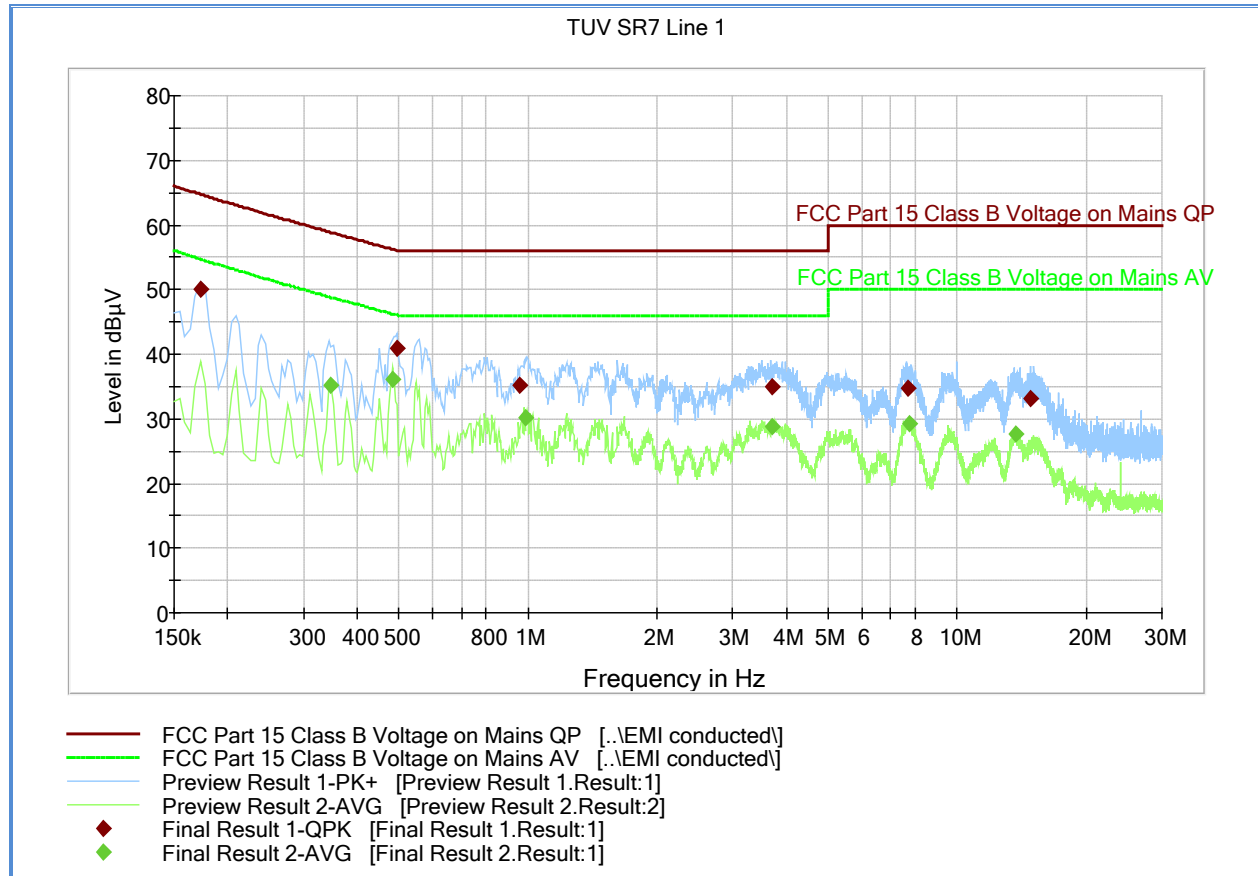
2.9.7 Additional Observations

- The EUT was verified using AC adapter supplied by the manufacturer.
- EUT verified using input voltage of 120VAC 60Hz.
- NU and CU verified separately.
- Measurement was done using EMC32 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 2.9.8 for sample computation.

2.9.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (db μ V) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7567 (LISN)	0.30	
Reported QuasiPeak Final Measurement (db μ V) @ 150kHz			26.2

2.9.9 Test Results - Conducted Emissions Line 1 – Hot (NU)



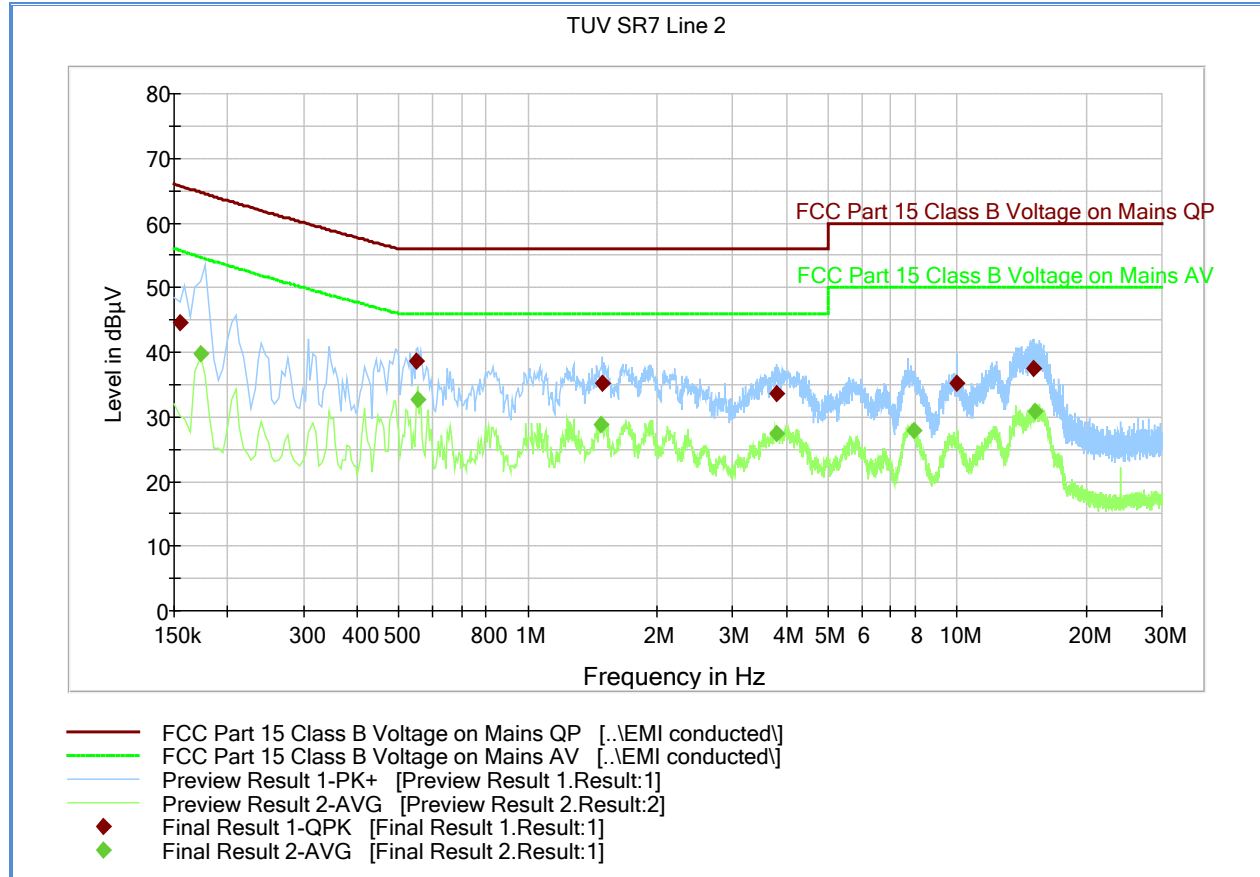
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.172500	50.0	1000.0	9.000	Off	L1	20.1	14.7	64.8
0.496500	40.9	1000.0	9.000	Off	L1	20.0	15.2	56.1
0.960000	35.2	1000.0	9.000	Off	L1	20.0	20.8	56.0
3.696000	35.0	1000.0	9.000	Off	L1	20.1	21.0	56.0
7.692000	34.8	1000.0	9.000	Off	L1	20.1	25.2	60.0
14.802000	33.2	1000.0	9.000	Off	L1	20.3	26.8	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.348000	35.3	1000.0	9.000	Off	L1	20.0	13.5	48.8
0.483000	36.0	1000.0	9.000	Off	L1	20.0	10.2	46.3
0.991500	30.1	1000.0	9.000	Off	L1	20.0	15.9	46.0
3.714000	28.7	1000.0	9.000	Off	L1	20.1	17.3	46.0
7.714500	29.3	1000.0	9.000	Off	L1	20.1	20.7	50.0
13.731000	27.6	1000.0	9.000	Off	L1	20.2	22.4	50.0

2.9.10 Test Results - Conducted Emissions Line 2 –Neutral (NU)



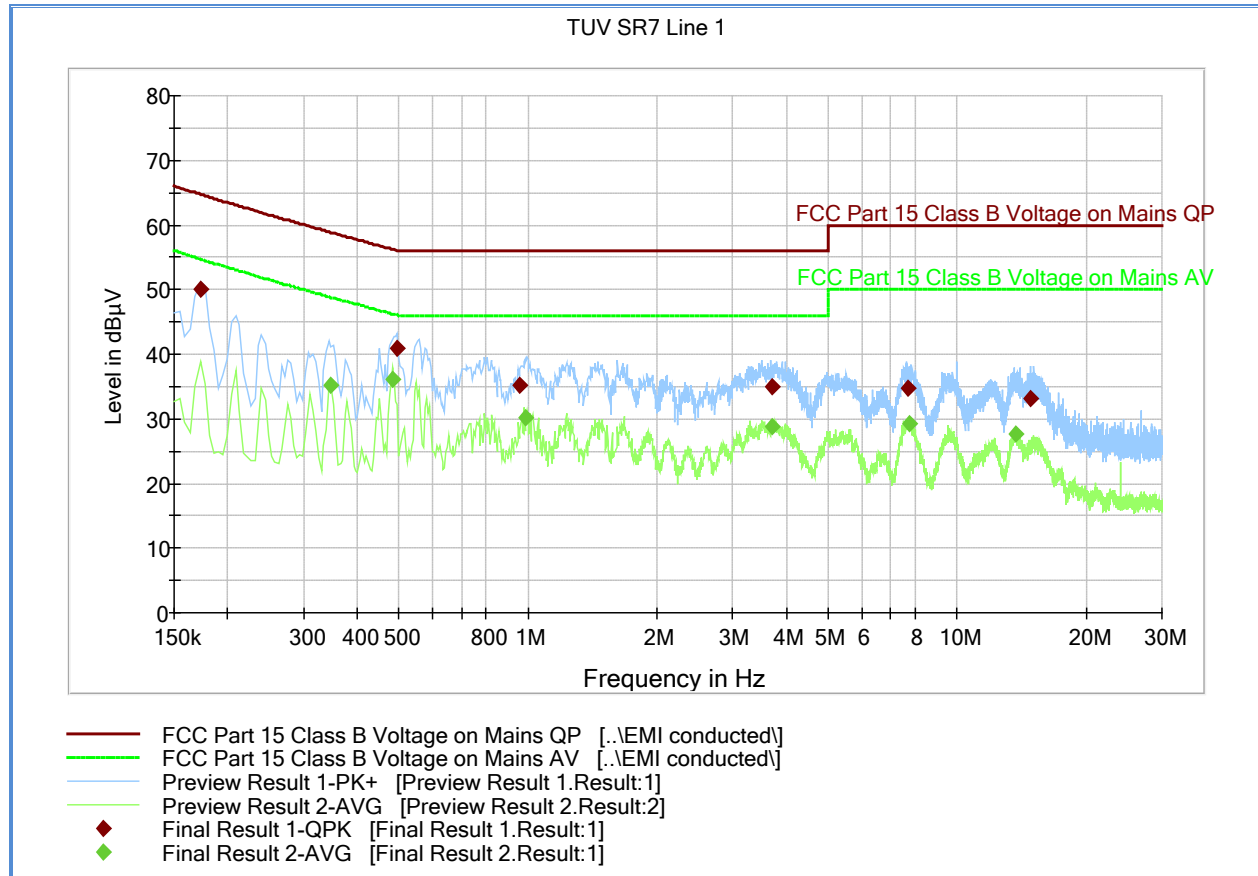
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.154500	44.6	1000.0	9.000	Off	N	20.2	21.1	65.7
0.550500	38.6	1000.0	9.000	Off	N	20.0	17.4	56.0
1.491000	35.1	1000.0	9.000	Off	N	20.0	20.9	56.0
3.804000	33.5	1000.0	9.000	Off	N	20.1	22.5	56.0
10.000500	35.1	1000.0	9.000	Off	N	20.2	24.9	60.0
15.112500	37.4	1000.0	9.000	Off	N	20.3	22.6	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.172500	39.8	1000.0	9.000	Off	N	20.1	14.9	54.7
0.555000	32.7	1000.0	9.000	Off	N	20.0	13.3	46.0
1.477500	28.7	1000.0	9.000	Off	N	20.0	17.3	46.0
3.799500	27.4	1000.0	9.000	Off	N	20.1	18.6	46.0
7.935000	27.8	1000.0	9.000	Off	N	20.1	22.2	50.0
15.144000	30.9	1000.0	9.000	Off	N	20.3	19.1	50.0

2.9.11 Test Results - Conducted Emissions Line 1 – Hot (CU)



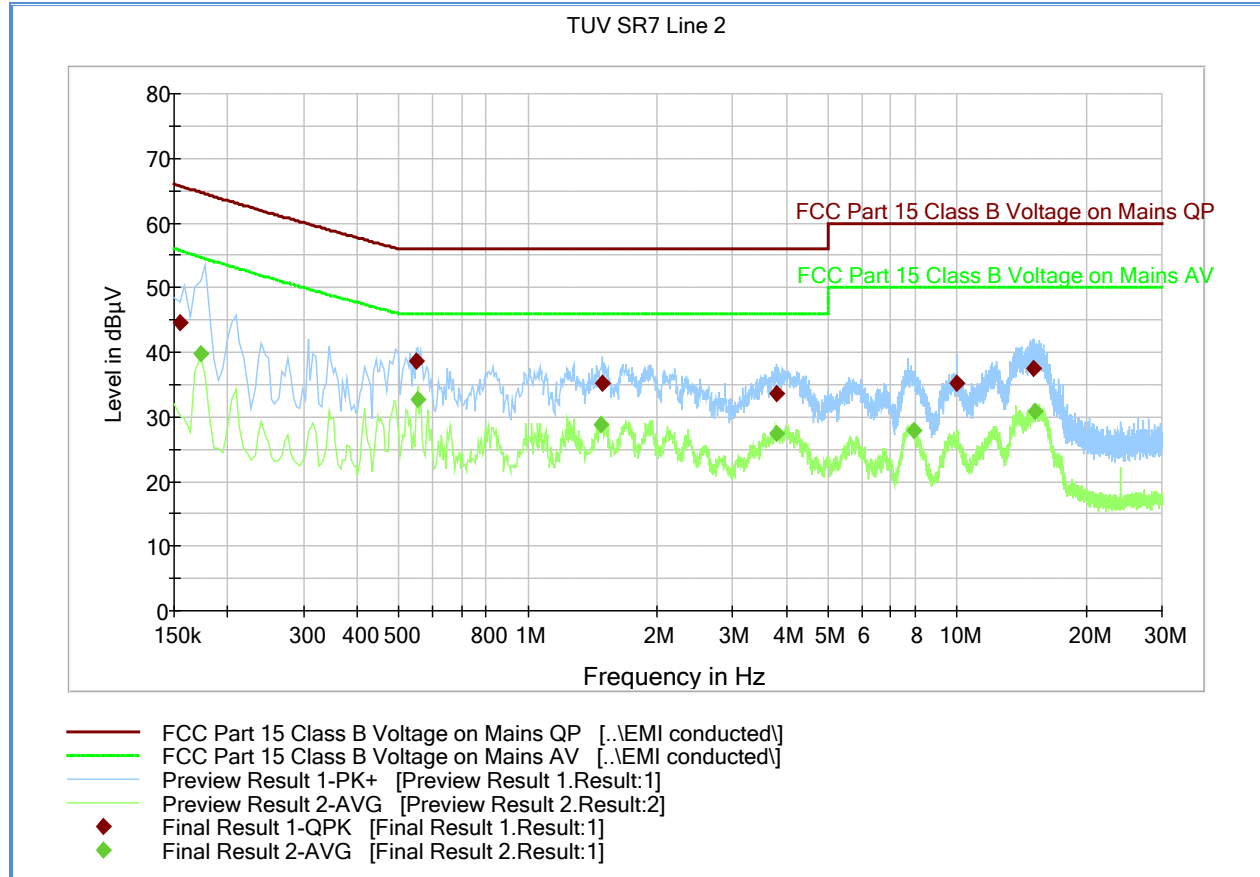
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.172500	50.0	1000.0	9.000	Off	L1	20.1	14.7	64.8
0.496500	40.9	1000.0	9.000	Off	L1	20.0	15.2	56.1
0.960000	35.2	1000.0	9.000	Off	L1	20.0	20.8	56.0
3.696000	35.0	1000.0	9.000	Off	L1	20.1	21.0	56.0
7.692000	34.8	1000.0	9.000	Off	L1	20.1	25.2	60.0
14.802000	33.2	1000.0	9.000	Off	L1	20.3	26.8	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.348000	35.3	1000.0	9.000	Off	L1	20.0	13.5	48.8
0.483000	36.0	1000.0	9.000	Off	L1	20.0	10.2	46.3
0.991500	30.1	1000.0	9.000	Off	L1	20.0	15.9	46.0
3.714000	28.7	1000.0	9.000	Off	L1	20.1	17.3	46.0
7.714500	29.3	1000.0	9.000	Off	L1	20.1	20.7	50.0
13.731000	27.6	1000.0	9.000	Off	L1	20.2	22.4	50.0

2.9.12 Test Results - Conducted Emissions Line 2 –Neutral (CU)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.154500	44.6	1000.0	9.000	Off	N	20.2	21.1	65.7
0.550500	38.6	1000.0	9.000	Off	N	20.0	17.4	56.0
1.491000	35.1	1000.0	9.000	Off	N	20.0	20.9	56.0
3.804000	33.5	1000.0	9.000	Off	N	20.1	22.5	56.0
10.000500	35.1	1000.0	9.000	Off	N	20.2	24.9	60.0
15.112500	37.4	1000.0	9.000	Off	N	20.3	22.6	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.172500	39.8	1000.0	9.000	Off	N	20.1	14.9	54.7
0.555000	32.7	1000.0	9.000	Off	N	20.0	13.3	46.0
1.477500	28.7	1000.0	9.000	Off	N	20.0	17.3	46.0
3.799500	27.4	1000.0	9.000	Off	N	20.1	18.6	46.0
7.935000	27.8	1000.0	9.000	Off	N	20.1	22.2	50.0
15.144000	30.9	1000.0	9.000	Off	N	20.3	19.1	50.0



SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

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

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Antenna Conducted Port Setup						
7604	P-Series Power Meter	N1912A	SG45100273	Agilent	05/27/15	05/27/16
7605	50MHz-18GHz Wideband Power Sensor	N1921A	MY51100054	Agilent	04/10/15	04/10/16
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	10/05/15	10/05/16
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	07/29/15	07/29/16
7562	Wideband Radio Communication Tester	CMW 500	1201.0002k50 /103829	Rhode & Schwarz	For signalling	
8772	10dB Attenuator	606-10-1F4/DR	-	MECA	Verified by 7582 and 7608	
Radiated Emissions						
1033	Bilog Antenna	3142C	00044556	EMCO	09/25/15	09/25/16
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	03/21/16	03/21/17
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	01/11/16	01/11/17
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	09/29/15	09/29/16
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
1016	Pre-amplifier	PAM-0202	187	PAM	12/15/15	12/15/16
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 7582 and 7608	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	09/03/15	09/03/16
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	05/08/15	05/08/16
Conducted Emissions						
7620	EMI Test Receiver	ESU40	100399	Rhode & Schwarz	09/03/15	09/03/16
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	07/14/15	07/14/16
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	10/28/15	10/28/16
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/29/16	02/28/17
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/29/16	02/28/17
7562	Wideband Radio Communication Tester	CMW 500	1201.0002k50 /103829	Rhode & Schwarz	For signalling	



Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/14/15	08/14/16
7560	Barometer/Temperature /Humidity Transmitter	iBTHX-W	1240476	Omega	10/19/15	10/19/16
	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 Conducted Measurements

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
4	Attenuator	Rectangular	0.30	0.17	0.03
5	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.80
Coverage Factor (k):					2
Expanded Uncertainty:					1.59

3.2.2 Radiated Measurements (Below 1GHz)

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	Preamplifier	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.57

3.2.3 Radiated Emission Measurements (Above 1GHz)

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	Preamplifier	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.56

3.2.4 Conducted Antenna Port Measurement

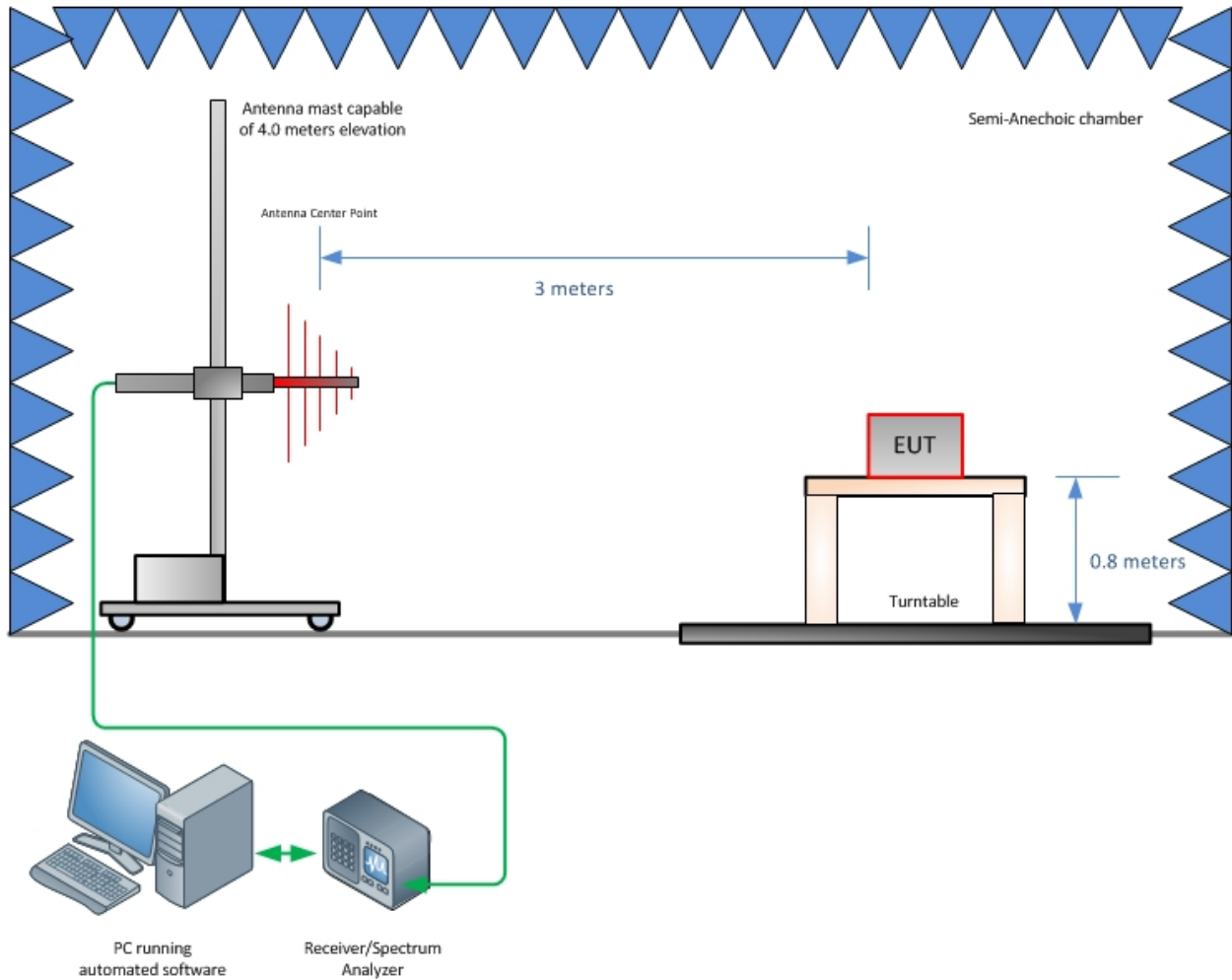
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.50	0.29	0.08
3	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.72
Coverage Factor (k):					2
Expanded Uncertainty:					1.45



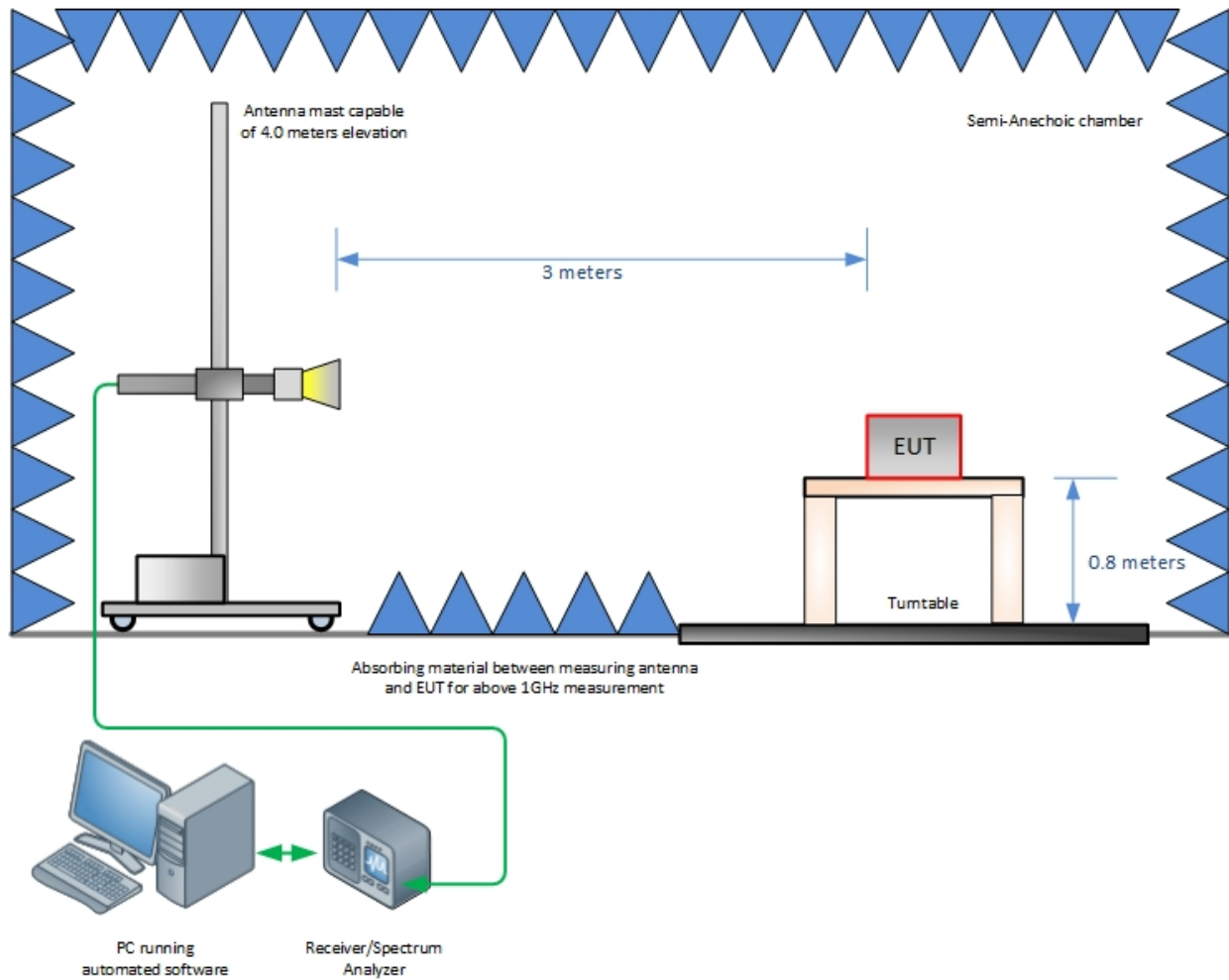
SECTION 4

DIAGRAM OF TEST SETUP

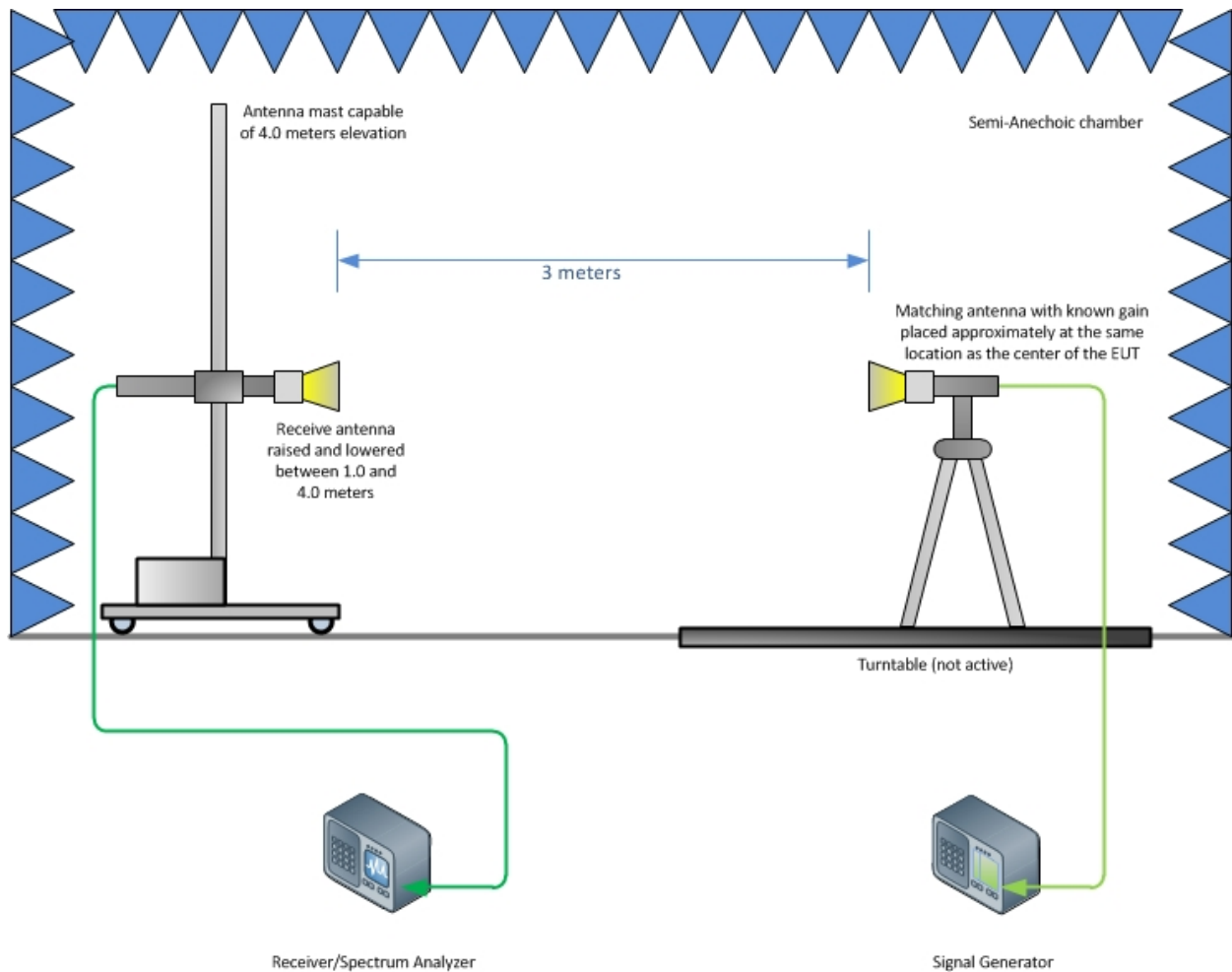
4.1 TEST SETUP DIAGRAM



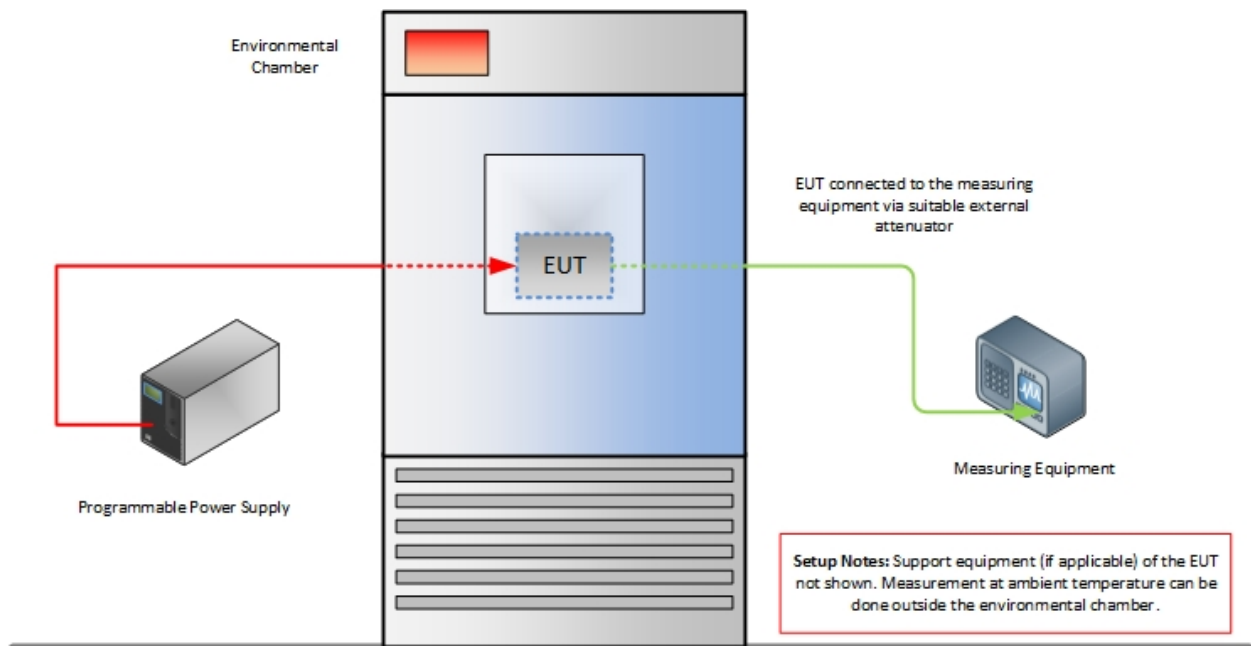
Radiated Emission Test Setup (Below 1GHz)



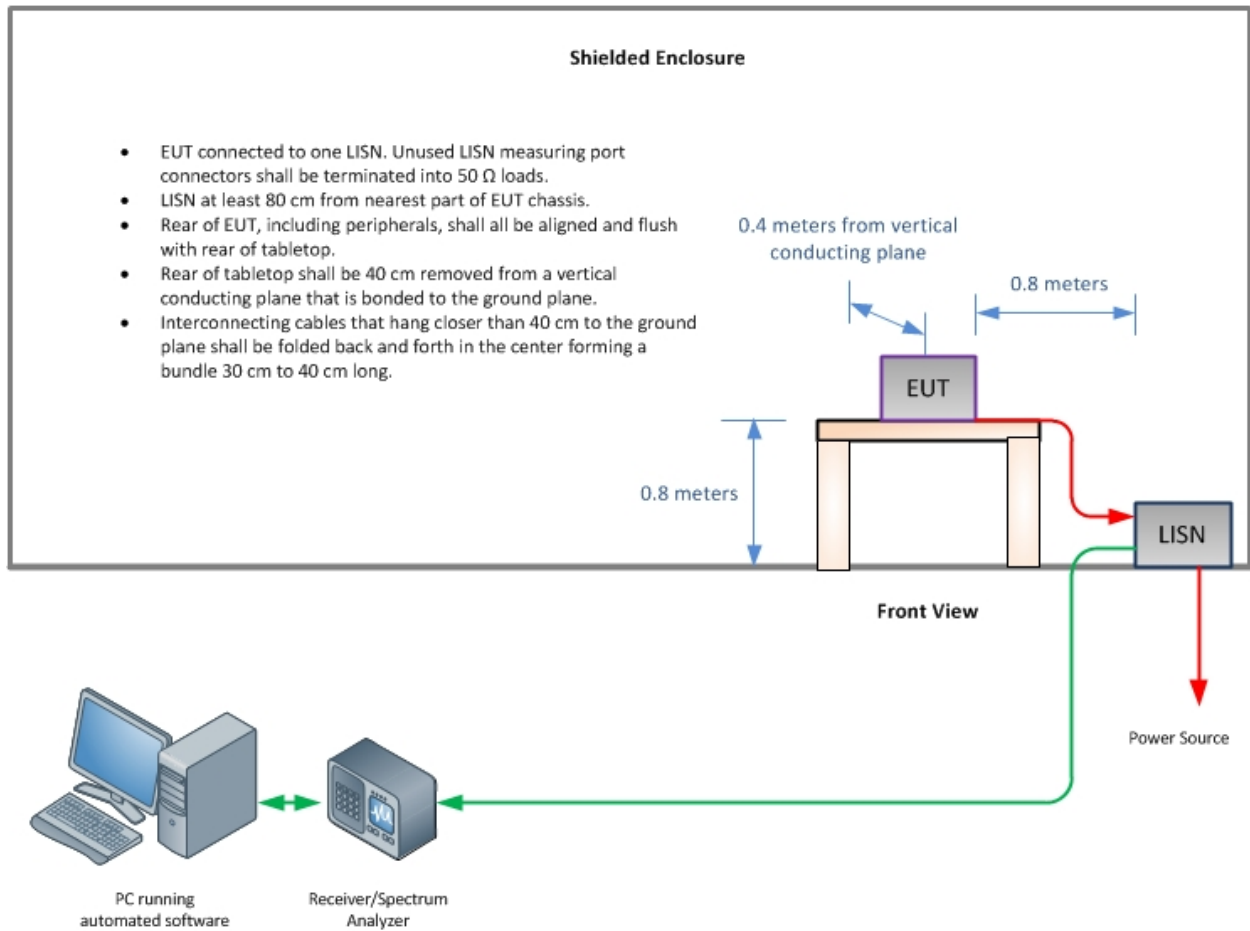
Radiated Emission Test Setup (Above 1GHz)



Substitution Test Method (Above 1GHz, if applicable)



Frequency Stability Test Configuration



Conducted Emissions Test Configuration (if applicable)



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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