Choose certainty.
Add value.

Report On

Application for Grant of Equipment Authorization of the Nextivity Inc.
Cel-Fi GO RED Industrial Signal Booster

FCC CFR 47 Part 2 and 90
RSS-GEN and RSS-140 and RSS-131

Report No. 72141009B **November 2018**

REPORT ON	Radio Testing of the Nextivity Inc. Cel-Fi GO RED Industrial Signal Booster
TEST REPORT NUMBER	72141009B
PREPARED FOR	Nextivity Inc. 16550 West Bernardo Drive, Bldg 5, Suite 550, San Diego, CA 92127, USA
CONTACT PERSON	CK Li Sr. Principal Engineer, Regulatory (858) 485-9442 CLi@Nextivity.com
PREPARED BY	Xiaoying Zhang **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: Senior EMC Test Engineer/Wireless Team Lead
DATED	November 01, 2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

Revision History

72141009B Nextivity Inc. Cel-Fi GO RED Industrial Signal Booster					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
11/01/2018	Initial Release				Ferdinand Custodio

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

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
1.5 Deviations from the Standard 14
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 Power Measurements 18
2.2 Effective Radiated Power 21
2.3 Occupied Bandwidth 23
2.4 Peak-Average Power Ratio 27
2.5 Band Edge 30
2.6 Conducted Spurious Emissions 34
2.7 Field Strength of Spurious Radiation 42
2.8 Frequency Stability 48
2.9 Power Line Conducted Emissions 52
2.10 AGC Threshold Level 56
2.11 Out-of-Band Rejection 58
2.12 Input-versus-Output Signal Comparison 61
2.13 Emission Mask 71
2.14 Input and Output Power and Amplifier/Booster Gain 73
2.15 Noise Figure 77

3 TEST EQUIPMENT USED 80

3.1 Test Equipment Used 81
3.2 Measurement Uncertainty 83

4 DIAGRAM OF TEST SETUP 85

4.1 Test Setup Diagram 86

5 ACCREDITATION, DISCLAIMERS AND COPYRIGHT 91

5.1 Accreditation, Disclaimers and Copyright 92

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 1

REPORT SUMMARY

Radio Testing of the
Nextivity Inc.
Cel-Fi GO RED Industrial Signal Booster

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Nextivity Inc. Cel-Fi GO RED G32-12/14 Industrial Signal Booster to the requirements of the following:

- FCC CFR 47 Part 2 and 90
- RSS-Gen Issue 5 April 2018
- RSS-140 Issue 1 April 2018

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.
EUT	Industrial Signal Booster
Product Marketing Name	Cel-Fi GO RED
Model Number(s)	G32-12/14
FCC ID Number	YETG32-1214
IC Number	N/A
Serial Number(s)	382829000271 and 382829000042
Number of Samples Tested	2
Test Specification/Issue/Date	• FCC CFR 47 Part 2 and 90 (October 1, 2017) • KDB 935210 D05 Indus Booster Basic Meas v01r02 (October 27, 2017) • RSS-140 - Equipment Operating in the Public Safety Broadband Frequency Bands 758-768 MHz and 788-798 MHz (Issue 1, April 2018) • RSS-131 - Zone Enhancer (Issue 3, May 2017) • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 5, April 2018) • ANSI C63.26-2015: American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
Start of Test	September 21, 2018
Finish of Test	October 16, 2018
Name of Engineer(s)	Xiaoying Zhang
Related Document(s)	• KDB412172 D01 Determining ERP and EIRP v01r01 August 07, 2015: Guidelines for determining the Effective Radiated Power (ERP) and Equivalent Isotropically Radiated Power (EIRP) of an RF transmitting system • KDB971168 D01 Power Meas License Digital Systems v03r01: April 9 2018: Measurement guidance for certification of licensed digital transmitters

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 2 and 90 with cross-reference to the corresponding ISED RSS standards is shown below.

Section	Spec Clause					Test Description	Result
	FCC Part 2	FCC Part 90	KDB 935210 D05	RSS-140	RSS-131		
2.1	2.1046	-	-	-	-	Transmitter Conducted Output Power	Compliant
2.2	2.1046	90.542(a)(6) 90.219(e)(1)	-	4.3	-	Effective Radiated Power	Compliant
2.3	2.1049	-	-	RSS-Gen 6.7	-	Occupied Bandwidth	Compliant
2.4	-	-	-	4.3	-	Peak-Average Ratio	Compliant
2.5	2.1051	90.543(e)(1)(3)(4)(5)	-	4.4	-	Band Edge	Compliant
2.6	2.1051	90.543(e)(1)(3)(4)(5)(f), 90.210(c)(3)	4.7.3	4.4	-	Conducted Spurious Emissions	Compliant
2.7	2.1053	90.543(e)(f)	4.9	4.4	-	Field Strength of Spurious Radiation	Compliant
2.8	2.1055	90.539	4.8	4.2	5.2.4	Frequency Stability	Compliant
-	-	-	-	RSS-Gen 7.1	-	Receiver Spurious Emissions	N/A
2.9	15.207 (a)	-	-	RSS-GEN 8.8	-	Power Line Conducted Emissions	Compliant
2.10	-	-	4.2	-	-	ACG Threshold Level	Compliant
2.11	-	-	4.3	-	5.2.1	Out of Band Rejection	Compliant
2.12	-	90.219 (e)(4)(ii)	4.4	-	5.2.2	Input-versus-output signal comparison	Compliant
2.13	-	90.219 (e)(4)(iii), 90.210	4.4	-	-	Emission Mask	Justification
2.14	-	90.219(e)(1)	4.5	-	5.2.3	Input / Output Power and Amplifier / Booster Gain	Compliant
2.15	-	90.219(e)(2)	4.6	-	-	Noise Figure	Compliant
-	-	90.210	4.7.2	-	-	Intermodulation	N/A*

N/A: Not applicable. EUT is not a Stand-Alone receiver.
N/A: Not applicable. Intermodulation-product spurious emission measurements are not required for single-channel boosters that can not accommodated two simultaneous signals within the pass band.*

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.3 PRODUCT INFORMATION

1.3.1 EUT General Description

The Equipment Under Test (EUT) was a Nextivity Inc. Cel-Fi GO RED G32-12/14 Industrial Signal Booster. The EUT is a LTE Distributed Antenna System (DAS) to improve voice and data cellular performance in a Fix Indoor environment. The unit includes Bluetooth LE connectivity. With the use of Nextivity smartphone application, it allows user to register the product, updated software, capture/display details metrics of the system. Only the LTE Band 14 function of the EUT was verified in this test report.

1.3.2 Technical Description

EUT Description	Industrial Signal Booster
Product Marketing Name	Cel-Fi GO RED
Model Number(s)	G32-12/14
Rated Voltage	15V DC via external AC/DC adapter
Mode Verified	LTE Band 14
Frequency Bands	Uplink: 788 – 798 MHz Downlink: 758 – 768 MHz

Product Specifications

Frequency Band	Band 14
Technology	LTE
Booster Bandwidth	10 MHz
Downlink Output Power	16dBm
Uplink Output Power	23dBm
Max. Antenna Gain	External Antenna (Supplied by customer)

Capability	LTE (Band 12 and 14) and BT LE
Primary Unit (EUT)	☒ Production ☐ Pre-Production ☐ Engineering
Environment	Fix, Indoor
Manufacturer Declared Temperature Range	-20°C to 65°C

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.3.3 Transmit Frequency Table

Mode	Channel Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	ERP	
				Max. Power Avg (dBm)	Max. Power Avg (W)
LTE Band 14 Downlink	10	788 – 798	8M73F9W	36.99	5.0
LTE Band 14 Uplink	10	758 - 798	8M83F9W	36.99	5.0

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Downlink (CU TX). Input signal is applied to B14 antenna port of NU. Output is monitored from B14 antenna port of CU.
B	Uplink (NU TX). Input signal is applied to B14 antenna port of CU. Output is monitored from B14 antenna port of NU.
C	Radiated test setup. Downlink (CU TX). Input signal is applied to B14 antenna port of NU. B14 antenna port of CU is terminated with a 50Ω load.
D	Radiated test setup. Uplink (NU TX). Input signal is applied to B14 antenna port of CU. B14 antenna port of NU is terminated with a 50Ω load.

1.4.2 EUT Exercise Software

Manufacturer provided configuration software (ConformanceTest.exe v5.1.331) and Nextivity Chart Interface v2.0.0.16 (for Out of Band Rejection test only) 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
Sony	Support Laptop	M/N PCG-31311L S/N 27545534 3006488
Sony	Support Laptop AC Adapter	M/N PCGA-AC19V9 S/N 147839091 0023259
HON-KWANG	I.T.E Power Supply	Model: HK-AY-150A160-US S/N: KH30000031 Input: 100-240V, 50/60Hz, 0.8A; Output: 15 VDC 1.6A
API Technologies Corp.	DC Block	M/N: 8037
-	Omni Whip Antenna	Model A21-V33-100 Max. gain 3.0 dBi
-	Omni Whip Antenna	Model A41-V30-100 Max. Gain 2.5 dBi

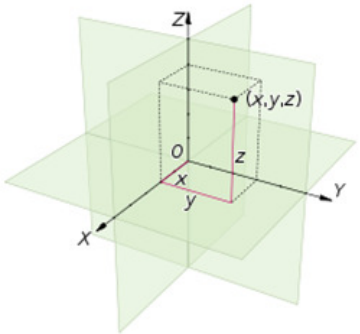
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.4.4 Worst Case Configuration

Worst-case configuration used in this test report as per output power measurements:

Mode	Bandwidth	Channel No.	Frequency
LTE Band 14 Downlink	10MHz	Middle Channel 5330	763.0MHz
LTE Band 14 Uplink	10MHz	Middle Channel 23330	793.0MHz

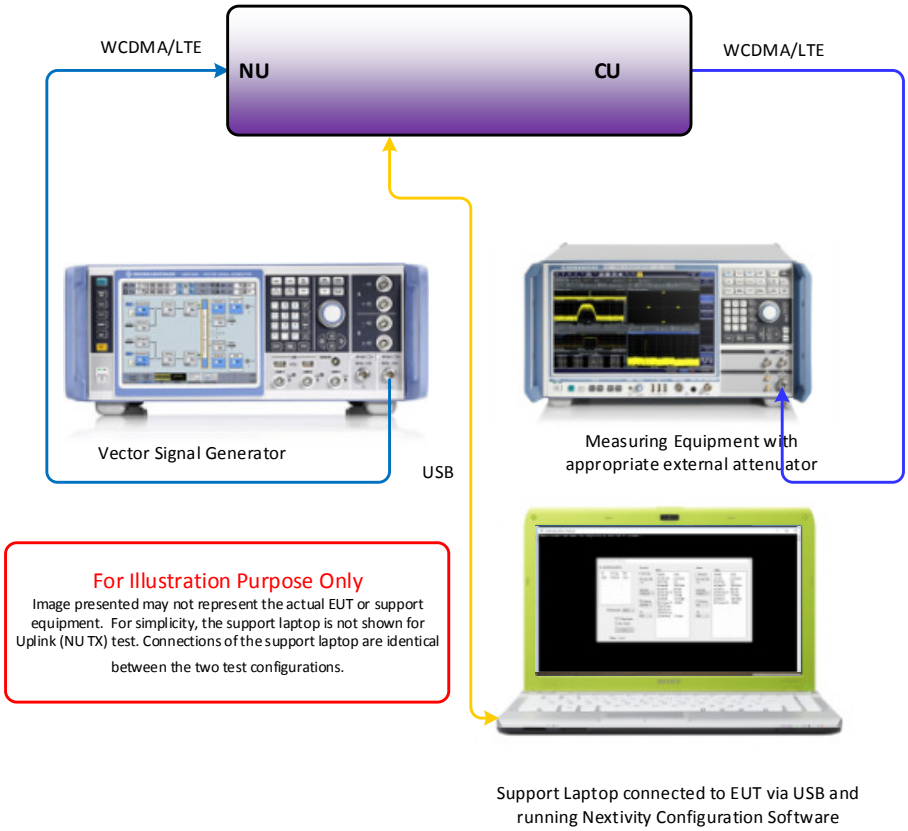
For radiated measurements X, Y, and Z orientations were verified. The verification was determined "Y" as worst case configuration.



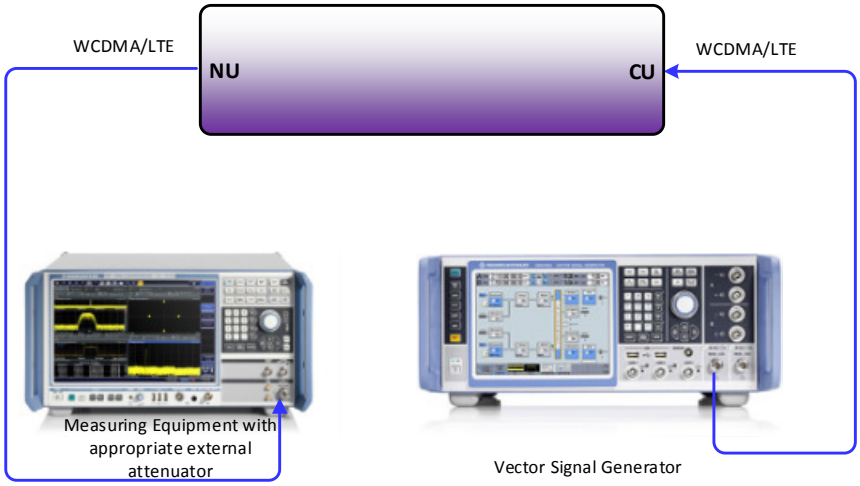
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.4.5 Simplified Test Configuration Diagram

Downlink (CU Port) Conducted Test

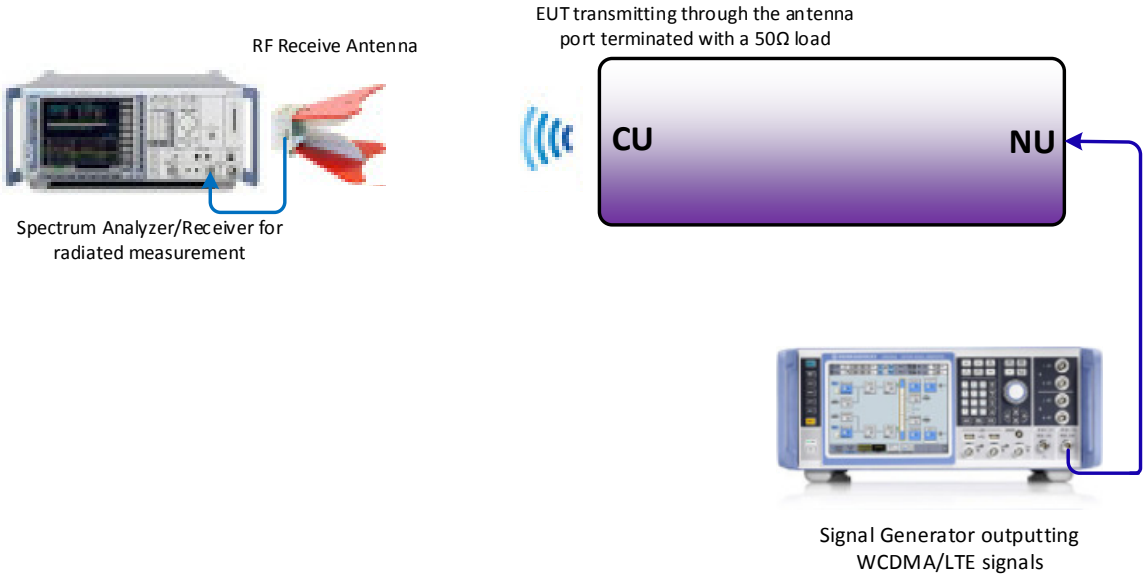


Uplink (NU Port) Conducted Test

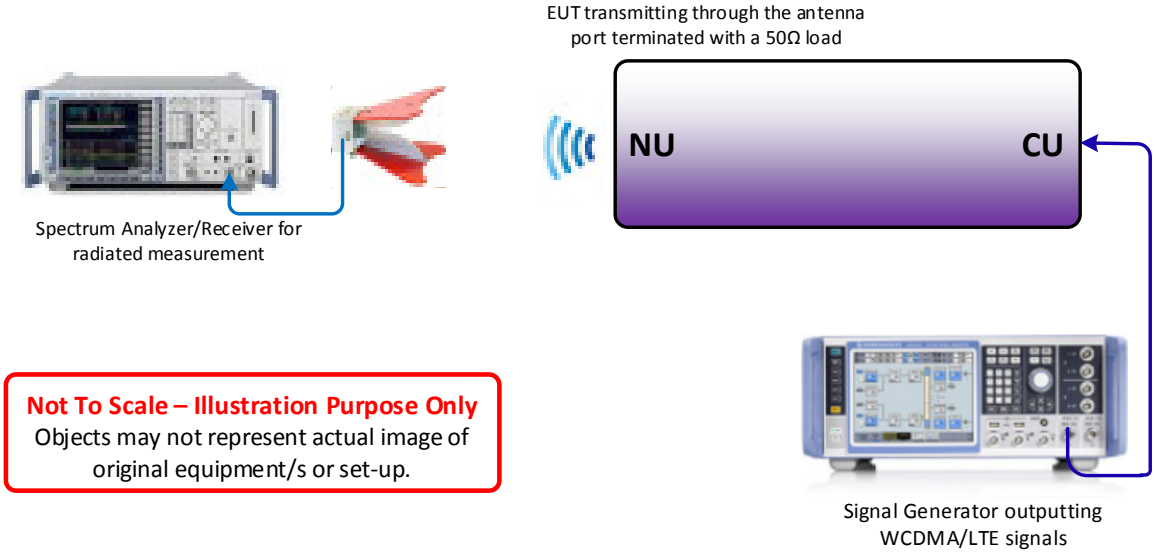


TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

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.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

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: 382829000271 and 382829000042		
None	–	–

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)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: (858) 678-1400 Fax: (858) 546-0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Designation 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.

1.9.5 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.

1.9.6 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.

1.9.7 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.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.10 SAMPLE CALCULATIONS

1.10.1 LTE Emission Designator (QPSK)

Emission Designator = 1M30F9W
F = Frequency Modulation
9= Composite Digital Info
W = Combination (Audio/Data)

1.10.2 Spurious Radiated Emission (below 1GHz)

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**

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:

P_{EIRP} = -18 dBm + 7.8 dBi – 1dB
= 11.2 dBm
P_{ERP} = P_{EIRP} – 2.15 dB
= 11.2 dBm – 2.15 dB
= 9.05 dBm

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 2

TEST DETAILS

Radio Testing of the
Nextivity Inc.
Cel-Fi GO RED Industrial Signal Booster

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.1 TRANSMITTER CONDUCTED POWER MEASUREMENTS

2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046

2.1.2 Standard Applicable

The conducted power mesurements were made in accordance to FCC Part 2 Clasue 2.1046.

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.

2.1.3 Equipment Under Test and Modification State

Serial No: 382829000271 / Test Configuration A and B

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

October 08, 2018 / XYZ

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. Rancho Bernardo facility

Ambient Temperature	24.1°C
Relative Humidity	55.5%
ATM Pressure	98.6kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.1.7 Additional Observations

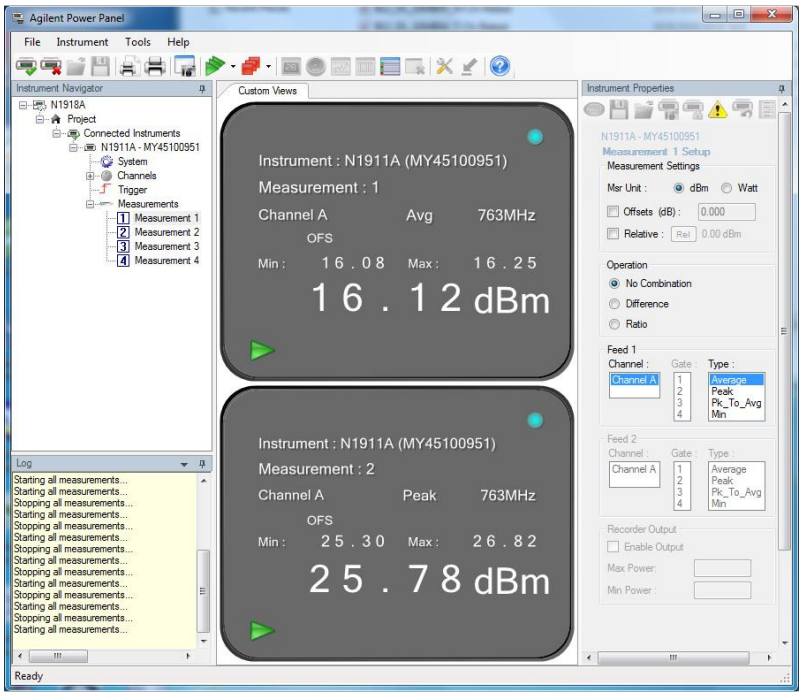
- This is a conducted test using Power Meter.
- The path loss were measured and entered as a level offset.
- Both Peak and Average measurements presented.
- Low, Middle and High channels for all bandwidths were verified and reported.

2.1.8 Test Results

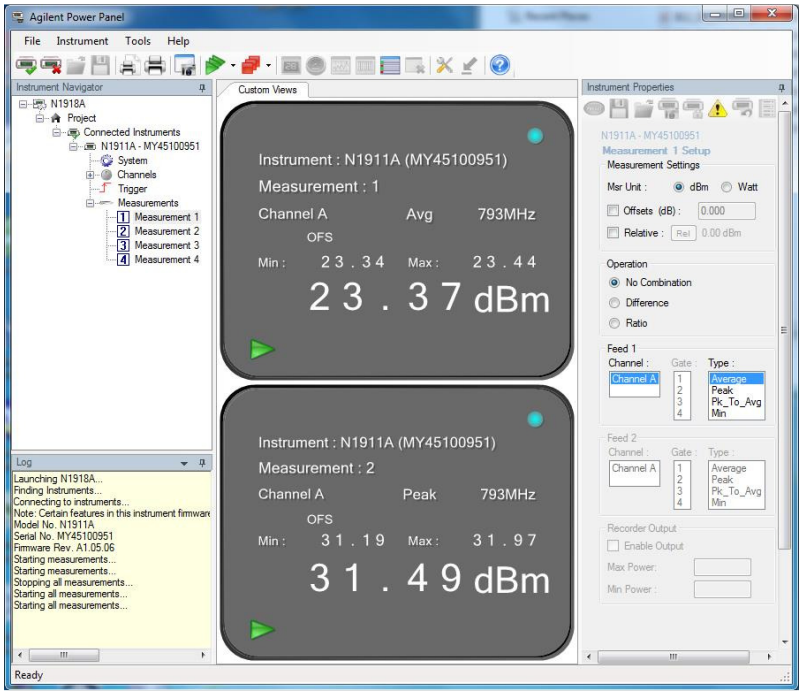
LTE Band 14							
Mode	Bandwidth (MHz)	Channel	Frequency (MHz)	Average Power		PK Power	
				(dBm)	(W)	(dBm)	(W)
Downlink	10	5330	763.0	16.12	0.041	25.78	0.378
Uplink	10	23330	793	23.37	0.217	31.49	1.409

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.1.9 Sample Test Measurement Screen



LTE Band 14 DL 10MHz Bandwidth Middle Channel



LTE Band 14 UL 10MHz Bandwidth Middle Channel

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.2 EFFECTIVE RADIATED POWER

2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046
FCC 47 CFR Part 90, Clause 90.542(a)(6)
FCC 47 CFR Part 90, Clause 90.219(e)(1)
RSS-140, Clause 4.3

2.2.2 Standard Applicable

FCC 47 CFR Part 90, Clause 90.542(a):
(6) Control stations and mobile stations transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 30 watts ERP.

FCC 47 CFR Part 90, Clause 90.219(e):
(1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

RSS-140, Clause 4.3:
The e quivaltent radiated power (e.r.p.) for control and mobile equipment shall not exceed 30 W.

2.2.3 Equipment Under Test and Modification State

Serial No: 382829000042 / Test Configuration (N/A, calculation only)

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

October 08, 2018 / XYZ

2.2.5 Test Equipment Used

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

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.2.6 Additional Observations

- ERP was calculated as per Section 1.2 and 1.3 of KDB412172 D01 (Determining ERP and EIRP v01r01).
- Calculation formula in logarithmic terms:

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

Where:

P_T = transmitter conducted output power dBm (Section 2.1 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 (EUT configuration during verification is mounted on an interface board with short direct connection to the antenna port. The loss between the EUT and the antenna port is considered negligible).

2.2.7 Test Results

LTE Band 14						
Mode	**Bandwidth (MHz)**	**Frequency (MHz)**	**Max Power Average (dBm)**	**Antenna Gain (dBi)**	**ERP (dBm)**	**Limit (dBm)**
Downlink	10	763	16.12	< 20.87	< 36.99	36.99
Uplink	10	793	23.37	< 13.62	< 36.99	36.99

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.3 OCCUPIED BANDWIDTH

2.3.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049
RSS-GEN 6.7

2.3.2 Standard Applicable

The transmitted signal bandwidth shall be reported as the 99% emission bandwidth, that is the frequency bandwidth suuch that, below its lower and above its upper frequency limits, the mean powers radiated are eqch equal to 0.5 percent of the total mean power radiated by a give emission.

26dB 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 by at least 26 dB below the transmitter power.

Using the occupied bandwidth meansurement function in the spectrum analyzer, the 99% occupied bandwith was measured.

In addition, the 26dB bandwidth was measured in accorance with FCC KDB 971168 D01 V0202 Clause 4.1 using the ndB measurement function in the spectrum analyzer.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be at least 3x RBW.

2.3.3 Equipment Under Test and Modification State

Serial No: 382829000271 / Test Configuration A and B

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

September 24, 2018 / XYZ

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. Rancho Bernardo facility

Ambient Temperature	24.6°C
Relative Humidity	60.2%
ATM Pressure	98.8kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.3.7 Additional Observations

- This is a conducted test. Both 26dB bandwidth and 99% bandwidth presented.
- The transducer factor (TDF) used is from the external attenuators and cables used.
- Using the occupied bandwidth meansurement function in the spectrum analyzer, the 99% occupied bandwith was measured.
- The 26dB bandwidth was measured in accorance with ANSI C63.26 clause 5.4.3 using the ndB measurement function in the spectrum analyzer.
- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The RBW is set to 1% of the OBW while VBW is ≥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.

2.3.8 Test Results

LTE Band 14					
Mode	**Bandwidth (MHz)**	**Channel**	**Frequency (MHz)**	**OBW (MHz)**	**-26dB BW (MHz)**
Downlink	10	5330	763.0	8.73	9.33
Uplink	10	23330	793	8.83	9.42

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.3.9 Example Test Plots

LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763.0 MHz / 99%OBW

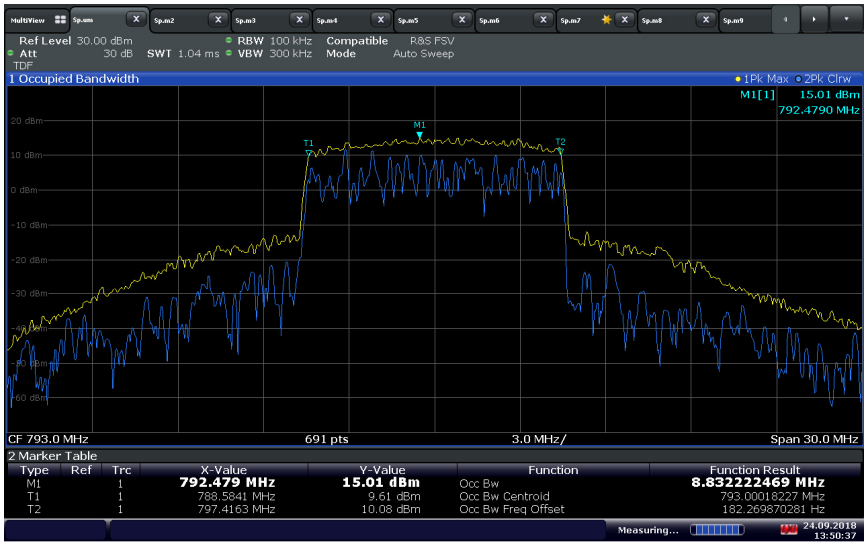
12:38:02 24.09.2018

LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763.0 MHz / 26dB BW

12:38:31 24.09.2018

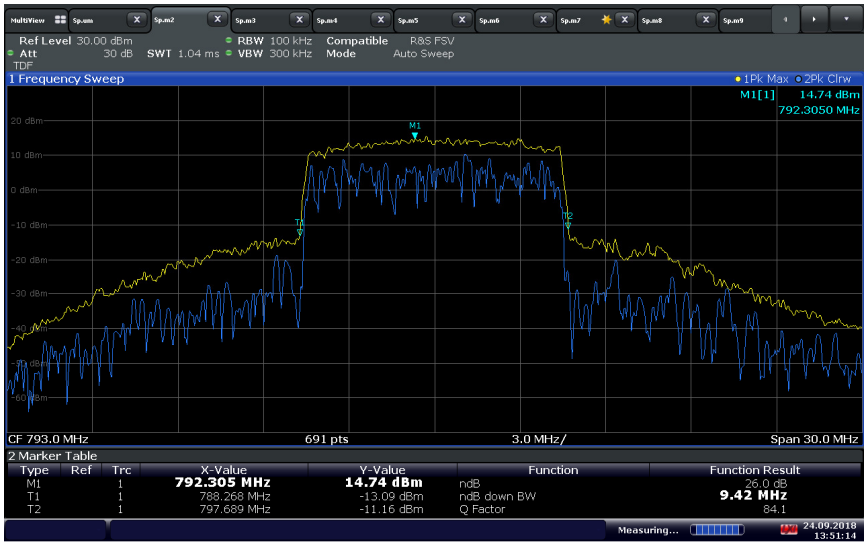
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793.0 MHz / 99%OBW



13:50:38 24.09.2018

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793.0 MHz / 26dB BW



13:51:15 24.09.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.4 PEAK-AVERAGE POWER RATIO

2.4.1 Specification Reference

RSS-140, Clause 4.3

2.4.2 Standard Applicable

RSS-140, Clause 4.3:
The equivalent radiated power (e.r.p.) for control and mobile equipment shall not exceed 30 W. The e.r.p. for portable equipment including handheld devices shall not exceed 3 W.

Fixed and base sation equipment shall comply with the e.r.p limits in SRSP-540.

In addition, the peak-to-average power ratio (PAPR) of the equipmet shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

2.4.3 Equipment Under Test and Modification State

Serial No: 382829000271 / Test Configuration A and B

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

September 24 and 28, 2018/XYZ

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	24.6 - 25.3°C
Relative Humidity	55.3 - 60.2%
ATM Pressure	98.7 - 98.8kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.4.7 Additional Observations

- This is a conducted test.
- As per FCC KDB 971168 D01 v03r01 clause 5.7, the PAPR was measured in accorance with ANSI C63.26 clause 5.2.3.4.
- The transducer factor (TDF) used is from the external attenuators and cables used.
- 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) A CCDF curve depicts the probability of the peak signal amplitude exceeding the average power level. Most contemporary measurement instrumentation include the capability to produce CCDF curves for an input signal provided that the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth.
- Low, Middle and High channels for all bandwidths were verified.
- RBW was set to maximum the SA can support.
- There are no measured PAR levels greater than 13dB.

2.4.8 Test Results

LTE Band 14				
Mode	**Bandwidth (MHz)**	**Channel**	**Frequency (MHz)**	**PAR (dB)**
Downlink	10	5330	763.0	10.69
Uplink	10	23330	793	9.67

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.4.9 Example Test Plots

LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz

12:37:13 24.09.2018

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793 MHz

10:44:48 28.09.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.5 BAND EDGE

2.5.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1051
FCC 47 CFR Part 90, Clause 90.543(e)(1)(3)(4)(5)
RSS-140, Clause 4.4

2.5.2 Standard Applicable

FCC 47 CFR Part 90.543:
(e) For operations in the 758 – 768 MHz and the 788 – 798 MHz bands, the power of any emission outside the licensees frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

FCC 47 CFR Part 90.543:
(e) For operations in the 758 – 768 MHz and the 788 – 798 MHz bands, the power of any emission outside the licnsees frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log(P) dB in a 6.25 kHz band segment, for base and fixed stations.
(3) On any frequency between 775 – 788 MHz, above 805 MHz, and below 758 MHz, by at leaset 43 + 10 log(P) dB.
(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate sepctral energy in a 6.25 kHz setment.
(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the used of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

RSS-140, Clause 4.4:
The power of any unwanted emission outside the bands 758-768 MHz band and the 788-798 MHz shall be attenuated below the transmitter output power P in dBw as follows, where p is the transmitter output power in watts:

a) For any frequency between 769-775 MHz and 799-806 MHz:
   i) 76 + 10 log (p), dB in a 6.25 kHz band for fixed and base station equipment
b) For any frequeny between 775–788 MHz, above 806 MHz, and below 758 MHz:
   43 + 10 log (P), dB in a bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjactent to the frequency bands 758-768 MHz and 788-798 MHz, a resolution bandwidth of 30 kHz may be employed.

In addition, the equivalent isotropically radiated power (e.i.r.p.) of all emissions, including harmonics in the band 1559-1610 MHz, shall not exceed −70 dBW/MHz for wideband emissions, and −80 dBW/kHz for discrete emissions of less than 700 Hz bandwidth.

2.5.3 Equipment Under Test and Modification State

Serial No: 382829000271 / Test Configuration A and B

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

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

September 25, 2018 / XYZ

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.5°C
Relative Humidity	53.8%
ATM Pressure	98.9kPa

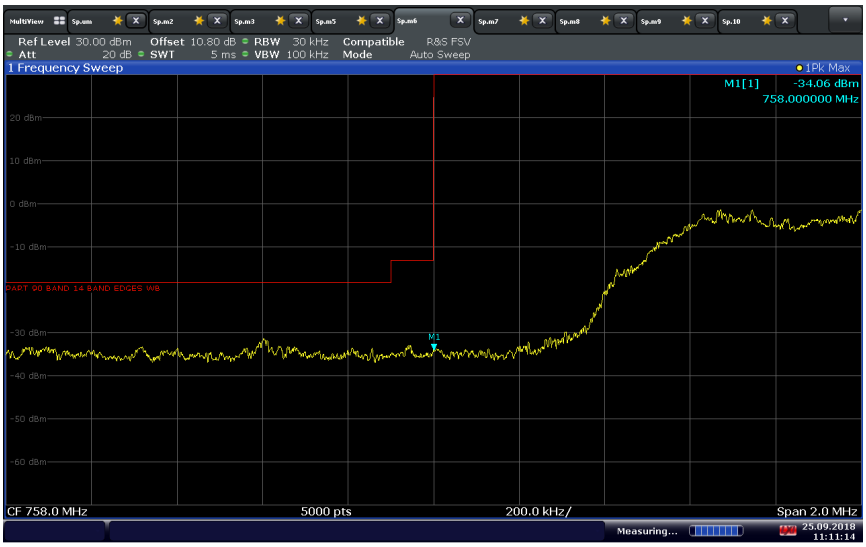
2.5.7 Additional Observations

- This is a conducted test. Test guidance is per Section 6.1 of KDB971168 (D01 Power Meas License Digital Systems v03r01).
- The path loss were measured and entered as a level offset.
- RBW is set to 30 kHz and VBW is set to ≥3 x RBW.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

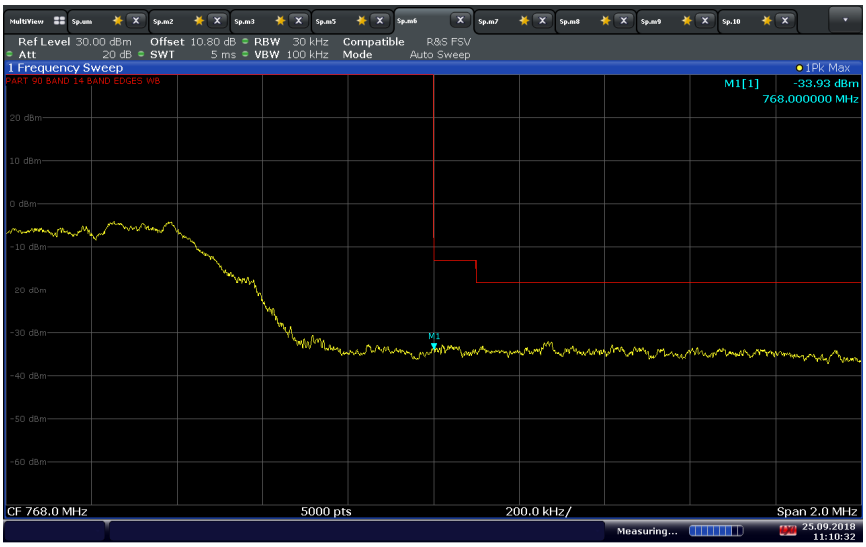
2.5.8 Test Results

LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz Low Band Edge @758 MHz



11:11:15 25.09.2018

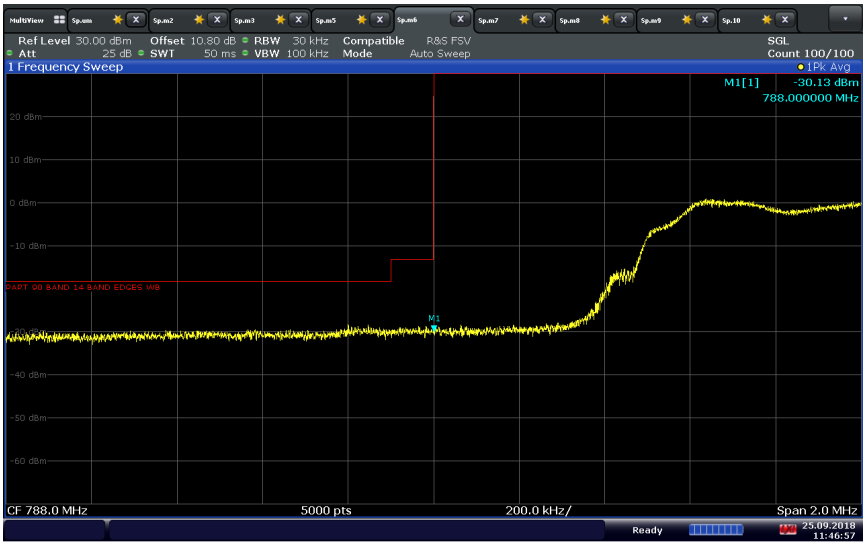
LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz High Band Edge @768 MHz



11:10:33 25.09.2018

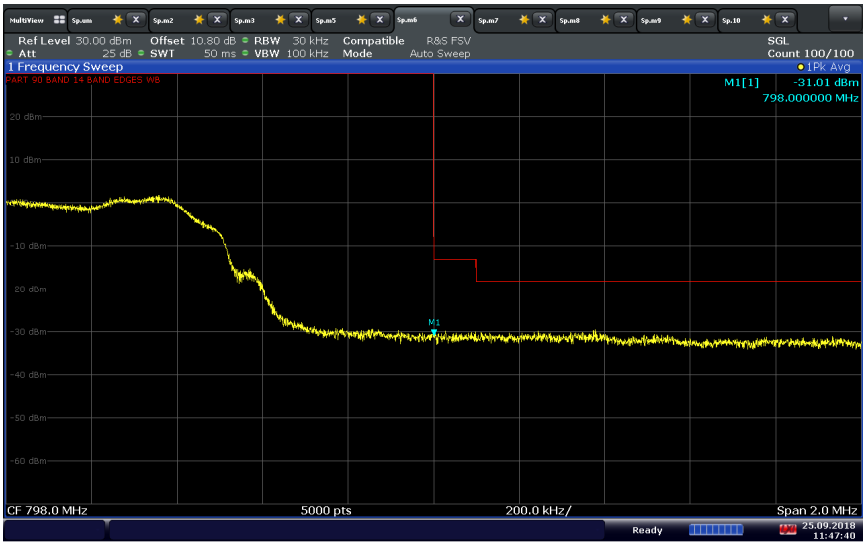
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793 MHz Low Band Edge @788 MHz



11:46:57 25.09.2018

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793 MHz High Band Edge @798 MHz



11:47:41 25.09.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.6 CONDUCTED SPURIOUS EMISSIONS

2.6.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1051
FCC 47 CFR Part 90, Clause 90.543(e)(1)(3)(4)(5)(f)
FCC 47 CFR Part 90, Clause 90.210(c)(3)
KDB 935210 D05, Clause 4.7.3
RSS-140, Clause 4.4

2.6.2 Standard Applicable

FCC 47 CFR Part 90, Clause 90.543:
(e) For operations in the 758 – 768 MHz and the 788 – 798 MHz bands, the power of any emission outside the licnsees frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log(P) dB in a 6.25 kHz band segment, for base and fixed stations.
(3) On any frequency between 775 – 788 MHz, above 805 MHz, and below 758 MHz, by at leaset 43 + 10 log(P) dB.
(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate sepctral energy in a 6.25 kHz setment.
(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the used of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758–775 MHz and 788–805 MHz bands, all emissions including harmonics in the band 1559–1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

FCC 47 CFR Part 90, Clause 90.210(c):
(3) On any On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

RSS-140, Clause 4.4:
The power of any unwanted emission outside the bands 758-768 MHz band and the 788-798 MHz shall be attenuated below the transmitter output power P in dBw as follows, where p is the transmitter output power in watts:

a) For any frequency between 769-775 MHz and 799-806 MHz:
   i) 76 + 10 log (p), dB in a 6.25 kHz band for fixed and base station equipment
b) For any frequeny between 775–788 MHz, above 806 MHz, and below 758 MHz:
   43 + 10 log (P), dB in a bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency bands 758-768 MHz and 788-798 MHz, a resolution bandwidth of 30 kHz may be employed.

In addition, the equivalent isotropically radiated power (e.i.r.p.) of all emissions, including harmonics in the band 1559-1610 MHz, shall not exceed −70 dBW/MHz for wideband emissions, and −80 dBW/kHz for discrete emissions of less than 700 Hz bandwidth.

2.6.3 Equipment Under Test and Modification State

Serial No: 382829000271 and 382829000042/ Test Configuration A and B

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

September 25, 28, and October 08, 11, 2018 / ZXY

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.9 - 25.3°C
Relative Humidity	49.7 - 55.5%
ATM Pressure	98.6 - 98.9kPa

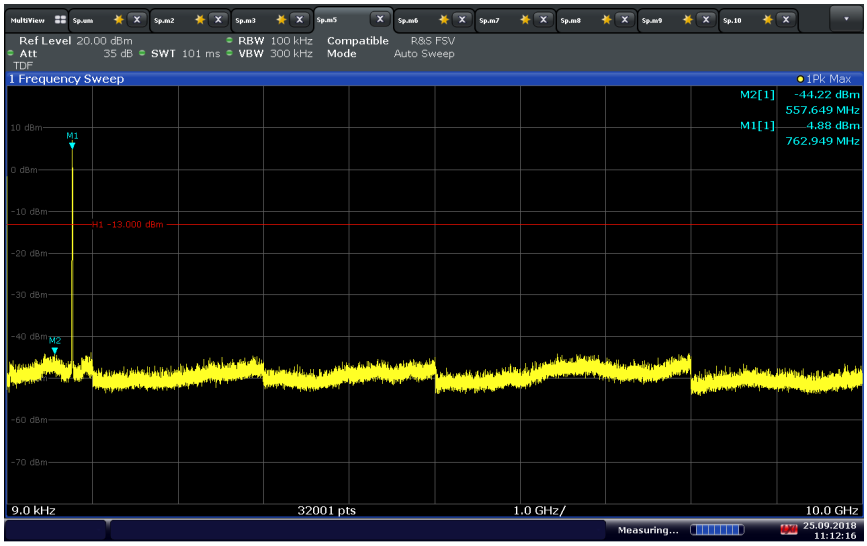
2.6.7 Additional Observations

- This is a conducted test.
- The path loss was measured and entered as a transducer factor (TDF).
- The spectrum was searched from 30MHz to the 10th harmonic (10GHz).
- All channels on all channel bandwidth are verified.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

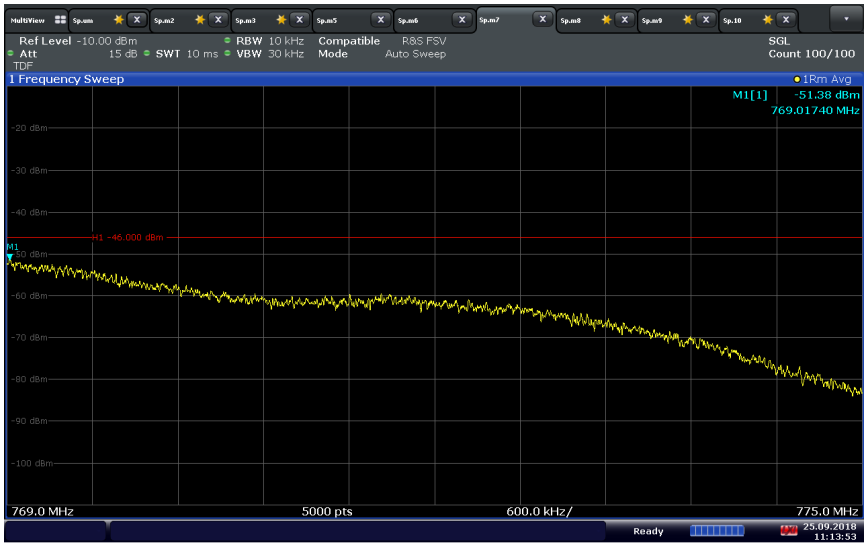
2.6.8 Test Results

LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz



11:12:16 25.09.2018

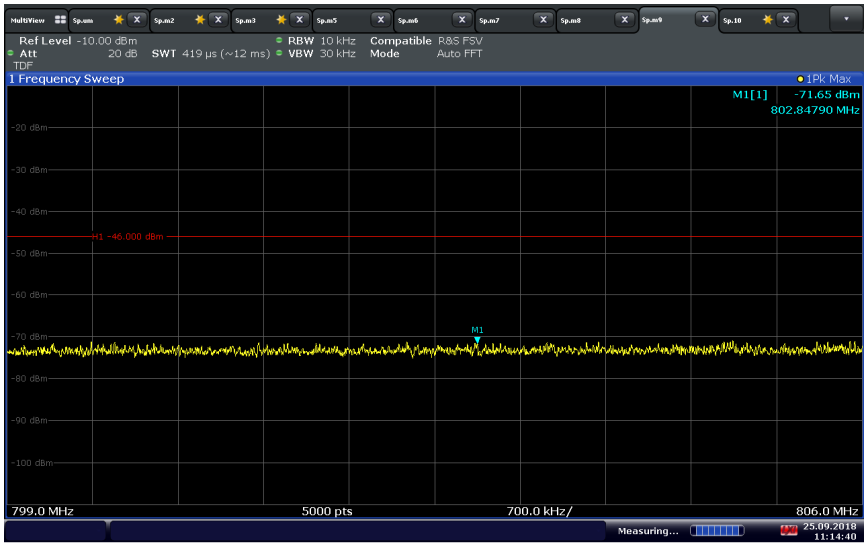
LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz Conducted Spurious Emissions (769-775 MHz)



11:13:53 25.09.2018

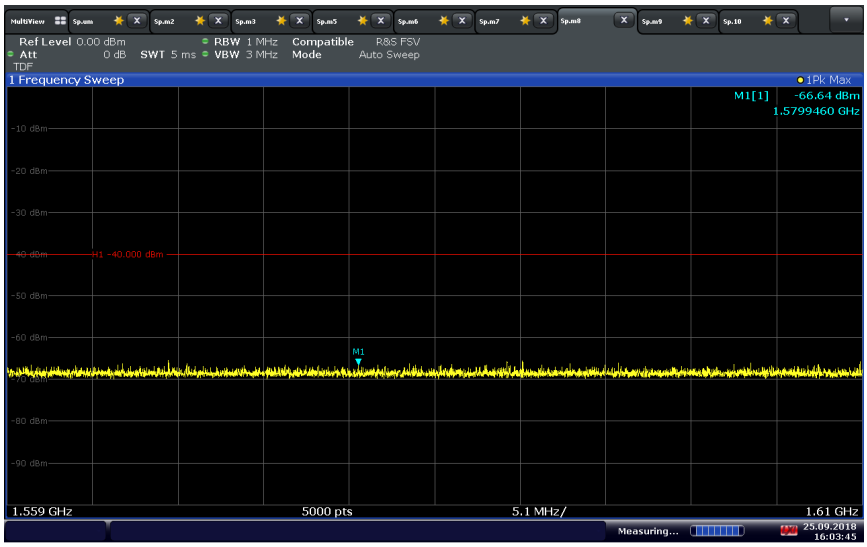
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz Conducted Spurious Emissions (799-806 MHz)



11:14:40 25.09.2018

LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz Conducted Spurious Emissions (1559-1610 MHz)

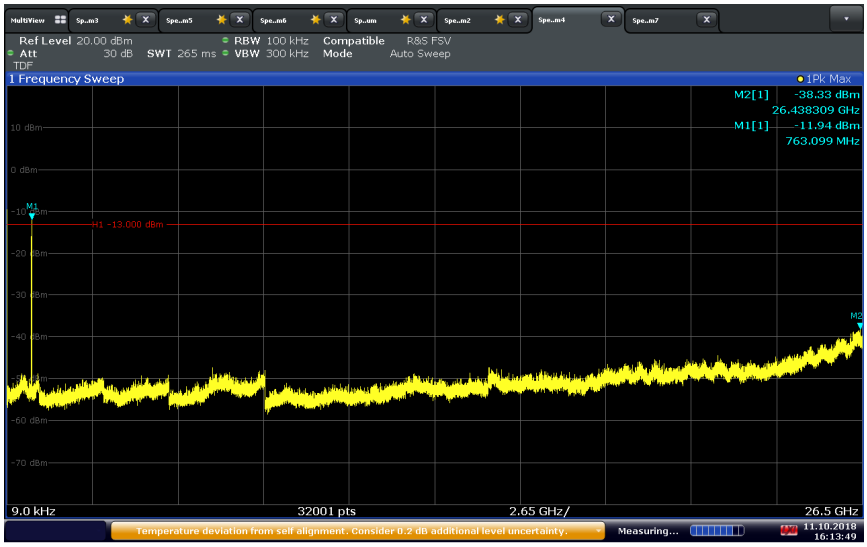


16:03:45 25.09.2018

Note: The limit should be changed to -56 dBm with max. DL antenna gain of 16 dB applied for EIRP.

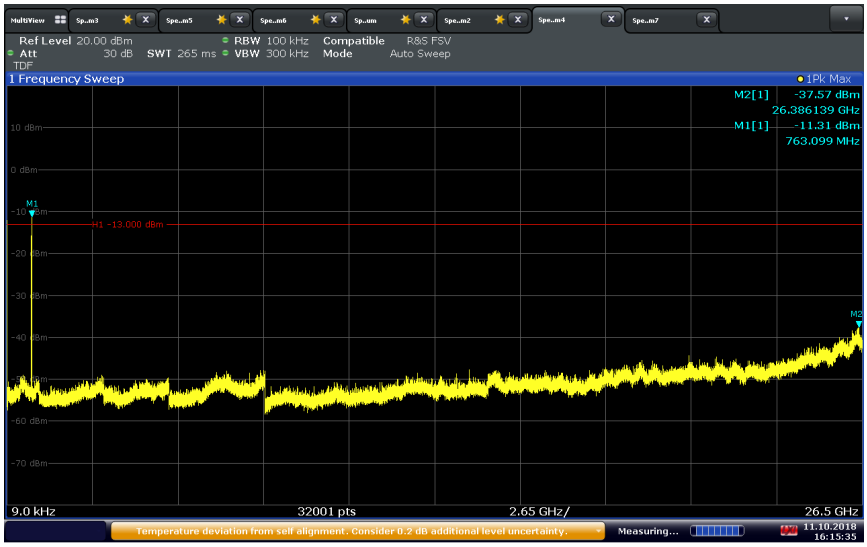
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz Conducted Spurious Emissions With CW signal at AGC Level injection



16:13:49 11.10.2018

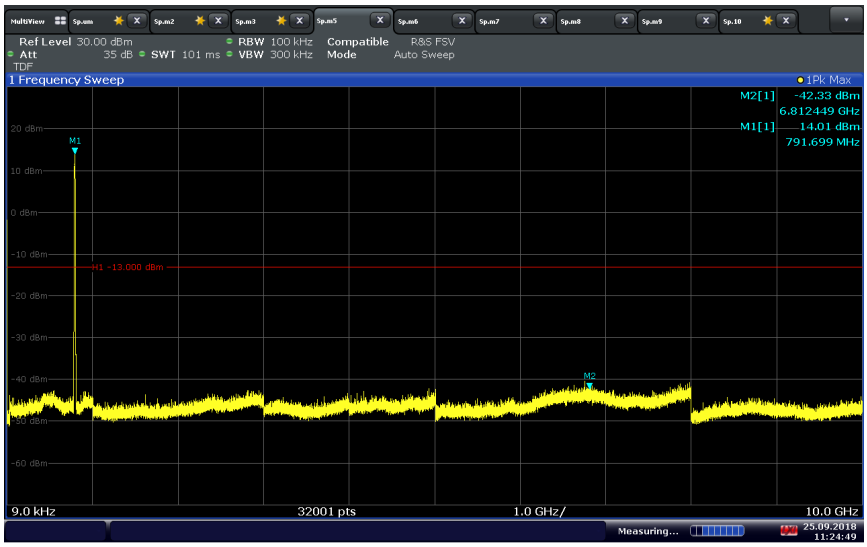
LTE Band 14 Downlink (10 MHz BW) / Middle Channel 763 MHz Conducted Spurious Emissions With CW signal at AGC + 3 dB Level injection



16:15:36 11.10.2018

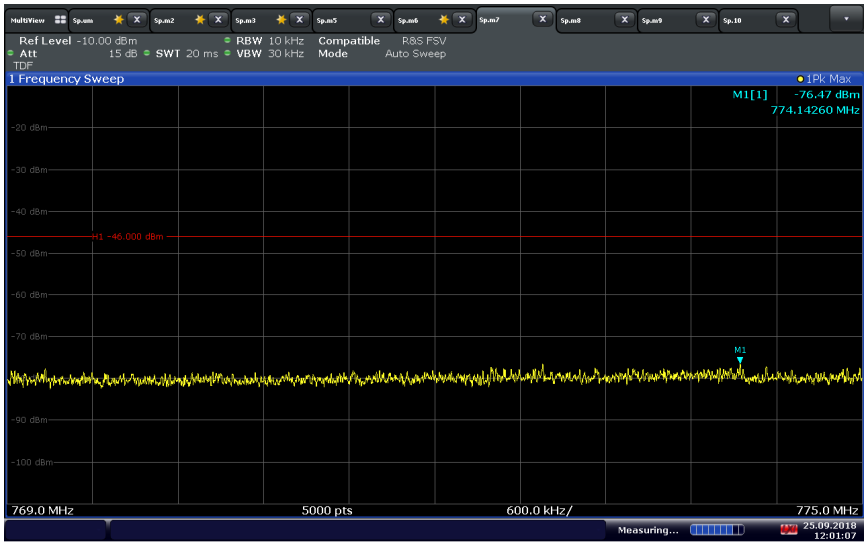
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793 MHz



11:24:50 25.09.2018

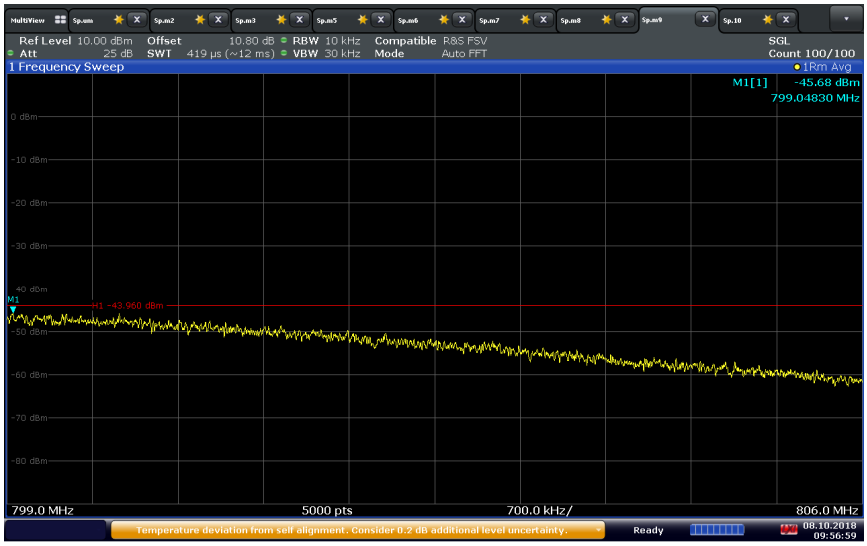
LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793 MHz Conducted Spurious Emissions (769-775 MHz)



12:01:08 25.09.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

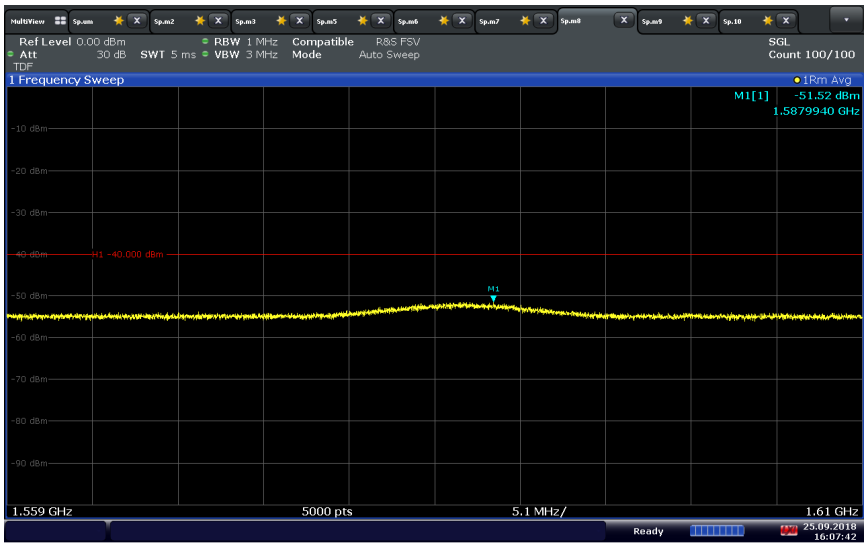
LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793 MHz Conducted Spurious Emissions (799-806 MHz)



09:56:59 08.10.2018

Note: Limit = -46 dBm + 10lg(10/6.25) = -43.96 dBm

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 793 MHz Conducted Spurious Emissions (1559-1610 MHz)

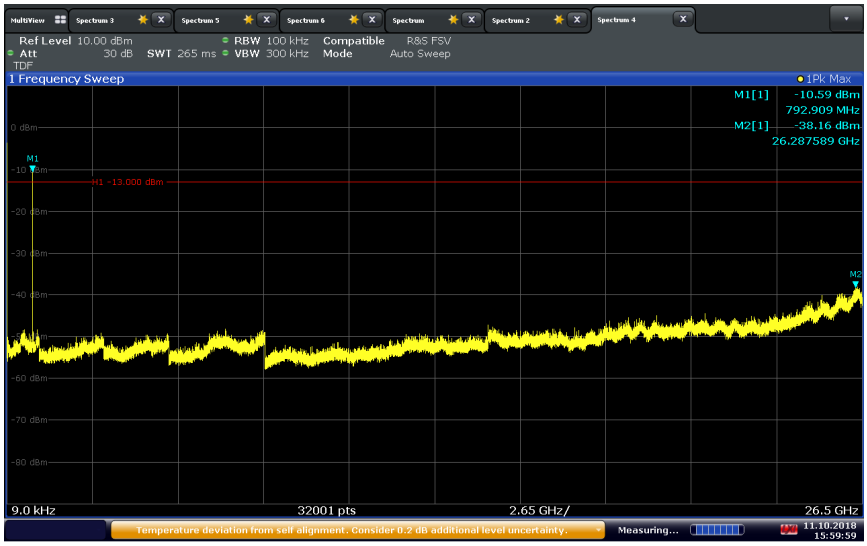


16:07:43 25.09.2018

Note: The limit should be changed to -50.2 dBm with max. UL antenna gain of 10.2 dB applied for EIRP.

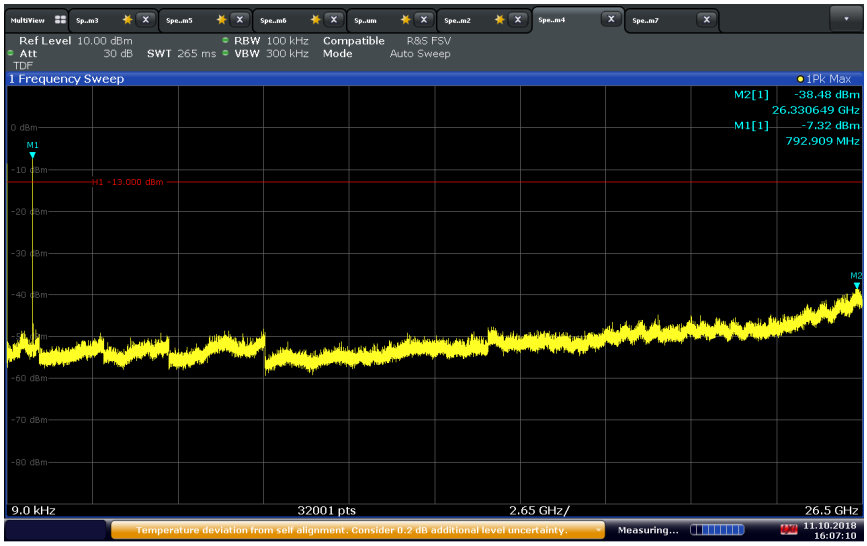
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 763 MHz Conducted Spurious Emissions With CW signal at AGC Level injection



15:59:59 11.10.2018

LTE Band 14 Uplink (10 MHz BW) / Middle Channel 763 MHz Conducted Spurious Emissions With CW signal at AGC + 3 dB Level injection



16:07:11 11.10.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.7 FIELD STRENGTH OF SPURIOUS RADIATION

2.7.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1053
FCC 47 CFR Part 90, Clause 90.543(e)(f)
KDB 935210 D05, Clause 4.9
RSS-140, Clause 4.4

2.7.2 Standard Applicable

FCC 47 CFR Part 90.543
(e) For operations in the 758 – 768 MHz and the 788 – 798 MHz bands, the power of any emission outside the licnsees frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769 – 775 MHz and 799 – 805 MHz, by a factor not less than 76 + 10 log(P) dB in a 6.25 kHz band segment, for base and fiexed stations.
(2) On all frequency between 769 – 775 MHz and 799 – 805 MHz, by a factor not less than 65 + 10 log(P) dB in a 6.25 kHz band segment, for mobile and portable stations.
(3) On any frequency between 775 – 788 MHz, above 805 MHz, and below 758 MHz, by at leaset 43 + 10 log(P) dB.

(f) For operations in the 758–775 MHz and 788–805 MHz bands, all emissions including harmonics in the band 1559 - 1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth.

RSS-140, Clause 4.4:
The power of any unwanted emission outside the bands 758 – 768 MHz and 788 – 798 MHz shall be attenuated below the transmitter output ower P in dBW as follows, where p is the transmitter output power in watts:

a) For any frequency between 769 – 775 MHz and 799 – 806 MHz:
i) 76 + 10 $\log_{10}$ P, dB in a 6.25 kHz band for fixed and base station equipment
ii) 65 + 10 log10 P, dB in a 6.25 kHz band for mobile and portable/hand-held equipment.

b) For any frequency between 775 – 788 MHz, above 806 MHz, and below 758 MHz:
43 + 10 $\log_{10}$(P) dB in a bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency bands 758 – 768 MHz and 788 – 798 MHz, a resolution bandwidth of 30 kHz may be employed.

In addition, the equivalent isotropically radiated power (e.i.r.p) of all emissions, including harmonics in the band 1559-1610 MHz, shall not exceed -70 dBW/MHz for wideband emissions, and -80 Dbw/kHz for discrete emissions of less than 700 Hz bandwidth.

2.7.3 Equipment Under Test and Modification State

Serial No: 382829000271 and 382829000042 / Test Configuration C and D

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

September 26, October 08 and 09, 2018/XYZ

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.7.5 Test Equipment Used

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

2.7.6 Environmental Conditions

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

Ambient Temperature	23.5 - 25.0 °C
Relative Humidity	50.3 - 55.5 %
ATM Pressure	98.6 - 99.0 kPa

2.7.7 Additional Observations

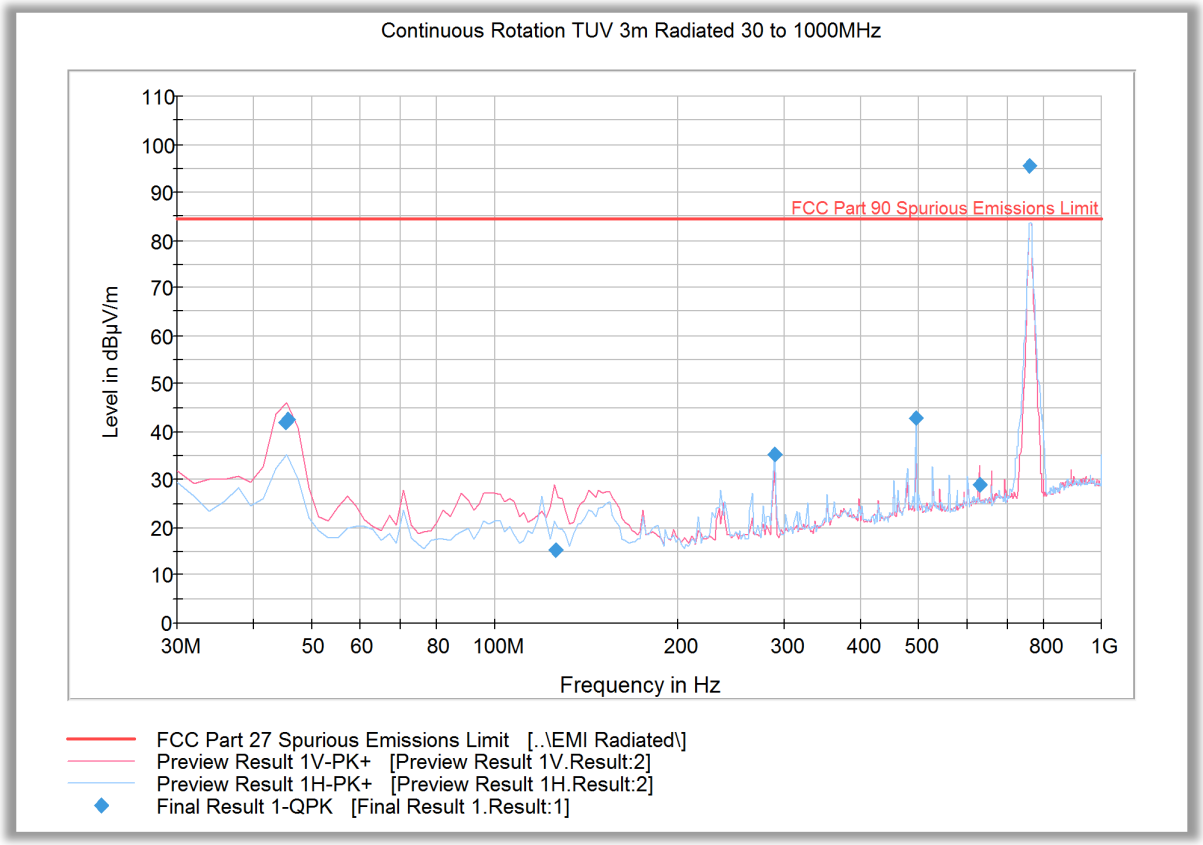
- This is a radiated test using substitution method as per Unwanted Emissions: Radiated Spurious method of measurement of ANSI/TIA/EIA-603-C 2004, August 17, 2004.
- Emissions within 6dB of the limit will be proven by substitution method.
- This is cabinet spurious emissions testing. Main antenna port was terminated during the test. Fundamental frequency measurement will be ignored for this test.
- 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.

2.7.8 Test Results

Compliant. See attached plots.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.7.9 Radiated Emission Test Results Below 1GHz (Downlink) - 10MHz Bandwidth Middle Channel



Quasi Peak Data

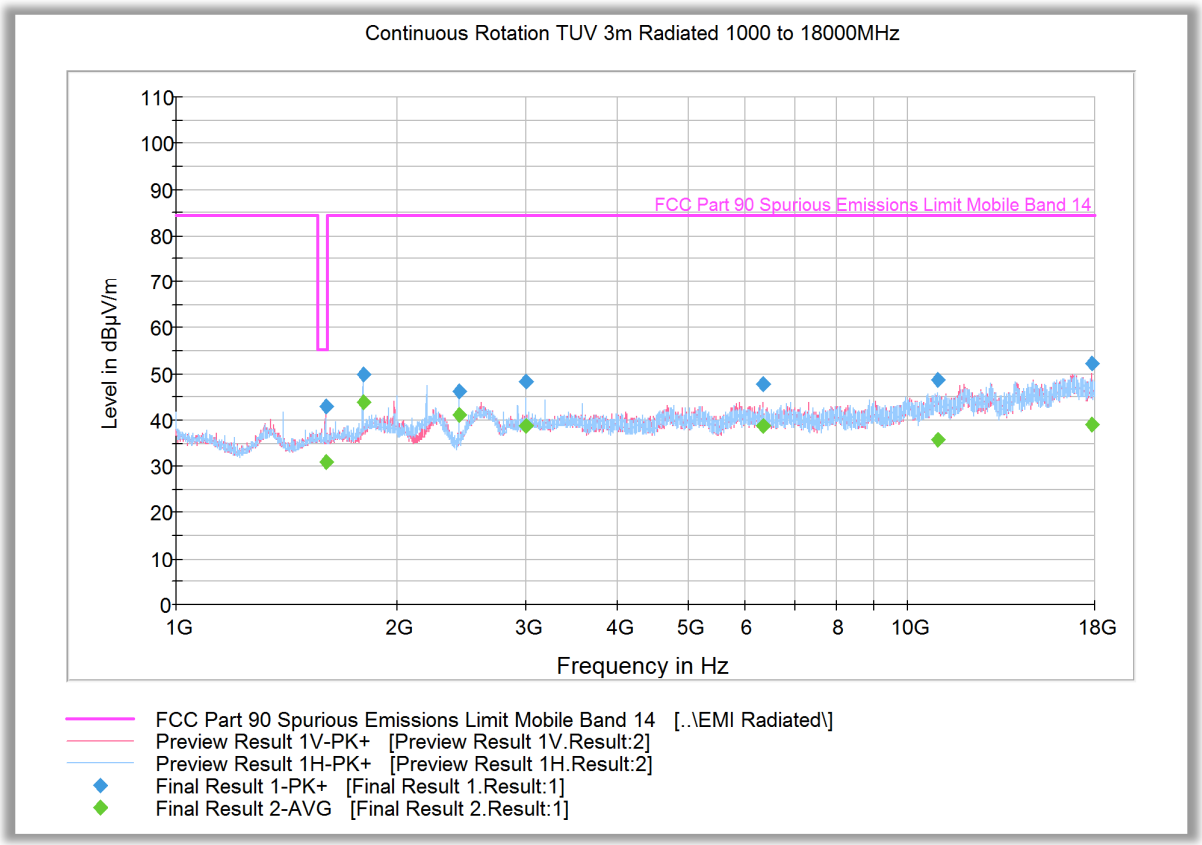
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
45.143327	41.9	1000.0	120.000	100.0	V	227.0	-14.0	42.5	84.4
45.791102	42.5	1000.0	120.000	100.0	V	340.0	-14.1	41.9	84.4
126.290501	15.2	1000.0	120.000	200.0	V	349.0	-16.1	69.2	84.4
288.577074	35.4	1000.0	120.000	109.0	H	172.0	-9.2	49.0	84.4
494.989178	42.8	1000.0	120.000	110.0	H	16.0	-1.6	41.6	84.4
628.557435	28.9	1000.0	120.000	191.0	V	8.0	1.5	55.5	84.4
760.181804	95.4	1000.0	120.000	313.0	H	130.0	4.2	Fundamental*	

***** This is the fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Note: Bluetooth LE was enabled as the worst case configuration when testing.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.7.10 Radiated Emission Test Results Above 1GHz (Downlink) - 10MHz Bandwidth Middle 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)
1600.500000	42.9	1000.0	1000.000	103.7	V	100.0	-5.8	12.4	55.2
1799.966667	49.8	1000.0	1000.000	102.7	H	76.0	-3.5	34.6	84.4
2439.733333	46.4	1000.0	1000.000	151.6	H	182.0	-0.8	38.0	84.4
3000.166667	48.3	1000.0	1000.000	111.7	H	50.0	0.8	36.1	84.4
6344.066667	47.9	1000.0	1000.000	143.7	V	185.0	5.9	36.5	84.4
11003.900000	48.6	1000.0	1000.000	265.3	H	189.0	11.5	35.8	84.4
17858.200000	52.3	1000.0	1000.000	128.7	V	328.0	17.7	32.1	84.4

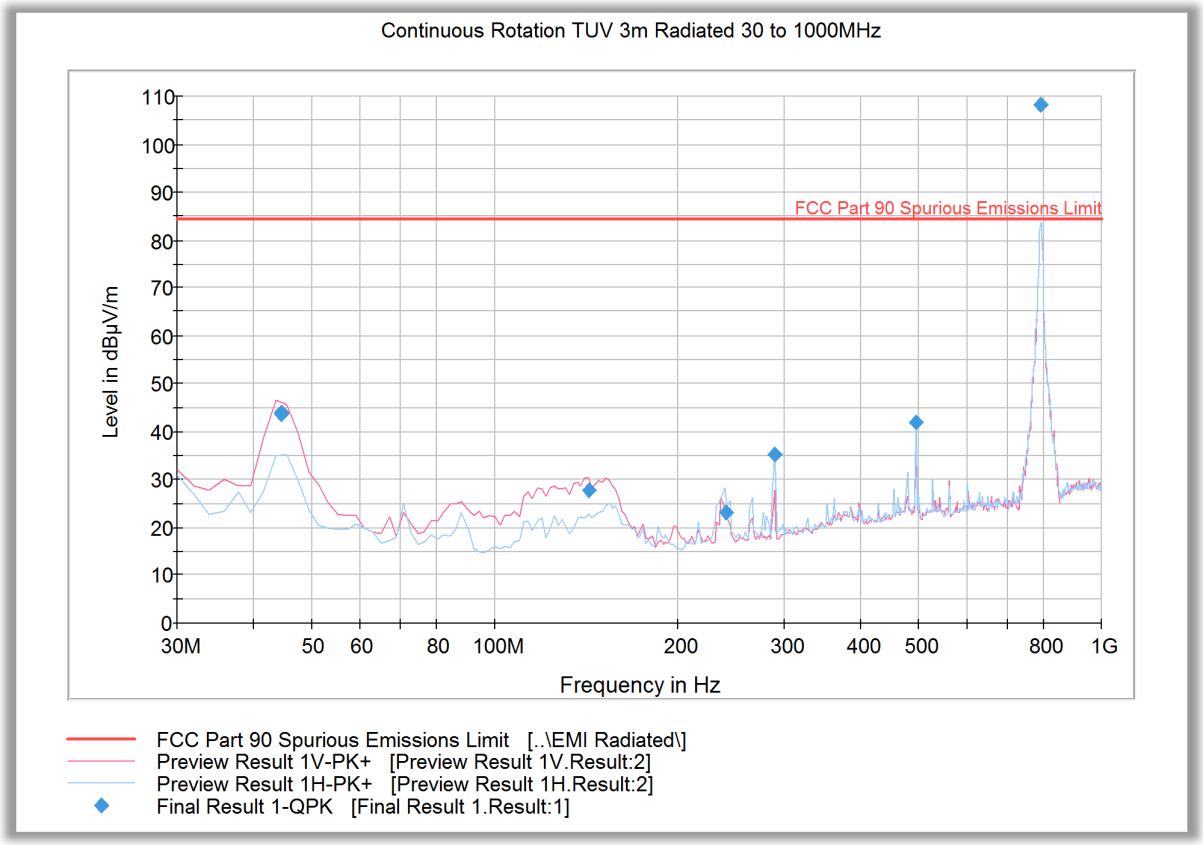
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1600.500000	31.1	1000.0	1000.000	103.7	V	100.0	-5.8	24.2	55.2
1799.966667	44.0	1000.0	1000.000	102.7	H	76.0	-3.5	40.4	84.4
2439.733333	41.3	1000.0	1000.000	151.6	H	182.0	-0.8	43.1	84.4
3000.166667	38.8	1000.0	1000.000	111.7	H	50.0	0.8	45.6	84.4
6344.066667	38.7	1000.0	1000.000	143.7	V	185.0	5.9	45.7	84.4
11003.900000	35.7	1000.0	1000.000	265.3	H	189.0	11.5	48.7	84.4
17858.200000	39.0	1000.0	1000.000	128.7	V	328.0	17.7	45.4	84.4

Note: Bluetooth LE was enabled as the worst case configuration when testing. Measurement was performed with a 2.4GHz Notch Filter.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.7.11 Radiated Emission Test Results Below 1GHz (Uplink) - 10MHz Bandwidth Middle Channel



Quasi Peak Data

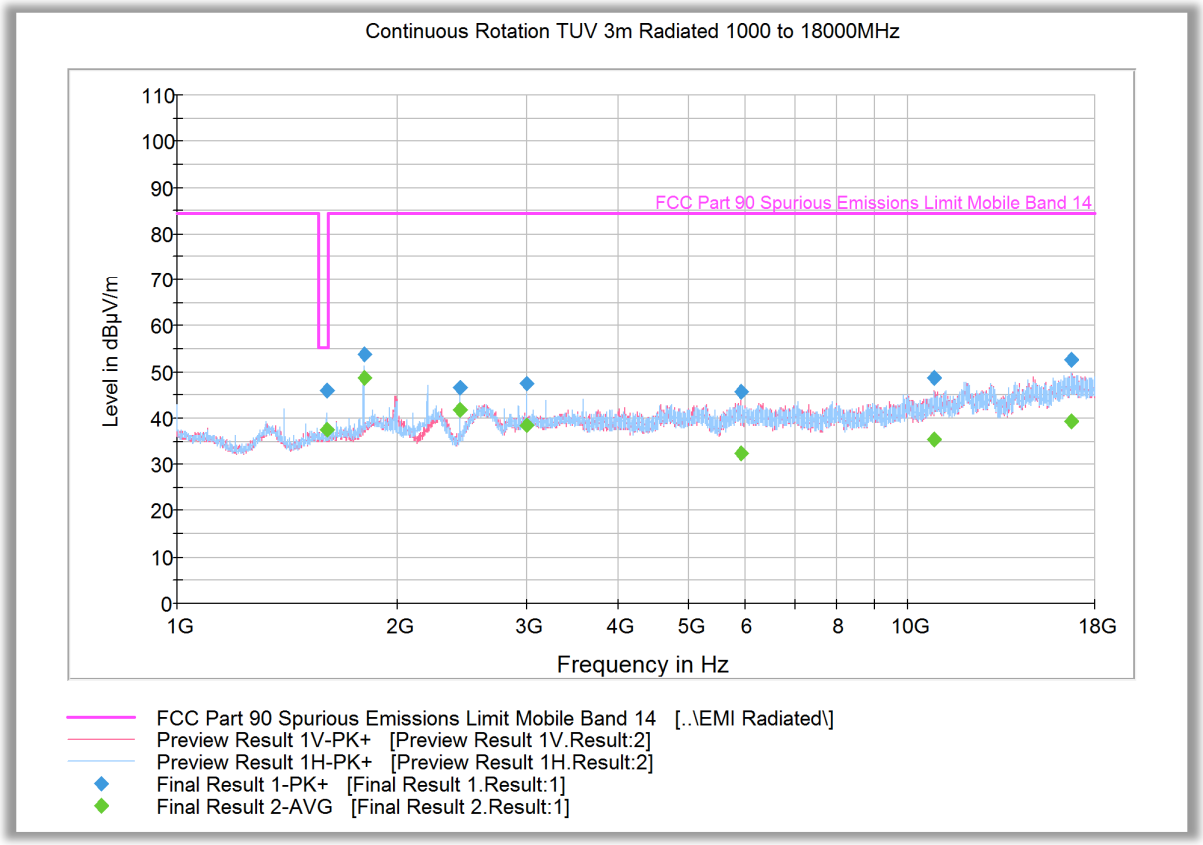
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
44.423327	43.9	1000.0	120.000	100.0	V	276.0	-13.9	40.5	84.4
44.527214	43.7	1000.0	120.000	100.0	V	260.0	-13.9	40.7	84.4
142.705491	27.9	1000.0	120.000	100.0	V	346.0	-15.0	56.5	84.4
240.739880	23.2	1000.0	120.000	197.0	H	209.0	-9.7	61.2	84.4
288.617074	35.2	1000.0	120.000	144.0	H	202.0	-9.2	49.2	84.4
494.989178	41.9	1000.0	120.000	132.0	H	343.0	-1.6	42.5	84.4
792.164008	108.3	1000.0	120.000	150.0	V	303.0	4.1	Fundamental*	

***** This is the fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Note: Bluetooth LE was enabled as the worst case configuration when testing.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.7.12 Radiated Emission Test Results Above 1GHz (Uplink) - 10MHz Bandwidth Middle 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)
1599.900000	46.0	1000.0	1000.000	151.6	V	339.0	-5.8	9.2	55.2
1799.966667	53.8	1000.0	1000.000	103.7	H	308.0	-3.5	30.6	84.4
2439.933333	46.6	1000.0	1000.000	151.6	H	187.0	-0.8	37.8	84.4
2999.966667	47.4	1000.0	1000.000	111.7	H	29.0	0.8	37.0	84.4
5900.333333	45.8	1000.0	1000.000	151.6	V	345.0	5.4	38.6	84.4
10868.466667	48.6	1000.0	1000.000	142.7	V	272.0	11.5	35.8	84.4
16733.533333	52.6	1000.0	1000.000	302.2	H	288.0	17.7	31.8	84.4

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1599.900000	37.4	1000.0	1000.000	151.6	V	339.0	-5.8	17.8	55.2
1799.966667	48.6	1000.0	1000.000	103.7	H	308.0	-3.5	35.8	84.4
2439.933333	41.8	1000.0	1000.000	151.6	H	187.0	-0.8	42.6	84.4
2999.966667	38.5	1000.0	1000.000	111.7	H	29.0	0.8	45.9	84.4
5900.333333	32.5	1000.0	1000.000	151.6	V	345.0	5.4	51.9	84.4
10868.466667	35.5	1000.0	1000.000	142.7	V	272.0	11.5	48.9	84.4
16733.533333	39.2	1000.0	1000.000	302.2	H	288.0	17.7	45.2	84.4

Note: Bluetooth LE was enabled as the worst case configuration when testing. Measurement was performed with a 2.4GHz Notch Filter.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.8 FREQUENCY STABILITY

2.8.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1055
FCC 47 CFR Part 90, Clause 90.539
KDB 935210 D05, Clause 4.8
RSS-140, Clause 4.2
RSS-131, Clause 5.2.4

2.8.2 Standard Applicable

FCC Part 90, Clause 90.539:
(e) The frequency stability of mobile, portable, and control transmitters operating in the wideband segment must be 1.25 parts per million or better when AFC is locked to a ase staion, and 5 parts per million or better when AFC is not locked.

RSS-140, Clause 4.2:
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

RSS-131, Clause 5.2.4
Industrial zone enhancers shall comply with the frequency stability given in the RSS that applies to the equipment with which the zone enhancer is to be used. In cases where the frequency stability limit is not given in the applicable RSS, the equipment shall comply with a frequency stability of ± 1.5 ppm.

2.8.3 Equipment Under Test and Modification State

Serial No: 382829000271 / Test Configuration A and B

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

September 25, 26 and 28, 2018/XYZ

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	24.5 - 25.3°C
Relative Humidity	50.3 - 55.3%
ATM Pressure	98.7 - 99.0kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

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.
- Test performed in 10 MHz Bandwidth Middle channel as the representative configuration.
- Input Type "Tones" was selected and the EUT was injected a CW signal from a Signal Generator and maximum frequency error was monitored using the spectrum analyzer.
- 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. The EUT was tested over the temperature -30°C to +50°C.
- Voltage variation was also performed at 85% and 115% of the nominal voltage.

2.8.8 Test Results

LTE Band 14 Downlink – 10 MHz BW-Middle Channel 763 MHz				
Voltage (VDC)	**Temperature (°C)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**Limit (ppm)**
120	-30	0	0	± 1.25
	-20	0	0	± 1.25
	-10	0	0	± 1.25
	0	0	0	± 1.25
	+10	0	0	± 1.25
	+20	0	0	± 1.25
	+30	0	0	± 1.25
	+40	0	0	± 1.25
	+50	0	0	± 1.25
102	+20	0	0	± 1.25
138		0	0	± 1.25

The frequency stability of the EUT is sufficient to keep it within the authorised frequency ranges at any temperature interval and voltage variations across the measured range.

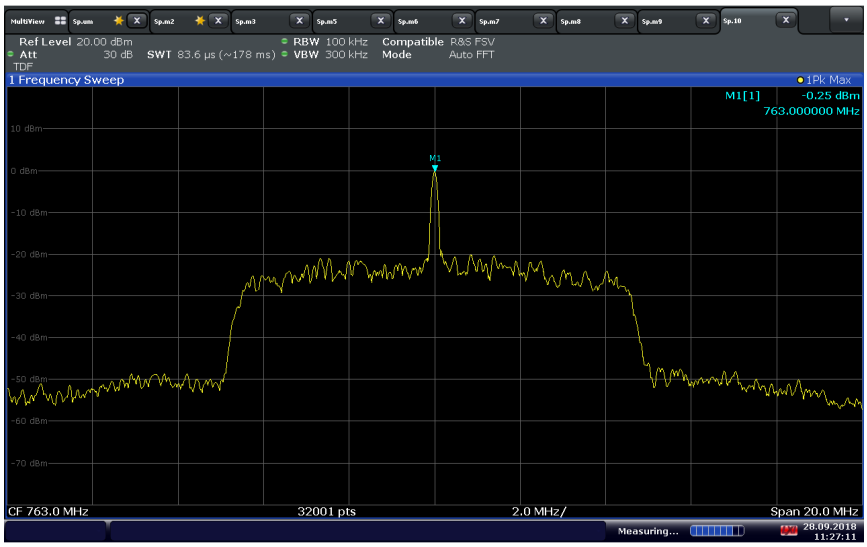
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink – 10 MHz BW Middle Channel 793 MHz				
Voltage (VDC)	**Temperature (°C)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**Limit (ppm)**
120	-30	0	0	± 1.25
	-20	0	0	± 1.25
	-10	0	0	± 1.25
	0	0	0	± 1.25
	+10	0	0	± 1.25
	+20	0	0	± 1.25
	+30	0	0	± 1.25
	+40	0	0	± 1.25
	+50	0	0	± 1.25
102	+20	0	0	± 1.25
138		0	0	± 1.25

The frequency stability of the EUT is sufficient to keep it within the authorised frequency ranges at any temperature interval and voltage variations across the measured range.

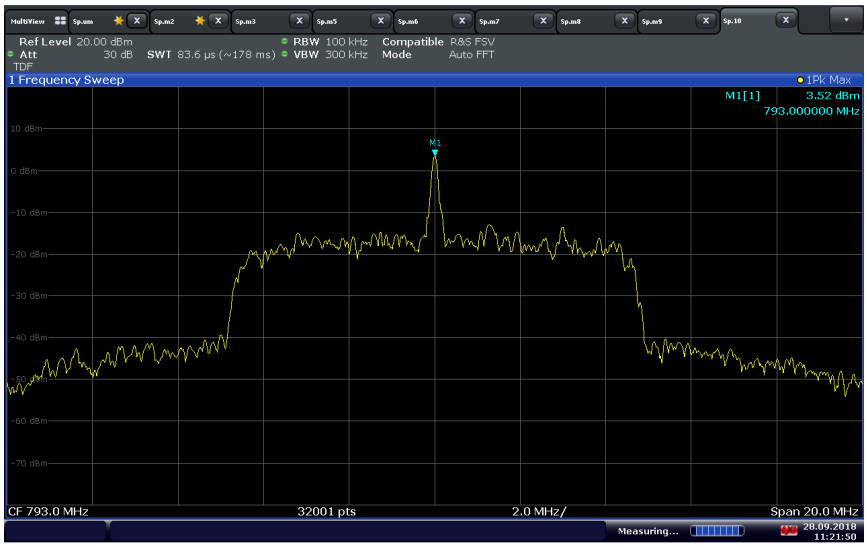
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.8.9 Sample Test plot



11:27:11 28.09.2018

Downlink Middle Channel 120VAC @ 20°C



11:21:50 28.09.2018

Uplink Middle Channel 120VAC @ 20°C

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.9 POWER LINE CONDUCTED EMISSIONS

2.9.1 Specification Reference

FCC CFR 47 Part 15, Clause 15.207(a)
RSS-Gen, Section 8.8

2.9.2 Standard Applicable

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

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: 382829000271/Test Configuration B

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

September 19, 2018/XYZ

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

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

Ambient Temperature	25.2 °C
Relative Humidity	50.3 %
ATM Pressure	98.8 kPa

2.9.7 Additional Observations

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. See Section 2.1.8 for sample computation.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.9.8 Sample Computation (Conducted Emission – Quasi Peak)

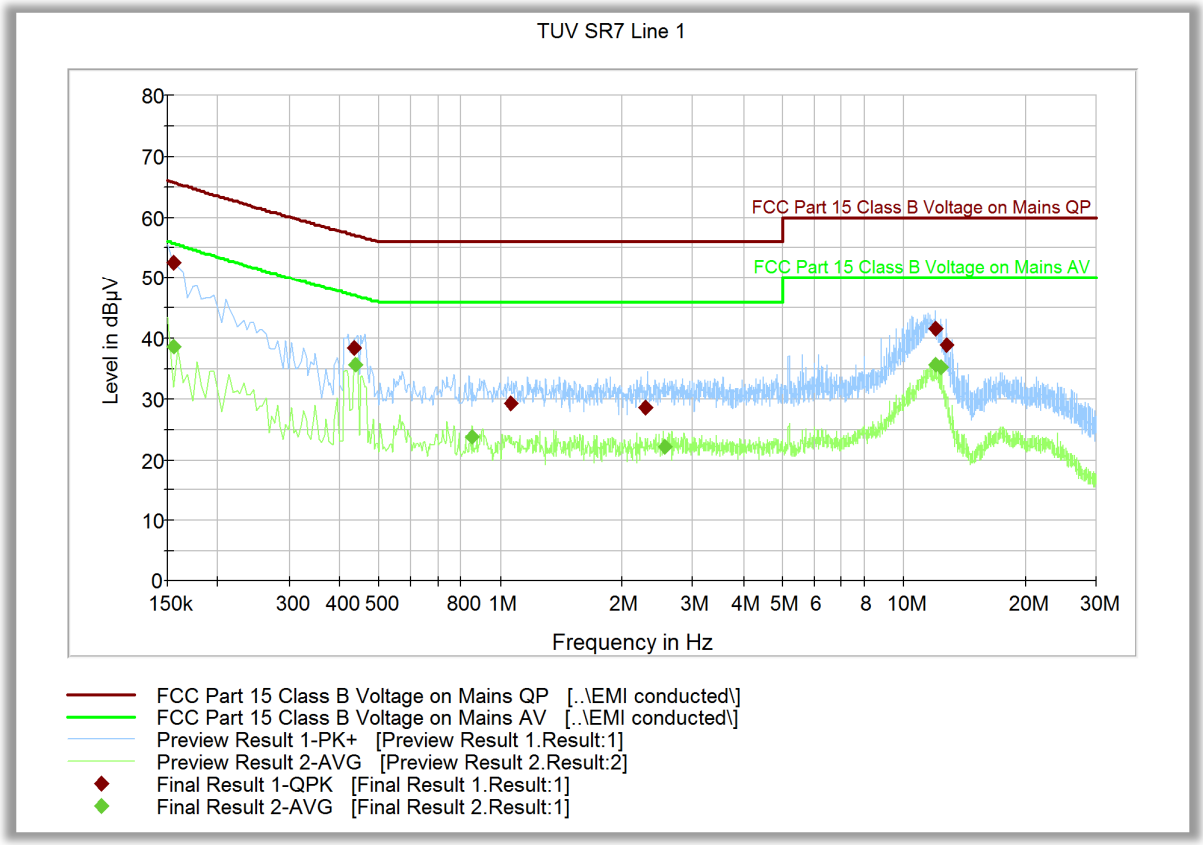
Measuring equipment raw measurement (dbµV) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7568 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbµV) @ 150kHz			**26.2**

2.9.9 Test Results

Compliant. See attached plots and tables.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.9.1 Test Results - Conducted Emissions Line 1 – Hot



Quasi Peak

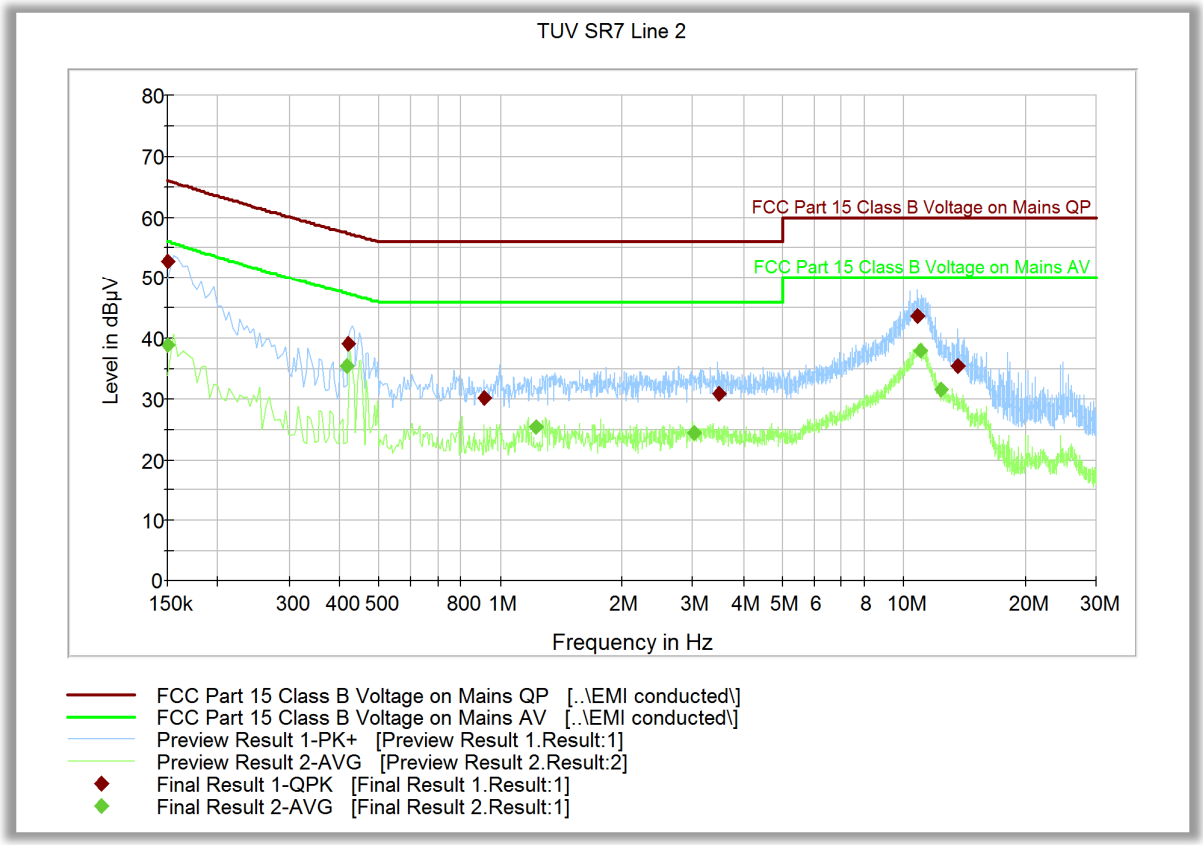
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.154500	52.7	1000.0	9.000	Off	L1	20.3	13.1	65.7
0.433500	38.5	1000.0	9.000	Off	L1	20.3	18.6	57.1
1.063500	29.3	1000.0	9.000	Off	L1	20.1	26.7	56.0
2.292000	28.6	1000.0	9.000	Off	L1	20.5	27.4	56.0
11.998500	41.7	1000.0	9.000	Off	L1	20.7	18.3	60.0
12.799500	39.0	1000.0	9.000	Off	L1	20.7	21.0	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.154500	38.7	1000.0	9.000	Off	L1	20.3	17.0	55.7
0.438000	35.6	1000.0	9.000	Off	L1	20.3	11.4	47.0
0.847500	23.8	1000.0	9.000	Off	L1	20.2	22.2	46.0
2.548500	22.3	1000.0	9.000	Off	L1	20.3	23.7	46.0
11.998500	35.7	1000.0	9.000	Off	L1	20.7	14.3	50.0
12.399000	35.3	1000.0	9.000	Off	L1	20.7	14.7	50.0

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.9.2 Test Result - Conducted Emissions Line 2 – Neutral



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	52.7	1000.0	9.000	Off	N	20.3	13.3	66.0
0.420000	39.0	1000.0	9.000	Off	N	20.3	18.4	57.3
0.915000	30.2	1000.0	9.000	Off	N	20.2	25.8	56.0
3.475500	30.9	1000.0	9.000	Off	N	20.5	25.1	56.0
10.797000	43.7	1000.0	9.000	Off	N	20.6	16.3	60.0
13.591500	35.5	1000.0	9.000	Off	N	20.7	24.5	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.150000	38.9	1000.0	9.000	Off	N	20.3	17.1	56.0
0.415500	35.5	1000.0	9.000	Off	N	20.3	12.0	47.4
1.221000	25.3	1000.0	9.000	Off	N	20.3	20.7	46.0
3.007500	24.5	1000.0	9.000	Off	N	20.5	21.5	46.0
10.986000	37.9	1000.0	9.000	Off	N	20.6	12.1	50.0
12.399000	31.4	1000.0	9.000	Off	N	20.7	18.6	50.0

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.10 AGC THRESHOLD LEVEL

2.10.1 Specification Reference

KDB 935210 D05, Clause 4.2

2.10.2 Standard Applicable

AGC Threshold Level is tested according to KDB 935210 D05, Clause 4.2:

The AGC threshold shall be determined by applying the procedure of 3.2 (of the current KDB), but with the signal generator configured to produce a test signal defined in Table 1, a CW input signal or a digitally modulated signal, consistent withe the discussion about signal types in 4.1.

Devices intended for used in 700 MHz Public Safety Broadband spectrum shall be tested using representative band-limited AWGN signal (99% OBW of 4.1 MHz) or the applicable signal type (e.g., LTE)

2.10.3 Equipment Under Test and Modification State

Serial No: 382829000271 / Test Configuration A and B

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

October 09, 2018 / ZXY

2.10.5 Test Equipment Used

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

2.10.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.5°C
Relative Humidity	54.9%
ATM Pressure	98.7kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.10.7 Additional Observations

- This is a conducted test.
- When testing output power of the EUT, a power meter was used according to method 3.5.4 of this KDB.
- LTE 10 MHz Signal was used as the applicable test signal type.
- The AGC threshold level was recorded when increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
- Both downlink and uplink are tested.

2.10.8 Test Results

LTE Band 14						
Mode	Bandwidth (MHz)	Channel	Frequency (MHz)	Average Power		AGC Threshold Level (dBm)
				(dBm)	(W)	
Downlink	10	5330	763.0	16.45	0.044	-77.97
Uplink	10	23330	793.0	23.52	0.225	-71.77

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.11 OUT-OF-BAND REJECTION

2.11.1 Specification Reference

KDB 935210 D05, Clause 4.3
RSS-131, Clause 5.2.1

2.11.2 Standard Applicable

RSS-131, Clause 5.2.1:
The gain-versus-frequency response and the 20 dB bandwidth of the zone enhancer shall be reported. The zone enhancer shall reject amplification of other signals outside the passband of the zone enhancer

Out-of-Band Rejection is tested according to KDB 935210 D05, Clause 4.3.

2.11.3 Equipment Under Test and Modification State

Serial No: 382829000042 / Test Configuration A and B

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

October 09, 2018 / ZXY

2.11.5 Test Equipment Used

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

2.11.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.5°C
Relative Humidity	54.9%
ATM Pressure	98.7kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.11.7 Additional Observations

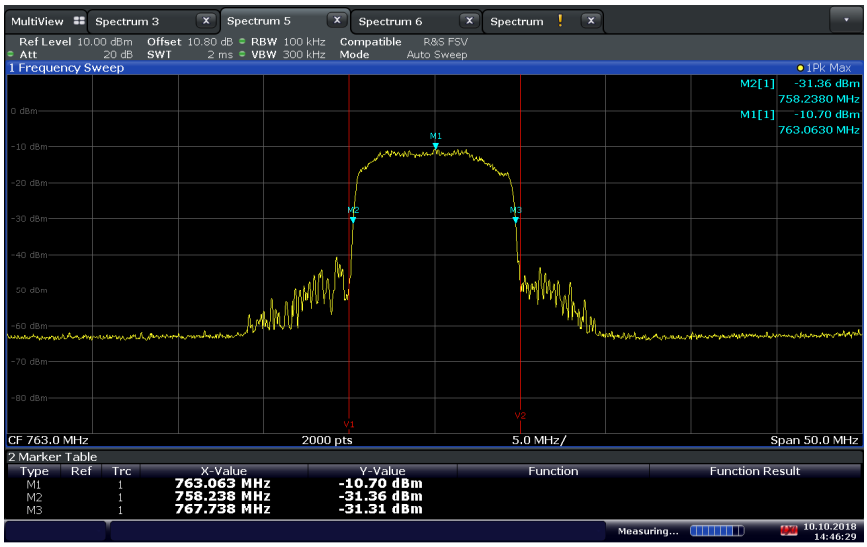
- This is a conducted test.
- The path loss was measured and entered as an offset.
- A swept CW signal whose frequency range is ±250% of the manufacturer's specified pass band is configured for the testing.
- The internal gain control of the EUT is set to the maximum gain. The input signal type is set to tones.
- The CW is 3 dB below the ACG threshold (determined according to section 3.2 of the current KDB), and doesn't activate the AGC threshold throughout the test.
- Dwell time is 10 ms.
- Frequency Step is 50 kHz.
- RBW is between 1% and 5% of the manufacturer's rated pass band.
- VBW is 3 x RBW.
- Detector is peak and trace is max hold.
- The peak amplitude frequency f_0 is determined and two additional -20 dB markers are determined using the marker-delta method).
- The 20dB Bandwidth plot is recorded as the out-of-band rejection frequency response.
- Both downlink and uplink are tested.

2.11.8 Test Results

LTE Band 14						
Mode	Bandwidth (MHz)	Channel	Frequency (MHz)	-20 dBc Point		20 dB BW (MHz)
				T1 (MHz)	T2 (MHz)	
Downlink	10	5330	763.0	758.238	767.738	9.50
Uplink	10	23330	793.0	788.213	797.788	9.57

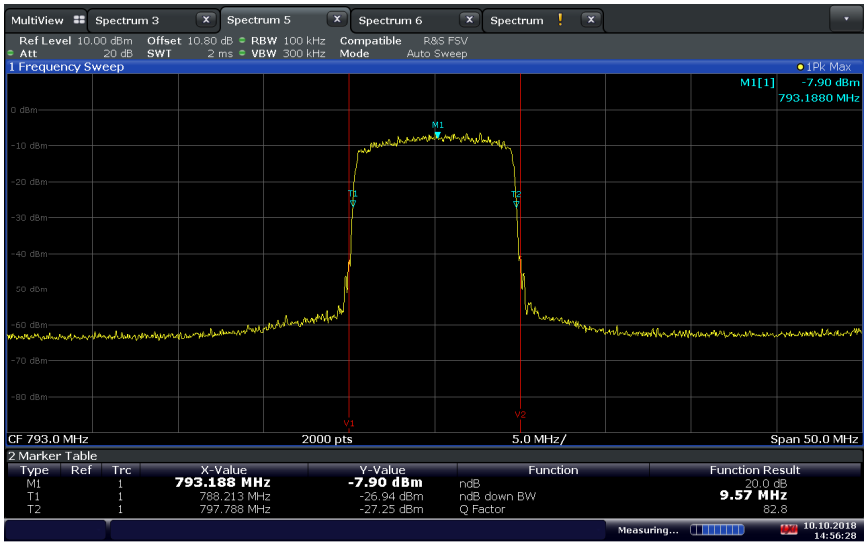
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) M Channel / Out-of-Band Rejection



14:46:30 10.10.2018

LTE Band 14 Uplink (10 MHz BW) M Channel / Out-of-Band Rejection



14:56:29 10.10.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.12 INPUT-VERSUS-OUTPUT SIGNAL COMPARISON

2.12.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.219 (e)(4)(ii)
KDB 935210 D05, Clause 4.4
RSS-131, Clause 5.2.2

2.12.2 Standard Applicable

FCC 47 CFR Part 90, Clause 90.219 (e)(4):
(ii) There is no change in the occupied bandwidth of the retransmitted signals.

RSS-131, Clause 5.2.2:
The spectral growth of the 26 dB bandwidth of the output signal shall be less than 5% of the input signal spectrum.

Input-versus-Output Signal Comparison is tested according to KDB 935210 D05, Clause 4.4.

2.12.3 Equipment Under Test and Modification State

Serial No: 382829000042 / Test Configuration A and B

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

October 11, 2018 / ZXY

2.12.5 Test Equipment Used

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

2.12.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.9°C
Relative Humidity	49.7%
ATM Pressure	98.6kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.12.7 Additional Observations

- The path loss was measured and entered as an offset.
- The signal generator is configured to transmit LTE 10 MHz Bandwidth signal.
- The signal amplitude is just below the ACG threshold (determined according to section 3.2 of the current KDB), and not more than 0.5 dB below.
- Span is between 2 times to 5 times the emission bandwidth (EBW) or alternatively, the OBW.
- RBW is 100 Hz, VBW is > 3 x RBW.
- Set the reference level of spectrum analyzer to accommodate the maximum input amplitude level.
- The noise floor of the spectrum analyzer is at least 36 dB below the reference level.
- Detector is positive peak and trace is max hold.
- The peak amplitude frequency f_0 is determined and the 99% occupied bandwidth was measured with the OBW function of spectrum analyzer.
- Repeat the testing with the input signal connected directly to the spectrum analyzer.
- Compare the spectral plot of the input signal to the output signal.
- Repeat the testing with input signal amplitude set to 3 dB above AGC threshold.
- Both downlink and uplink are tested.

2.12.8 Test Results

Compliant. The spectral growth of 26 dB bandwidth of the output signal is less than 5% of the input signal spectrum.

LTE Band 14 Downlink							
Signal Level	Bandwidth (MHz)	Channel	Frequency (MHz)	99% OBW (MHz)		-26 dB BW (MHz)	
				Output	Input*	Output	Input*
AGC Threshold Level	10	5330	763.0	8.673	8.960	9.14	9.34
AGC + 3 dB Level				8.670	8.960	9.18	9.34

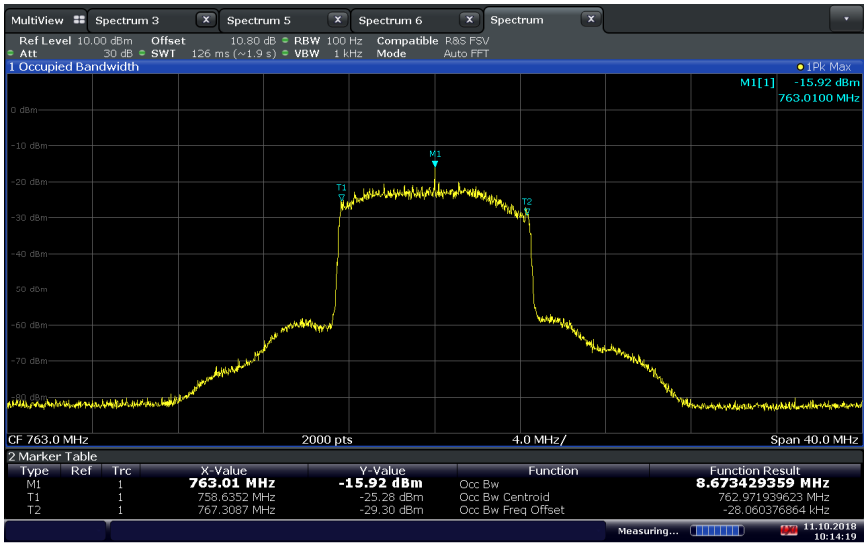
* Since the AGC Threshold level and AGC + 3 dB level for downlink are as low as -75 dBm, which is about the noise floor, the input levels are adjusted in order to get the right input 99% OBW and -26 dB BW when testing.

LTE Band 14 Uplink							
Signal Level	Bandwidth (MHz)	Channel	Frequency (MHz)	99% OBW (MHz)		-26 dB BW (MHz)	
				Output	Input*	Output	Input*
AGC Threshold Level	10	23330	793	8.767	8.970	9.20	9.32
AGC + 3 dB Level				8.772	8.970	9.20	9.32

* Since the AGC Threshold level and AGC + 3 dB level for Uplink are as low as -65 dBm, which is close to the noise floor, the input levels are adjusted in order to get the right input 99% OBW and -26 dB BW when testing.

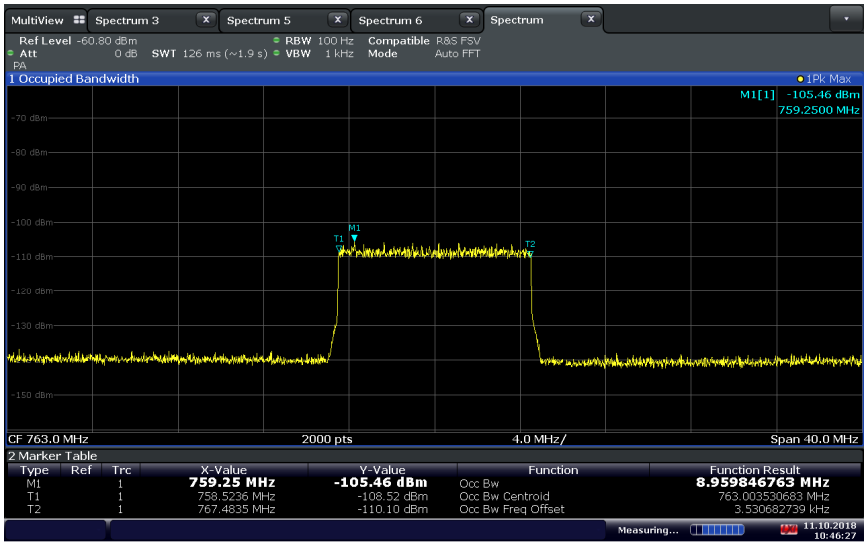
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) Mid Channel / 99% OBW at Output port with Input signal at AGC Threshold Level



10:14:19 11.10.2018

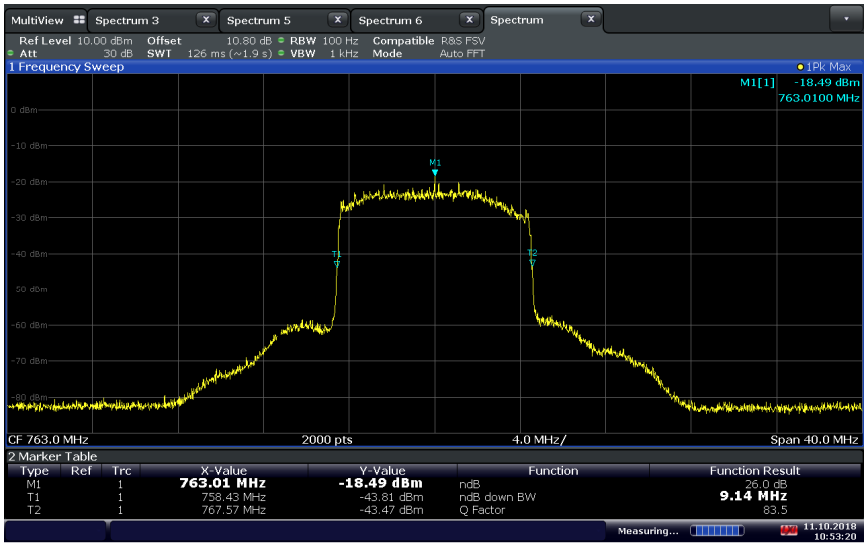
LTE Band 14 Downlink (10 MHz BW) Mid Channel / 99% OBW at Input port (Adjusted Level)



10:46:27 11.10.2018

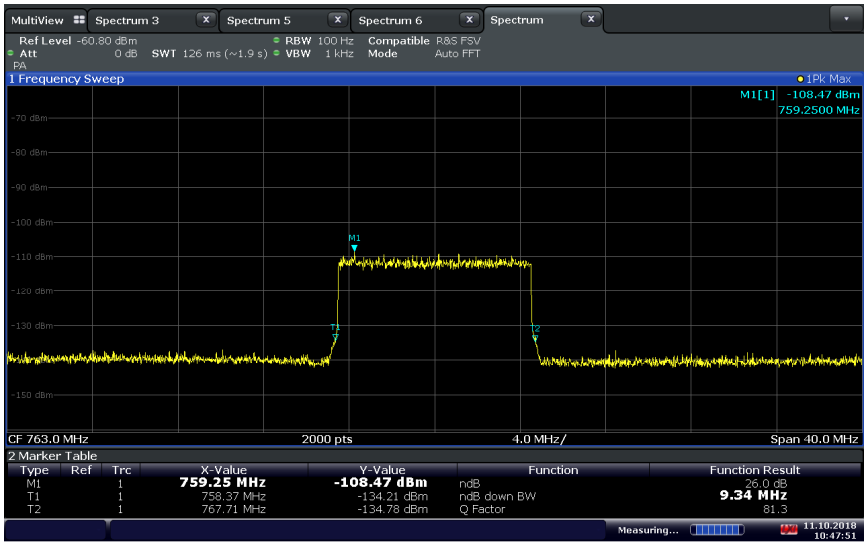
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) Mid Channel / 26 dB BW at Output port with Input signal at AGC Threshold Level



10:53:21 11.10.2018

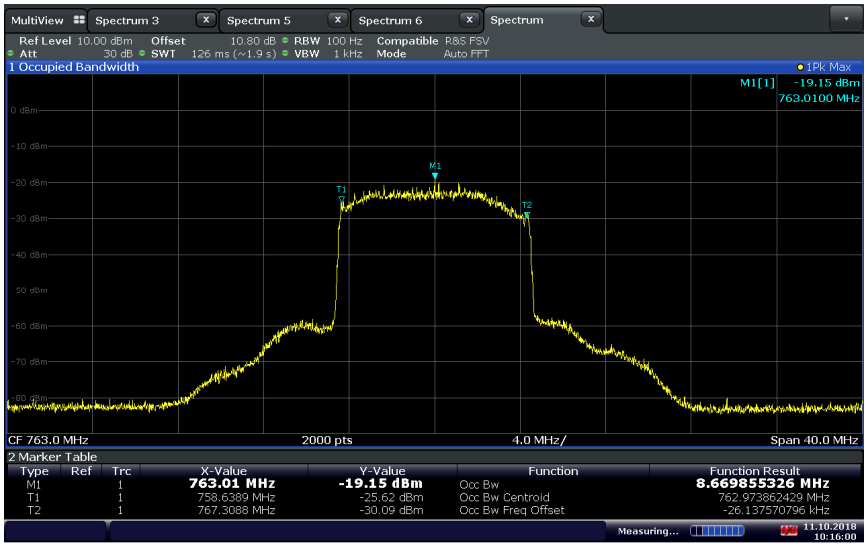
LTE Band 14 Downlink (10 MHz BW) Mid Channel / 26 dB BW at Input port (Adjusted Level)



10:47:51 11.10.2018

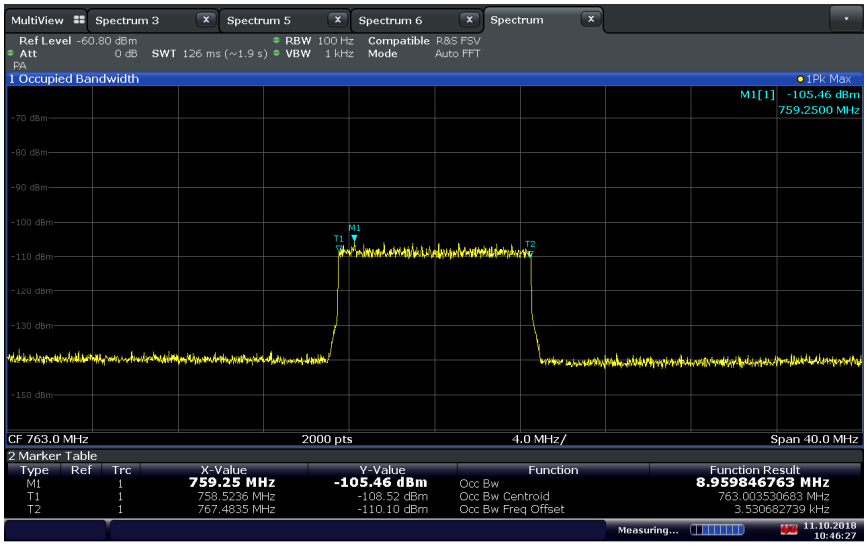
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) Mid Channel / 99% OBW at Output port with Input signal at AGC + 3 dB Level



10:16:01 11.10.2018

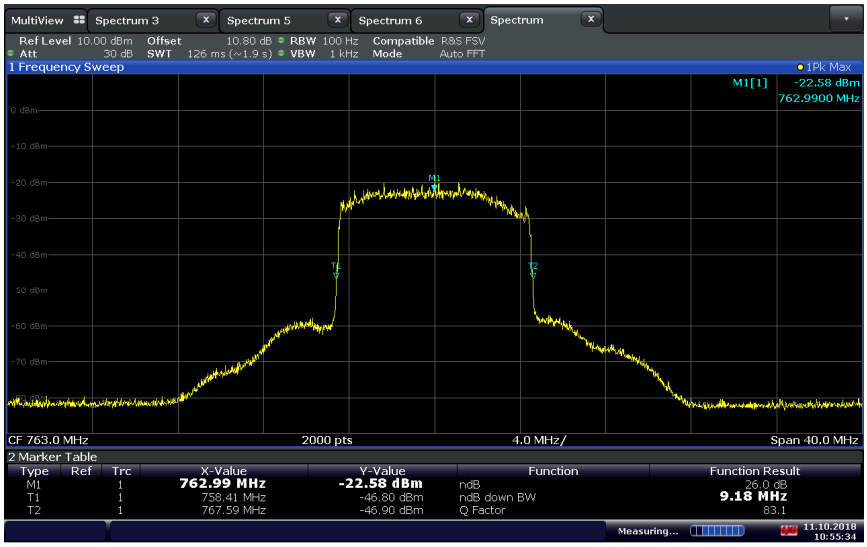
LTE Band 14 Downlink (10 MHz BW) Mid Channel / 99% OBW at Input port (Adjusted Level)



10:46:27 11.10.2018

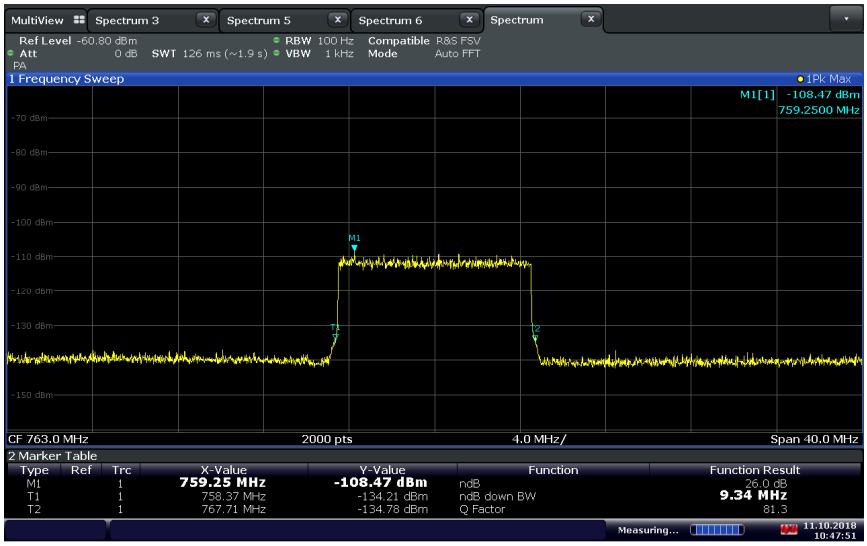
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) Mid Channel / 26 dB BW at Output port with Input signal at AGC + 3 dB Level



10:55:35 11.10.2018

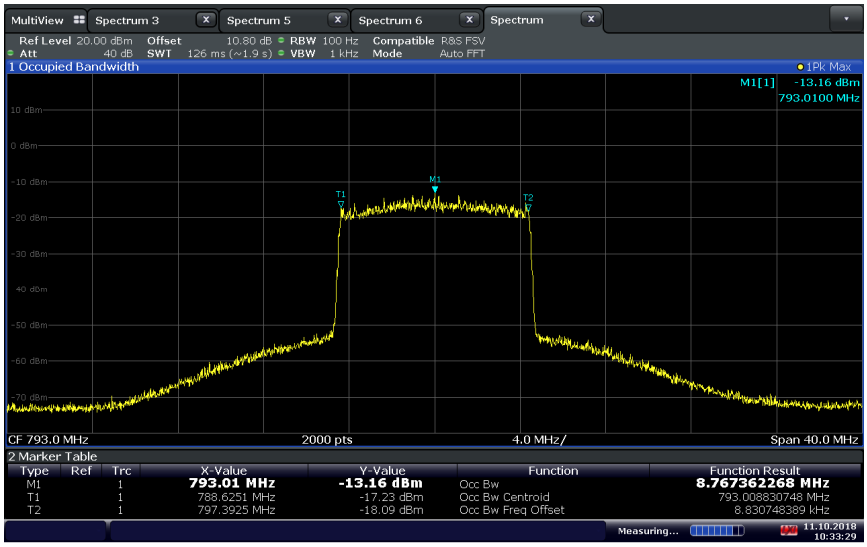
LTE Band 14 Downlink (10 MHz BW) Mid Channel / 26 dB BW at Input port (Adjusted Level)



10:47:51 11.10.2018

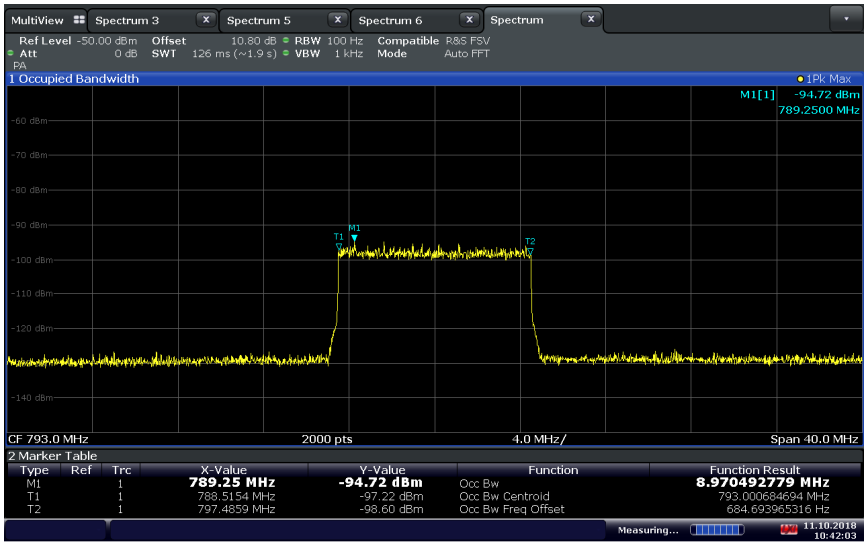
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) Mid Channel / 99% OBW at Output port with Input signal at AGC Threshold Level



10:33:29 11.10.2018

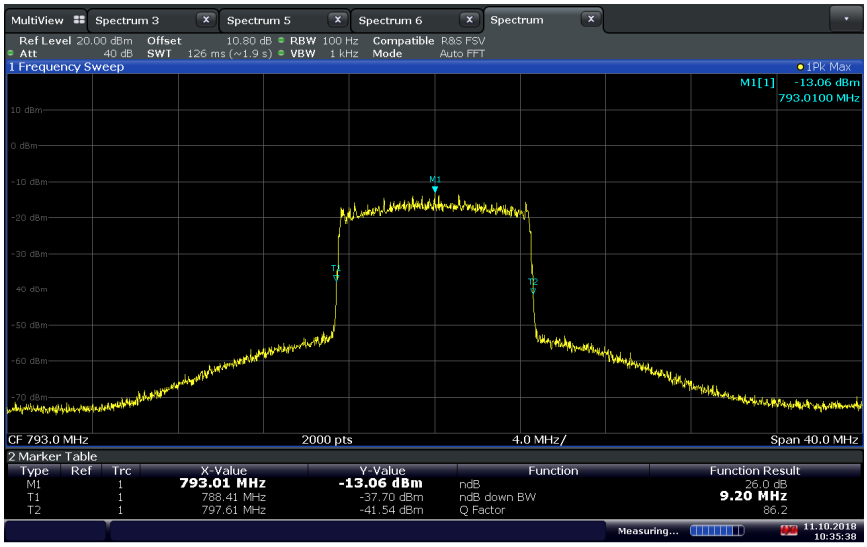
LTE Band 14 Uplink (10 MHz BW) Mid Channel / 99% OBW at Input port (Adjusted Level)



10:42:03 11.10.2018

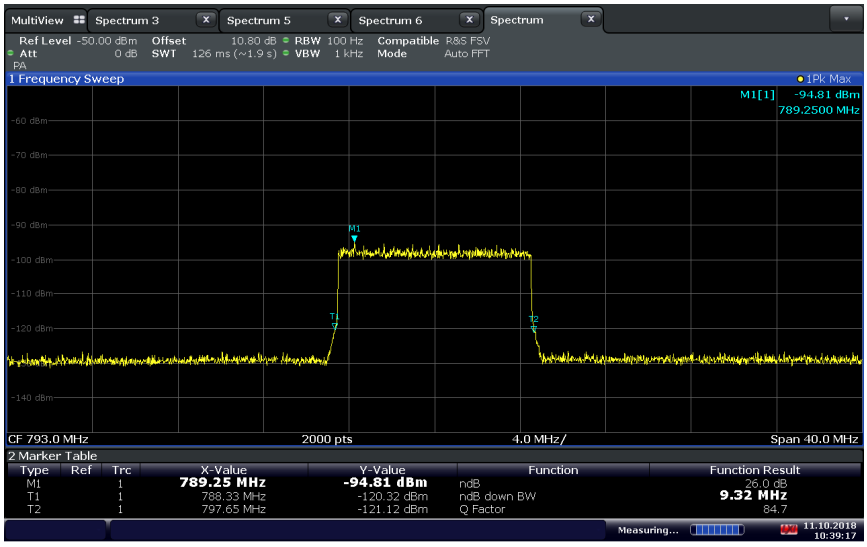
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) Mid Channel / 26 dB BW at Output port with Input signal at AGC Threshold Level



10:35:38 11.10.2018

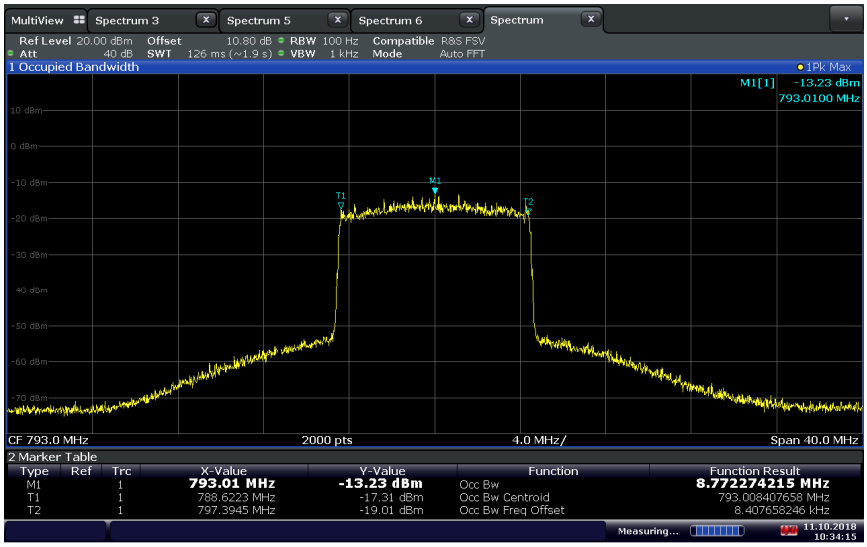
LTE Band 14 Uplink (10 MHz BW) Mid Channel / 26 dB BW at Input port (Adjusted Level)



10:39:18 11.10.2018

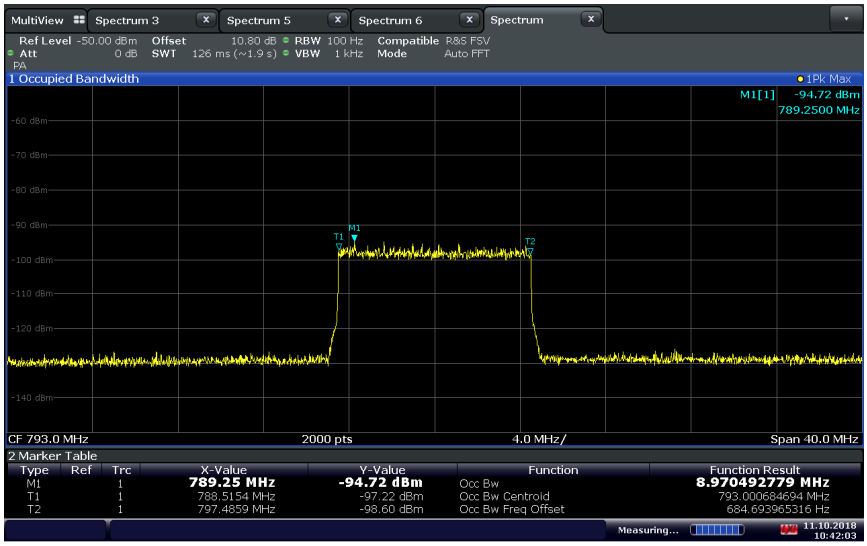
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) Mid Channel / 99% OBW at Output port with Input signal at AGC + 3 dB Level



10:34:16 11.10.2018

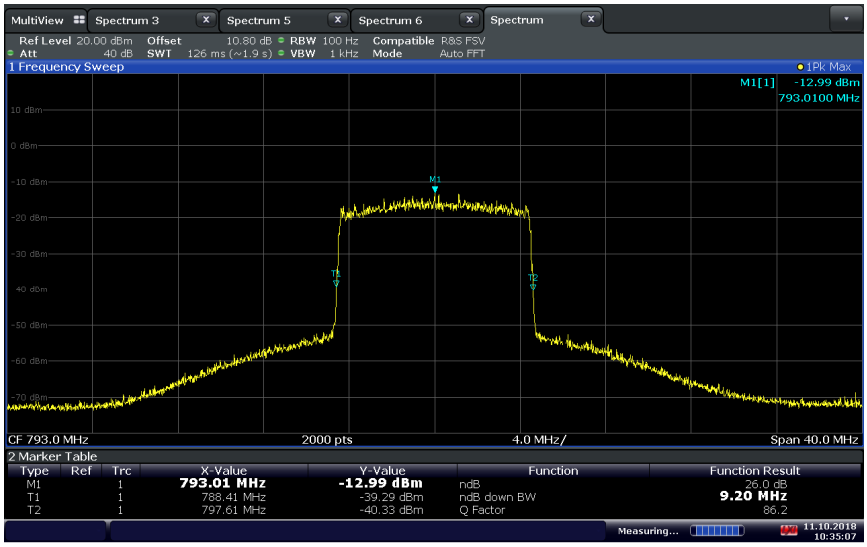
LTE Band 14 Uplink (10 MHz BW) Mid Channel / 99% OBW at Input port (Adjusted Level)



10:42:03 11.10.2018

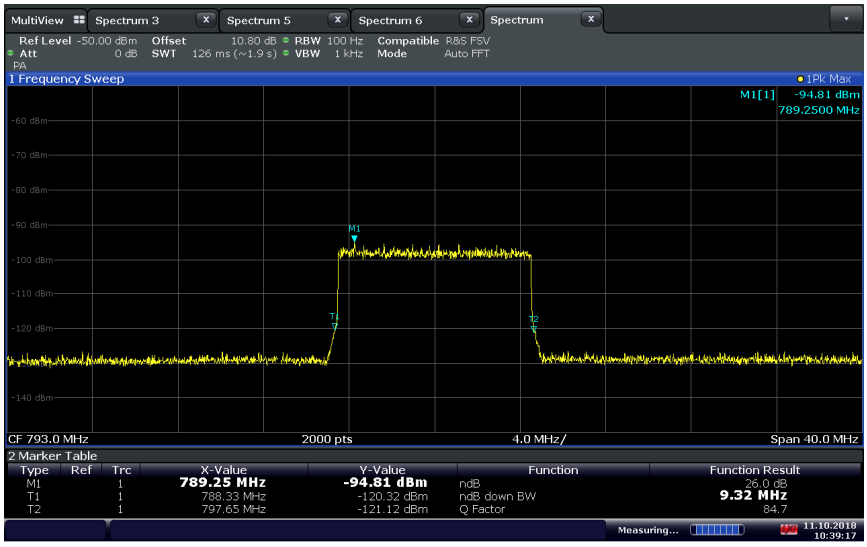
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) Mid Channel / 26 dB BW at Output port with Input signal at AGC + 3 dB Level



10:35:07 11.10.2018

LTE Band 14 Uplink (10 MHz BW) Mid Channel / 26 dB BW at Input port (Adjusted Level)



10:39:18 11.10.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.13 EMISSION MASK

2.13.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.219 (e)(4) (iii) and 90.210
KDB 935210 D05, Clause 4.4

2.13.2 Standard Applicable

FCC Part 90.219 (e)(4):
(iii) The retransmitted signals continue to meet the unwanted emissions limits of § 90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).

FCC Part 90.210:

APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25 [1]	A or B	A or C
25–50	B	C
72–76	B	C
150–174 [2]	B, D, or E	C, D or E
150 paging only	B	C
220–222	F	F
421–512 [2 5]	B, D, or E	C, D, or E
450 paging only	B	G
806–809/851–854 [6]	B	H
809–824/854–869 [3 5]	B	G
896–901/935–940	I	J
902–928	K	K
929–930	B	G
4940–4990 MHz	L or M	L or M
5850–5925 [4].		
All other bands	B	C

Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (f_d/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (f_d2/11) dB or 50 dB, whichever is the lesser attenuation.

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(4) In the 1427–1432 MHz band, licensees are encouraged to take all reasonable steps to ensure that unwanted emissions power does not exceed the following levels in the 1400–1427 MHz band:
(i) For stations of point-to-point systems in the fixed service: -45 dBW/27 MHz.
(ii) For stations in the mobile service: -60 dBW/27 MHz.

Emission Mask should be tested according to KDB 935210 D05, Clause 4.4.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.13.3 Justificaiton

According to FCC Part 90.219 (e)(4)(iii), the retransmitted signals continue to meet the unwanted emissions limits of § 90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin). As a equipment without audio low pass filter, Emission Mask C applies.

However, since the received signals are wideband LTE 10 MHz signals which does not meet the unwanted Emission Mask C limits of § 90.210 which is for narrow band. Therefore, emission mask is not applicable to the retransmitted output signals.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.14 INPUT AND OUTPUT POWER AND AMPLIFIER/BOOSTER GAIN

2.14.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.219(e)(1)
KDB 935210 D05, Clause 4.5
RSS-131, Clause 5.2.3

2.14.2 Standard Applicable

FCC 47 CFR Part 90, Clause 90.219(e):
(1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

Input and Output Power and Amplifier/Booster Gain should be tested according to KDB 935210 D05, Clause 4.5.

RSS-131, Clause 5.2.3:
The zone enhancer gain shall not exceed the nominal gain by more than 1.0 dB.

Input and Output Power and Amplifier/Booster Gain is tested according to KDB 935210 D05, Clause 4.5.

2.14.3 Equipment Under Test and Modification State

Serial No: 382829000042 / Test Configuration A and B

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

October 11, 2018 / ZXY

2.14.5 Test Equipment Used

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

2.14.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.9°C
Relative Humidity	49.7%
ATM Pressure	98.6kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.14.7 Additional Observations

- This is a conducted test.
- The path loss was measured and entered as an offset.
- The internal gain control of the EUT is adjusted to the maximum gain (95 dB).
- The input power levels (uplink and downlink) are set to maximum input ratings, and confirm the device is not capable of operating in saturation (non-linear mode) during the test.
- The signal generator is configured for CW operation.
- Frequency span is at least 1 MHz.
- RBW is 100 kHz.
- VBW is ≥ 3 x RBW.
- Detector is positive peak and trace is max hold.
- Record the peak value of the signal as the maximum power.
- The input power is tested with the signal generator connect to the spectrum analyzer directly.
- The output power is tested with the EUT in place.
- Both downlink and uplink are tested.

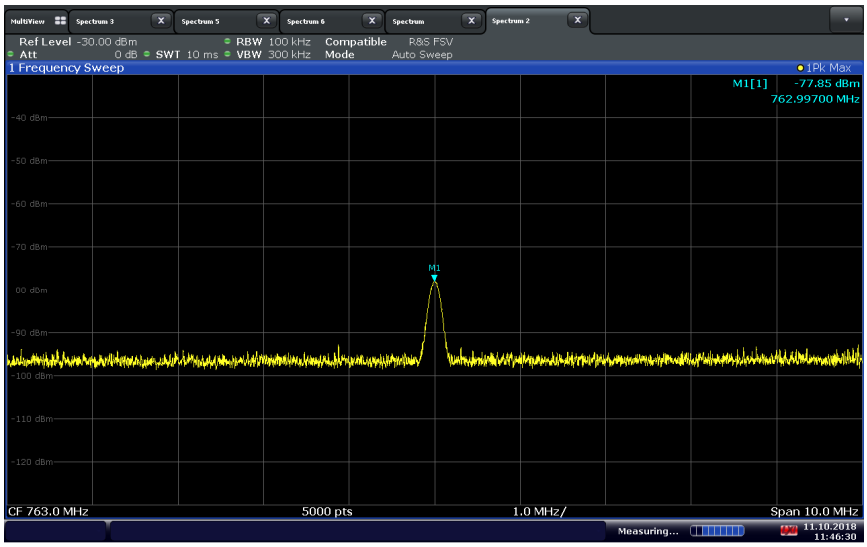
2.14.8 Test Results

Compliant. The booster gain does not exceed the nominal gain (95 dB) by more than 1.0 dB.

LTE Band 14						
Mode	**Bandwidth (MHz)**	**Channel**	**Frequency (MHz)**	**Input Power (dBm)**	**Output Power (dBm)**	**Booster Gain (dB)**
Downlink	10	5330	763.0	-77.85	12.83	90.68
Uplink	10	23330	793	-70.54	15.91	86.45

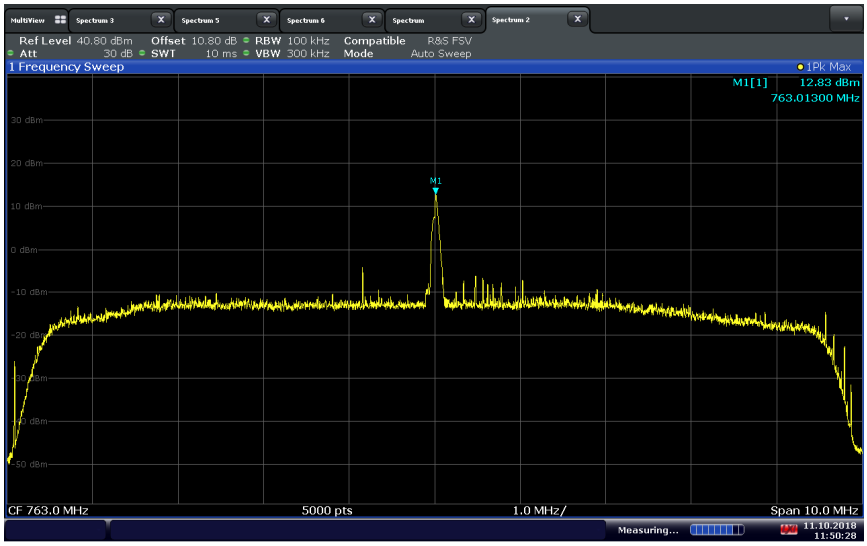
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) M Channel / Input Power



11:46:31 11.10.2018

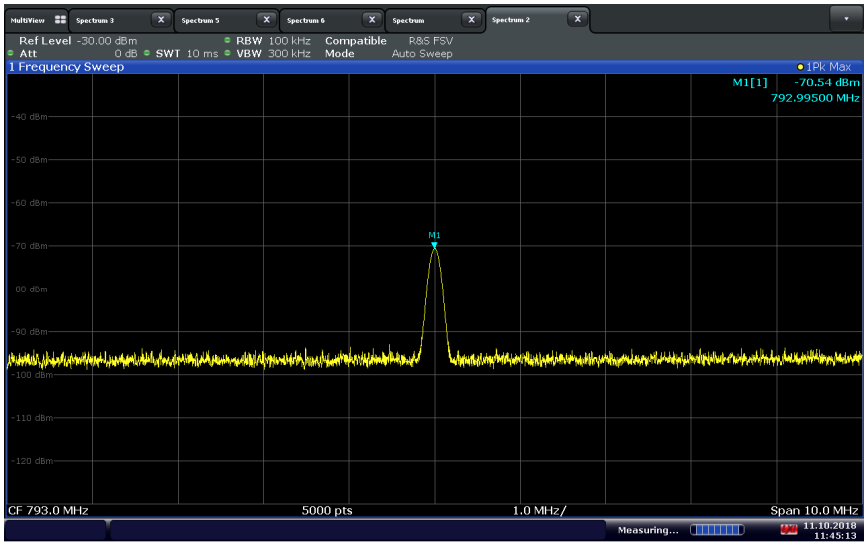
LTE Band 14 Downlink (10 MHz BW) M Channel / Output Power



11:50:28 11.10.2018

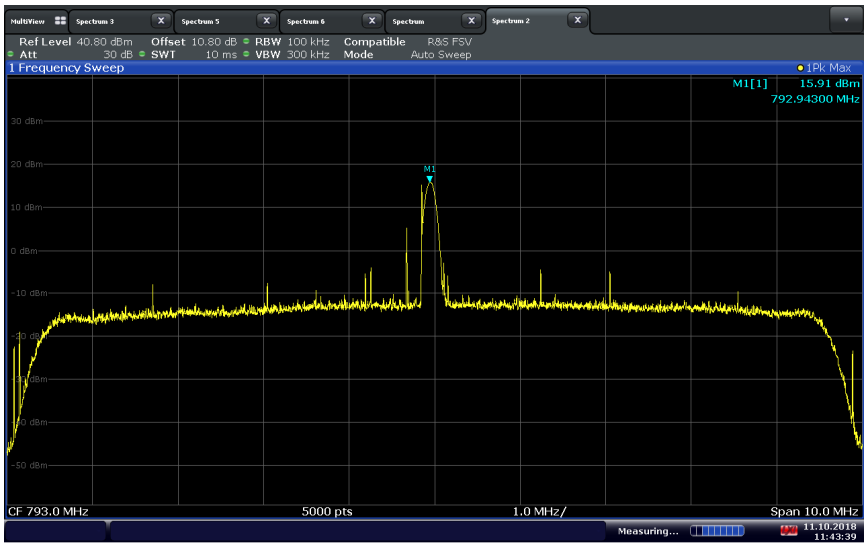
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Uplink (10 MHz BW) M Channel / Input Power



11:45:14 11.10.2018

LTE Band 14 Uplink (10 MHz BW) M Channel / Output Power



11:43:40 11.10.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.15 NOISE FIGURE

2.15.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.219 (e)(2)
KDB 935210 D05, Clause 4.6

2.15.2 Standard Applicable

FCC Part 90.219 (e)(2):
The noise figure of a signal booster must not exceed 9 dB in either direction.

Noise Figure is tested according to KDB 935210 D05, Clause 4.6.

2.15.3 Equipment Under Test and Modification State

Serial No: 382829000042 / Test Configuration A and B

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

October 11, 2018 / ZXY

2.15.5 Test Equipment Used

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

2.15.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.9°C
Relative Humidity	49.7%
ATM Pressure	98.6kPa

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.15.7 Additional Observations

- The path loss was measured and entered as an offset.
- The Downlink and Uplink Gains are measured with a LTE signal injected to the device under test.
- The input of the EUT is terminated when measuring the noise output.
- The spectrum analyzer was set to 100 trace average in RMS mode.
- RBW is 1 MHz, VBW is > 3 x RBW.
- A peak reading was recorded.
- The noise figure was calculated using the following formula:

  Noise Figure (NF) = N – Gain + 174 dB – $10\lg_{10}(B)$

  - N = Noise Power Output in dBm/MHz
  - Gain = Gain of the device under test
  - B = Resolution Bandwidth of spectrum analyzer in Hz
  - 174 = Thermal noise for 1 Hz RBW at room temperature

- Both Downlink and Uplink are tested.

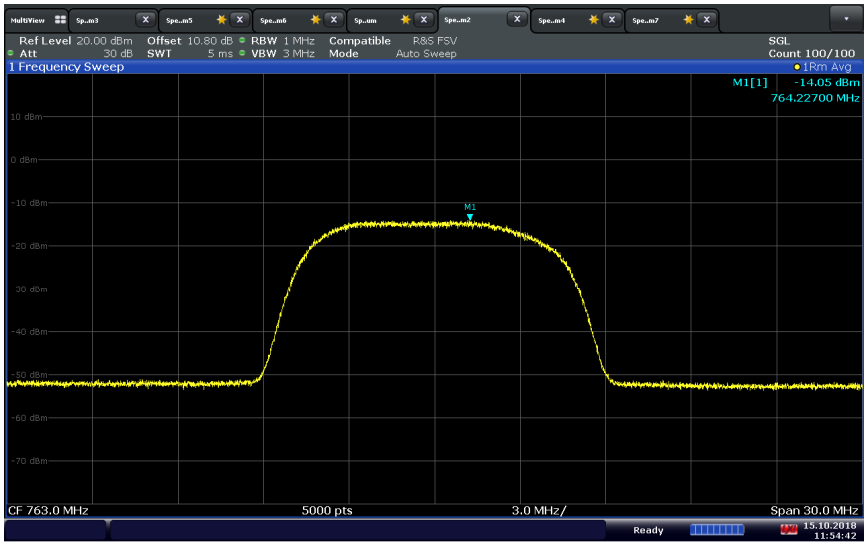
2.15.8 Test Results

LTE Band 14 Booster Gain					
Mode	**Bandwidth (MHz)**	**Frequency (MHz)**	**Input Power (dBm)**	**Output Power (dBm)**	**Gain (dB)**
Downlink	10	763.0	-79.32	14.73	94.05
Uplink	10	793.0	-72.57	21.67	94.24

LTE Band 14 Noise Figure							
Mode	**Bandwidth (MHz)**	**Frequency (MHz)**	**RBW (MHz)**	**Noise Output (dBm/MHz)**	**Booster Gain (dB)**	**Noise Figure (dB)**	**Limit (dB)**
Downlink	10	763.0	1	-14.05	94.05	5.90	9
Uplink	10	793.0	1	-13.81	94.24	5.95	9

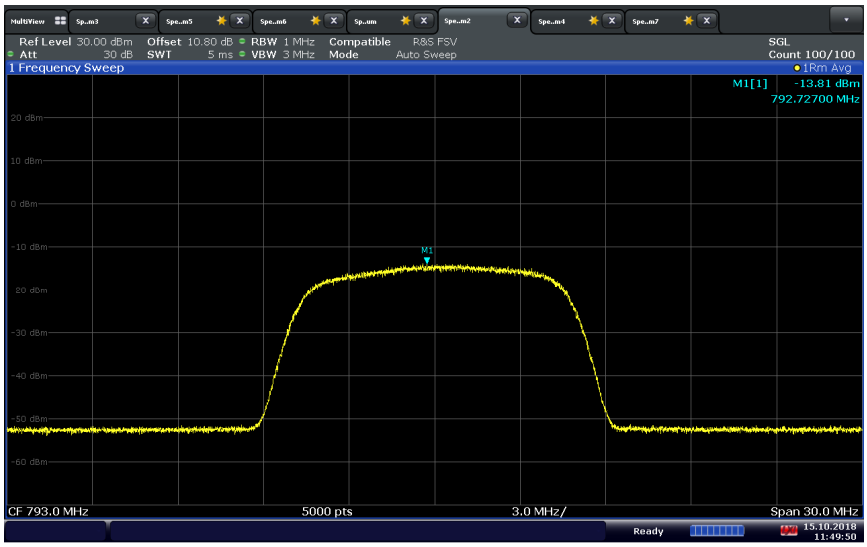
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 14 Downlink (10 MHz BW) M Channel / Noise Output



11:54:42 15.10.2018

LTE Band 14 Uplink (10 MHz BW) M Channel / Noise Output



11:49:51 15.10.2018

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 3

TEST EQUIPMENT USED

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

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						
7662	P-Series Power Meter	N1911A	MY45100951	Agilent	06/15/18	06/15/19
7661	50MHz-18GHz Wideband Power Sensor	N1921A	MY45241383	Agilent	06/15/18	06/15/19
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	05/09/18	05/09/19
-	20dB Attenuator	BW-S20W5+5W	N/A	MCL	Verified by 7608 and 7611	
8710	10dB Attenuator	HAT-10+	-	Mini Circuit	Verified by 7608 and 7611	
AC Conducted Emissions Test Setup						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	09/19/18	09/19/19
7567	LISN	FCC-LISN-50-25-2	120304	Fischer Custom Comm.	12/14/17	12/14/19
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	03/06/18	03/06/19
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	03/06/18	03/06/19
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	05/09/18	05/09/19
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
Radiated Test Setup						
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	05/09/18	05/09/19
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
1002	Bilog Antenna	3142C	00058717	EMCO	11/20/17	11/20/18
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	06/16/18	06/16/20
1193	Pre-amplifier	PAM-0202	185	A.H. Systems, Inc.	04/11/18	04/11/19
8921	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 7608 and 7611	
8923	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 7608 and 7611	
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/15/18	10/15/19
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	07/13/18	07/13/19
8628	Pre-amplifier	QLI-01182835-JO	8986002	Quinstar	02/06/18	02/06/19
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1049	

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

Miscellaneous						
6708	Multimeter	34401A	US36086974	Hewlett Packard	07/18/18	07/18/19
7579	Temperature Chamber	115	151617	TestQuity	08/24/18	08/24/19
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	02/26/18	02/26/19
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Radiated Emission 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	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	3.52	1.44	2.07
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (uc):	1.68
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.36

3.2.2 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	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.00	1.22	1.50
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.49
				Coverage Factor (k):	2
				Expanded Uncertainty:	2.99

3.2.3 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	0.34	0.20	0.04
2	Cables	Rectangular	0.30	0.17	0.03
3	EUT Setup	Rectangular	0.50	0.29	0.08
				Combined Uncertainty (u_c):	0.39
				Coverage Factor (k):	1.96
				Expanded Uncertainty:	0.76

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

3.2.4 AC Conducted Emissions

	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

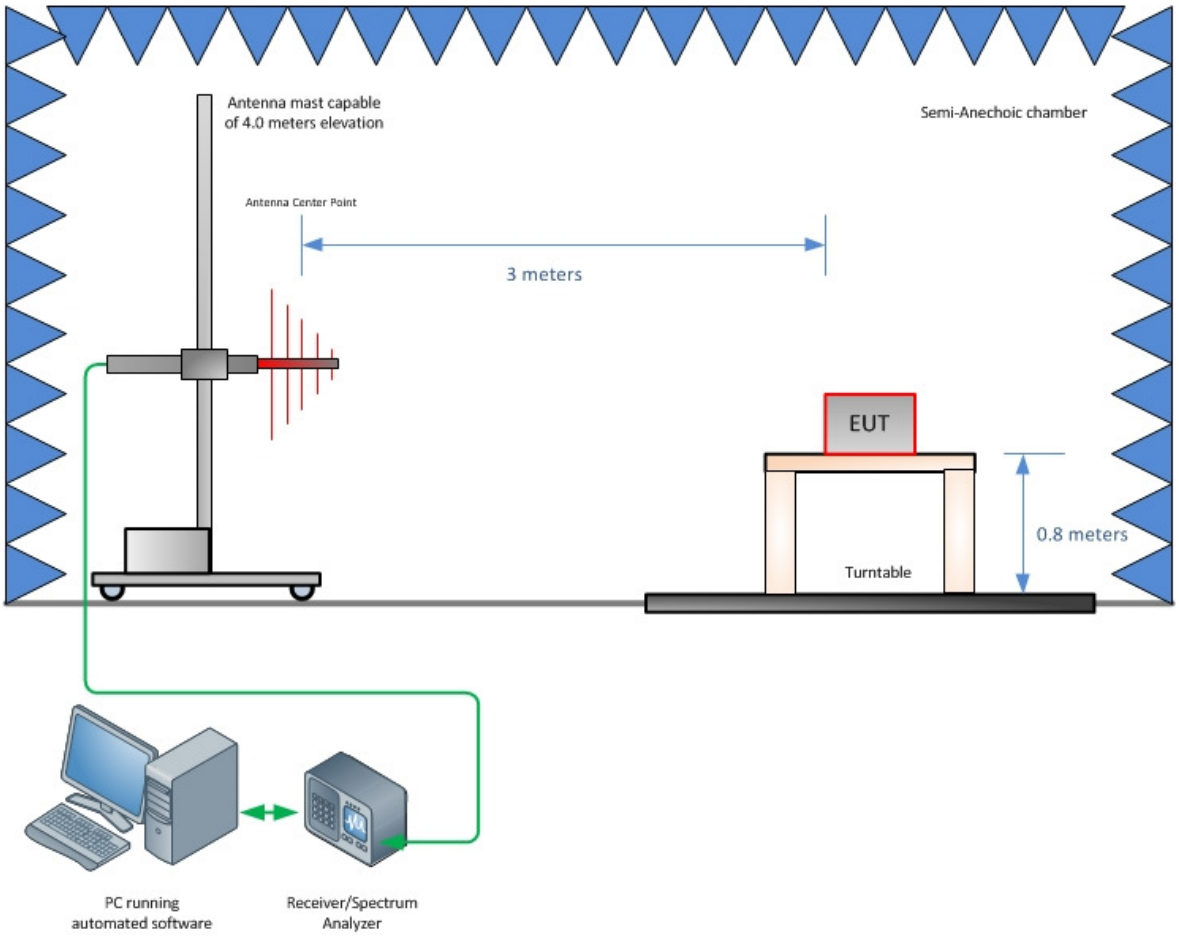
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 4

DIAGRAM OF TEST SETUP

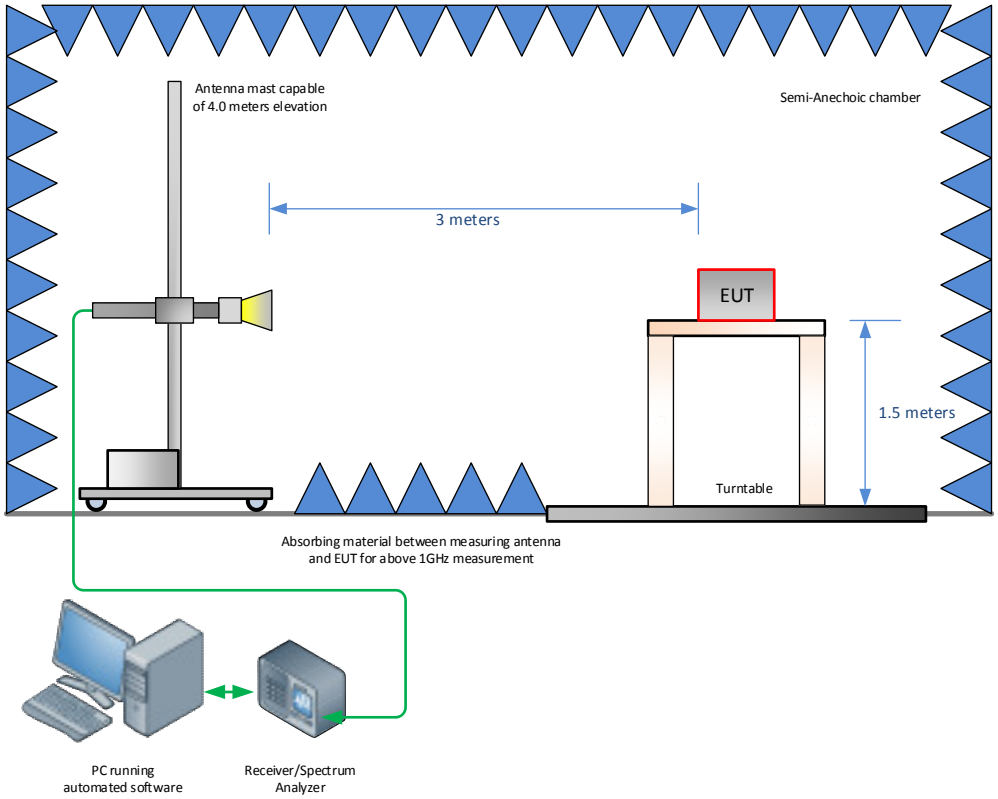
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

4.1 TEST SETUP DIAGRAM



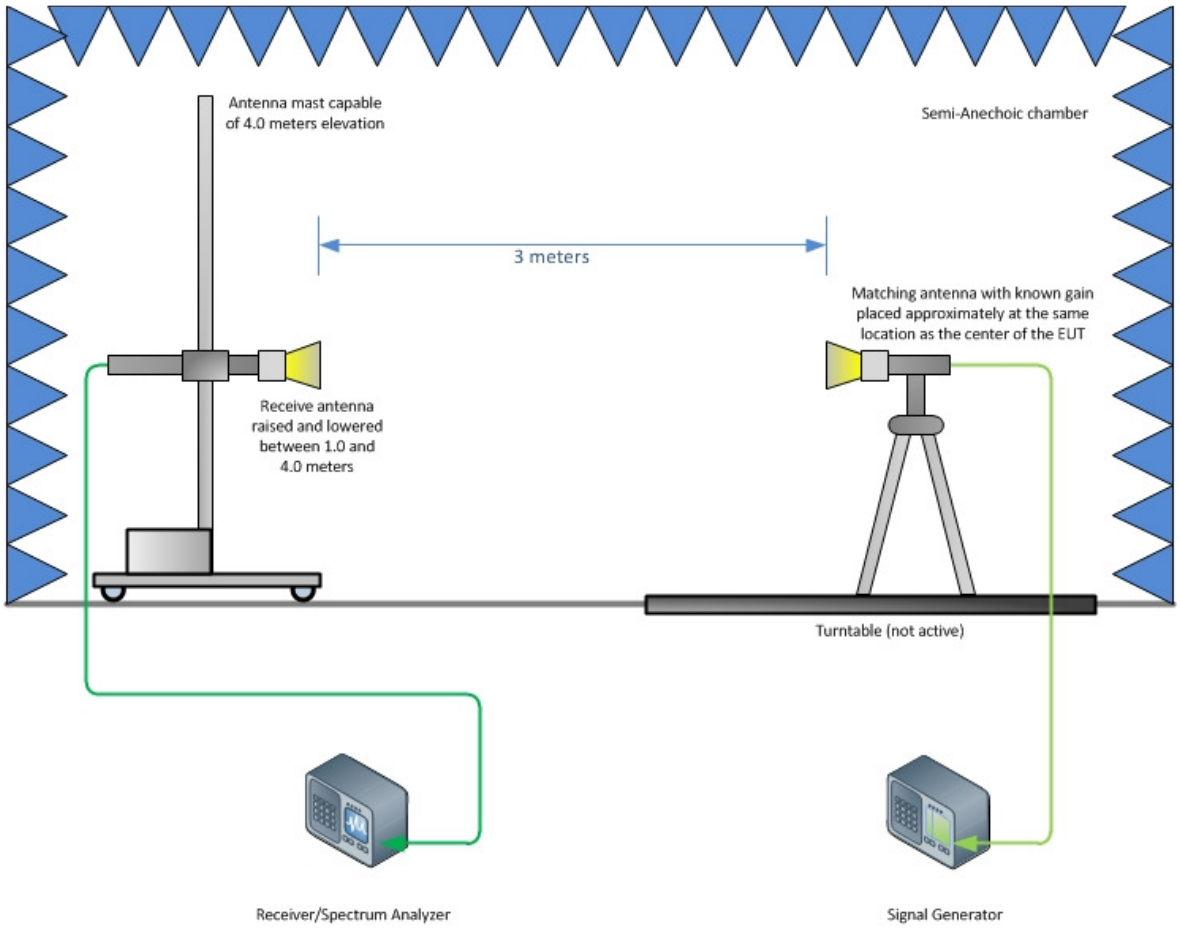
Radiated Emission Test Setup (Below 1GHz)

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364



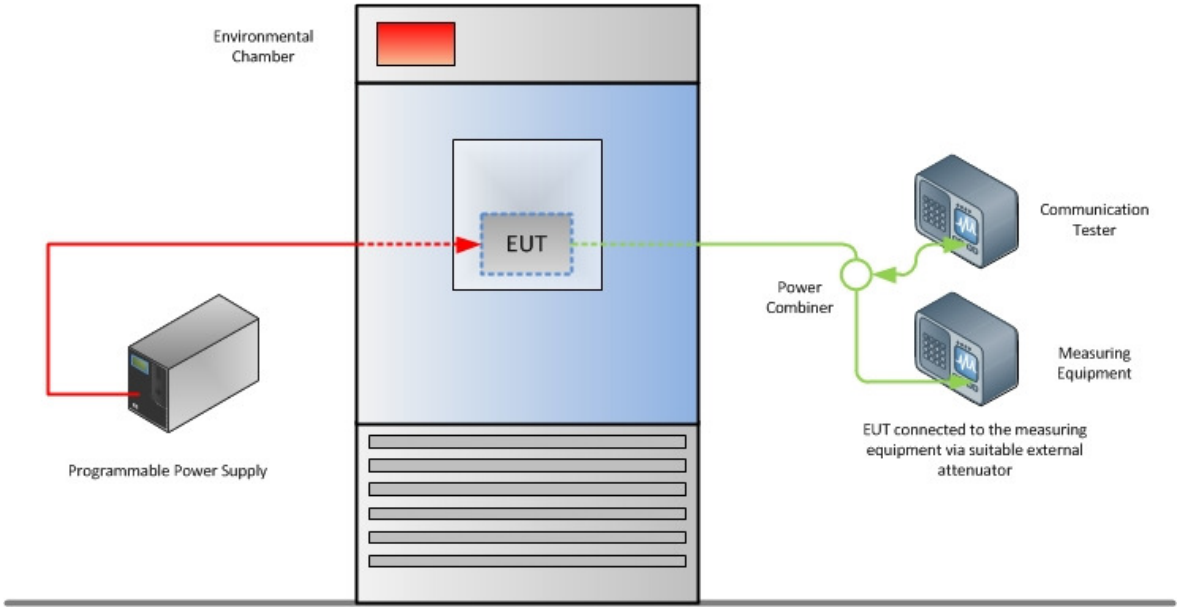
Radiated Emission Test Setup (Above 1GHz)

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364



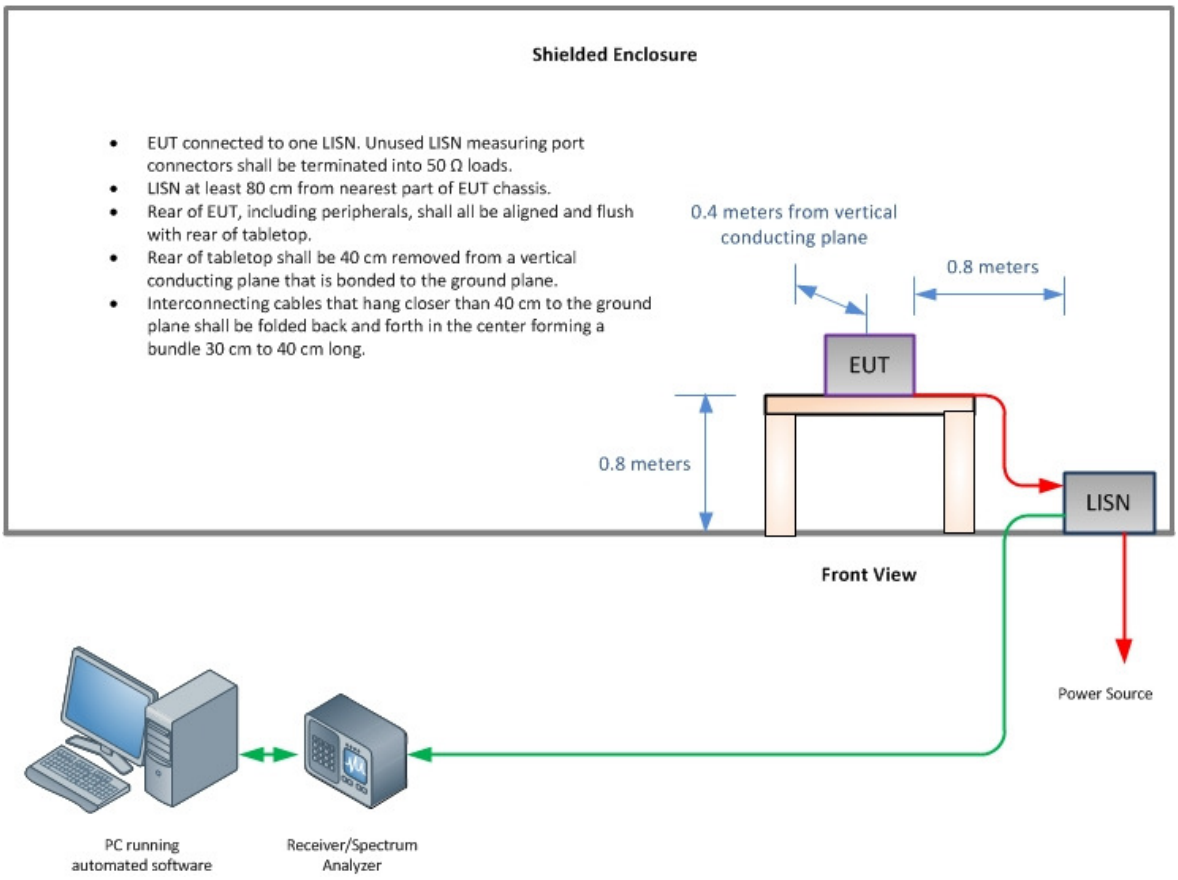
Substitution Test Method (Above 1GHz, if applicable)

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364



Frequency Stability Test Comfiguration

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364



Conducted Emissions Test Configuration (if applicable)

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.

TÜV SÜD America, Inc. and its professional staff hold government
and professional organization certifications for
AAMI, ACIL, AEA, ANSI, IEEE, A2LA, NIST and VCCI.

A2LA Cert. No. 2955.13

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364