Report On

Application for Grant of Equipment Authorization of the
u-blox AG
SARA-R404M LTE Cat-M1 Module

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

Report No. SD72122645-1216 **December 2016**

REPORT ON	Radio Testing of the u-blox AG LTE Cat-M1 Module
TEST REPORT NUMBER	SD72122645-1216
PREPARED FOR	u-blox AG Zuercherstrasse 68 8800 Thalwil, Switzerland
CONTACT PERSON	Jake Bascon Sr. Certification Engineer (858) 847-9611 x616 Jake.Bascon@u-blox.com
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
APPROVED BY	Juan Manuel Gonzalez Name Authorized Signatory Title: EMC SL Manager West Region
DATED	January 03, 2017

Revision History

SD72122645-1216 u-blox AG M/N SARA-R404M SARA-R404M LTE Cat-M1 Module					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
01/03/2017	Initial Release				Juan M Gonzalez

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SECTION 1

REPORT SUMMARY

Radio Testing of the
u-blox AG
SARA-R404M LTE Cat-M1 Module

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the u-blox AG LTE Cat-M1 Module to the requirements of FCC CFR 47 Part 2 and 27 and IC RSS-Gen and RSS-130.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	u-blox AG
Model Number(s)	SARA-R404M
FCC ID	XPY2AGQN1NNN
IC Number	N/A
Serial Number(s)	004402090412515
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC CFR 47 Part 2 and 27 (October 1, 2015). • RSS-130 – Mobile Broadband Services (MBS) Equipment Operating in the Frequency Bands 698-756 MHz and 777-787 MHz (Issue 1, October 2013). • RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 4, November 2014).
Start of Test	December 13, 2016
Finish of Test	December 16, 2016
Name of Engineer(s)	Ferdinand S. Custodio
Related Document(s)	• ANSI/TIA-603-C-2004 – Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards. • KDB971168 (D01 Power Meas License Digital Systems v02r02) Measurement Guidance For Certification Of Licensed Digital Transmitters • KDB412172 D01 Determining ERP and EIRP v0101 (Guidelines for Determining the Effective Radiated Power (ERP) and Equivalent Isotropically Radiated Power (EIRP) of a RF Transmitting System. • Supporting documents for EUT certification are separate exhibits.

1.2 BRIEF SUMMARY OF RESULTS

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

Section	Spec Clause			Test Description	Result
	FCC Part 2	FCC Part 27	RSS-130		
2.1	2.1046	27.50 (b)(9) and (10)	4.4	Transmitter Conducted Output Power	Compliant
2.2	-	-	4.4	Equivalent Isotropic Radiated Power	Compliant
		27.50 (b)(9) and (10)	-	Effective Radiated Power	Compliant
2.3	2.1049	27.53	RSS-Gen 6.6	Occupied Bandwidth	Reporting Purposes Only
2.4	-	27.50 (d)(5)	4.4	Peak-Average Ratio	Compliant
2.5	2.1051	27.53 (c)(2) and (5)	4.6.1	Band Edge	Compliant
2.6	2.1051	27.53 (c)(1),(2),(4),(5),(6) and (f)	4.6	Conducted Spurious Emissions	Compliant
2.7	Clause 7of KDB971168 D01 v02r02		-	Field Strength Of Spurious Radiation	Compliant
2.8	2.1055	27.54	4.3	Frequency Stability	Compliant
-	-	-	RSS-Gen 7.0	Receiver Spurious Emissions	N/A*
2.9	-	-	RSS-Gen 8.8	Power Line Conducted Emission	Compliant

N/A - *Not applicable. EUT does not fall to any category defined as Receiver under Section 5 of RSS-Gen Issue 4.*

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a u-blox San Diego, Inc. Model SARA-R404M™ LTE Cat-M1 Module. The EUT is based on Qualcomm Technologies' MDM9206 LTE modem designed to allow a larger number of devices to connect to the Internet of Things (IoT). LTE Cat M1 is part of the new 3GPP Release 13 standard supporting low power wide area technologies in the licensed spectrum and specifically supports IoT applications with low to medium data throughput rates, as well as devices that require long battery lifetimes.

1.3.2 EUT General Description

EUT Description	LTE Cat-M1 Module
Model Name	SARA-R404M
Model Number(s)	SARA-R404M
Rated Voltage	3.8VDC using a programmable power supply
Mode Verified	LTE Band 13 with 1.4 MHz BW
Frequency Range	777 MHz – 786.90 MHz (FCC)
	777.7 MHz -786.3 MHz (ISED)
Capability	LTE Band 13
Primary Unit (EUT)	☐ Production
	☒ Pre-Production
	☐ Engineering
Antenna Gain	13 dbi (this is the maximum antenna gain that can be used with the EUT and still complies with all relevant requirements of the Equipment Authorization for mobile use)

1.3.3 Transmit Frequency Table

Regulatory Agency	Channel	*Frequency (MHz)*	Emission Designator	Conducted Power	
				Max. Power (dBm)	Max. Power (W)
FCC	23180	777.0	1M09F9W	22.77	0.189
	23230	782.0	1M09F9W	22.89	0.194
	23279	***786.9***	***1M09F9W***	***22.99***	***0.195***
ISED	23187	777.7	1M09F9W	22.77	0.189
	23230	782.0	1M09F9W	22.89	0.194
	23273	786.3	1M09F9W	22.99	0.195

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	The EUT was installed on a development board powered by a programmable power supply. Nominal voltage is 3.8VDC. RF configuration is through a support laptop running Qualcomm Radio Control Toolkit connected via USB.

1.4.2 EUT Exercise Software

Manufacturer provided a configuration software (Qualcomm Radio Control Toolkit Version 3.0.242.0) running from a support laptop where the EUT is connected via USB. Major configuration parameters provided by the manufacturer are shown in Section 1.4.5 of this test report.

1.4.3 Support Equipment and I/O cables

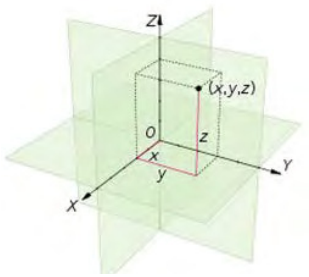
Manufacturer	Equipment/Cable	Description
Lenovo	Support Laptop (T410S)	P/N 0A31972 S/N R9-92MH0 10/11
LiteOn Technology Corporation	AC Adapter for Support Laptop	Model 42T4430 S/N 11S42T4430Z1ZGWE27AA9X REV G
Hewlett Packard	DC Power Supply	M/N E3610A S/N KR51311519
-	USB Cable (EUT to Support Laptop)	USB 2.0, 1.8 meters, USB A to Mini B connector
Pasternack	Support 20dB attenuator	M/N PE7017-20 25 watts DC-18GHz
Narda	Support 50Ω Termination	M/N 370BNM 50-Ohm Coaxial Termination DC-18GHz

1.4.4 Worst Case Configuration

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

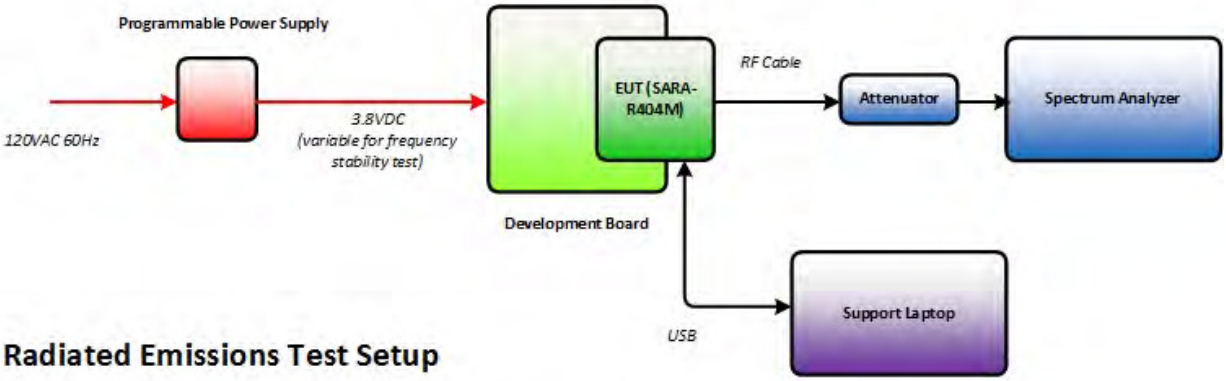
Modulation	Channel	Frequency	PUSCH RBs	PA Range	TX Gain
QPSK	23279	786.9	6	2	66

EUT is a RF module. For radiated measurements, the EUT was verified installed on a development board using the worst case axis (“X”) verified via prescan.

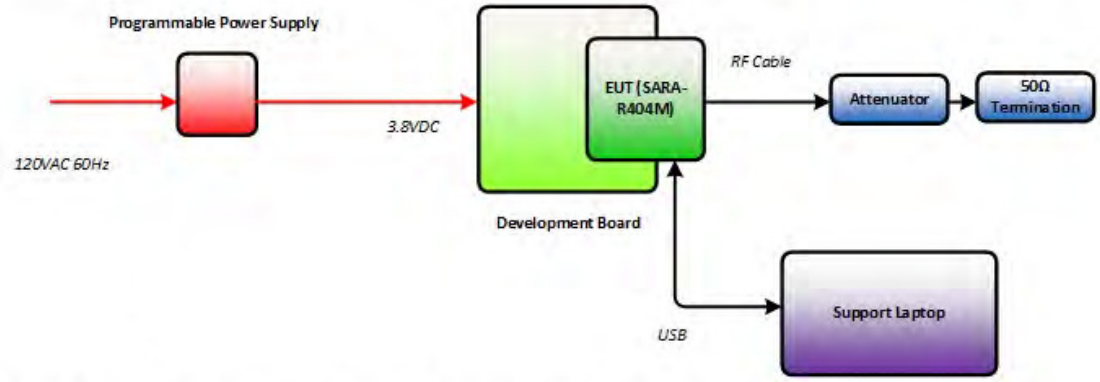


1.4.5 Simplified Test Configuration Diagram

Antenna Conducted Port Test Setup



Radiated Emissions Test Setup



General RF Test Configuration (Manufacturer provided)

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 004402090412515		
N/A	-	-

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

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.26 2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services and ANSI/TIA-603-C-2004 – Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards.

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 – Registration No.: US1146

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

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

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

1.9.3 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-0230

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.

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

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

1.10.3 Spurious Radiated Emission – Substitution Method

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

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

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

SECTION 2

TEST DETAILS

Radio Testing of the
u-blox AG
SARA-R404M LTE Cat-M1 Module

2.1 TRANSMITTER CONDUCTED OUTPUT POWER

2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046 (a) and (c)
FCC 47 CFR Part 27, Clause 27.50 (b)(9) and (10)
RSS-130, Clause 4.4

2.1.2 Standard Applicable

FCC 47 CFR Part 2, Clause 2.1046:
(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.
(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

FCC 47 CFR Part 27, Clause 27.50 (b)(9):
Control stations and mobile stations transmitting in the 746–757 MHz, 776–788 MHz, and 805–806 MHz bands and fixed stations transmitting in the 787–788 MHz and 805–806 MHz bands are limited to 30 watts ERP.

FCC 47 CFR Part 27, Clause 27.50 (b)(10):
Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

2.1.3 Equipment Under Test and Modification State

Serial No: 004402090412515 / Default Test Configuration

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

December 13, 2016/FSC

2.1.5 Test Equipment Used

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

2.1.6 Environmental Conditions

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

Ambient Temperature	22.3 °C
Relative Humidity	25.8 %
ATM Pressure	99.9 kPa

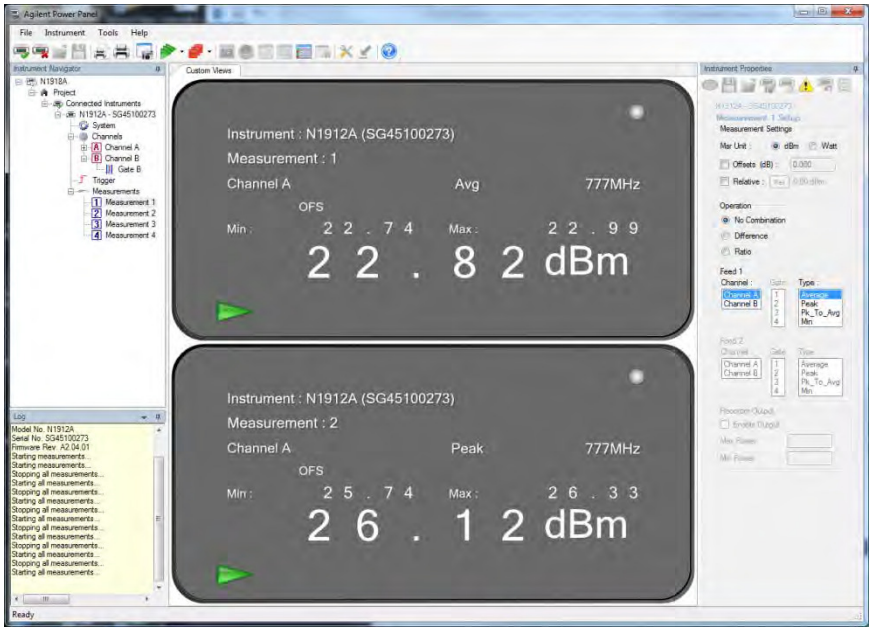
2.1.7 Additional Observations

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

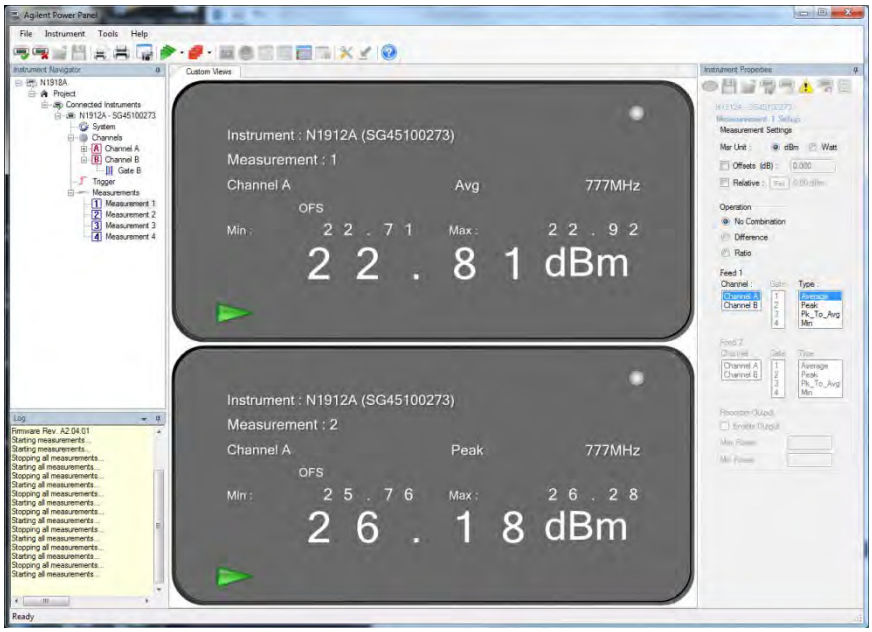
2.1.8 Test Results

LTE Band 13 Uplink (776 MHz - 788 MHz)					
Bandwidth	**Modulation**	**Channel**	***Frequency (MHz)***	***Average Power (dBm)***	***Peak Power (dBm)***
1.4 MHz	QPSK	23180	777.0	22.73	26.16
		23230	782.0	22.89	26.35
		23279	786.9	22.99	26.33
	16-QAM	23180	777.0	22.77	26.14
		23230	782.0	22.78	26.22
		23279	786.9	22.92	26.28
Results compared to worst case Portable Stations limit of 3 watts (34.77 dBm ERP) assuming the antenna gain is ≤13dBi.					

2.1.9 Sample Test Plot



LTE Band 13 QPSK 1.4 MHz Bandwidth High Channel



LTE Band 13 16-QAM 1.4 MHz Bandwidth High Channel

2.2 RADIATED POWER

2.2.1 Specification Reference

FCC 47 CFR Part 27, Clause 27.50 (b)(9) and (10)
RSS-130, Clause 4.4

2.2.2 Standard Applicable

FCC 47 CFR Part 27, Clause 27.50 (b)(9):
Control stations and mobile stations transmitting in the 746–757 MHz, 776–788 MHz, and 805–806 MHz bands and fixed stations transmitting in the 787–788 MHz and 805–806 MHz bands are limited to 30 watts ERP.

FCC 47 CFR Part 27, Clause 27.50 (b)(10):
Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

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

2.2.3 Equipment Under Test and Modification State

Serial No: 004402090412515 / Calculation Only

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

December 13, 2016/FSC

2.2.5 Additional Observations

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

$$\mathbf{ERP/EIRP = P_T + G_T - L_C}$$

Where:

$\mathbf{P_T}$ = transmitter conducted output power dBm (Section 2.1 of this test report).
$\mathbf{G_T}$ = gain of the transmitting antenna, in dBi for EIRP or dBd for ERP.
$\mathbf{L_C}$ = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

- Maximum antenna gain relationship between ERP and EIRP could be determined by the following equation:

$$\mathbf{ERP = EIRP - 2.15}$$

2.2.6 Sample Computation

ERP = $P_T + G_T - L_C$ - 2.15dB
= 22.29 dBm (Average) + 13dBi (EIRP) – 0 (transmitter conducted power presented has an offset already) -2.15 (ERP/EIRP relationship factor)
= 33.84 dBm (high channel/QPSK)

2.2.7 Test Results

LTE Band 13 Uplink (776 MHz - 788 MHz) 1.4MHz BW							
Modulation	**Channel**	***Frequency (MHz)***	***Average Power (dBm)***	***Antenna Gain (dBi)***	**EIRP (dBm)**	**ERP (dBm)**	**Limit (dBm)**
QPSK	23180	777.0	22.73	13	35.73	-	37.00
	23230	782.0	22.89	13	35.89	-	37.00
	23279	786.9	22.99	13	35.99	-	37.00
16-QAM	23180	777.0	22.77	13	35.77	-	37.00
	23230	782.0	22.78	13	35.78	-	37.00
	23279	786.9	22.92	13	35.92	-	37.00
QPSK	23180	777.0	22.73	13	-	33.58	34.77
	23230	782.0	22.89	13	-	33.74	34.77
	23279	786.9	22.99	13	-	33.84	34.77
16-QAM	23180	777.0	22.77	13	-	33.62	34.77
	23230	782.0	22.78	13	-	33.63	34.77
	23279	786.9	22.92	13	-	33.77	34.77

2.3 OCCUPIED BANDWIDTH

2.3.1 Specification Reference

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

2.3.2 Standard Applicable

FCC 47 CFR Part 27, Clause 27.53
The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-GEN Issue 4, Clause 6.6
The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

2.3.3 Equipment Under Test and Modification State

Serial No: 004402090412515/ Default Test Configuration

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

December 14 and 15, 2016/FSC

2.3.5 Test Equipment Used

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

2.3.6 Environmental Conditions

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

Ambient Temperature	22.7 – 23.7 °C
Relative Humidity	27.3 - 28.4 %
ATM Pressure	99.8 – 99.9 kPa

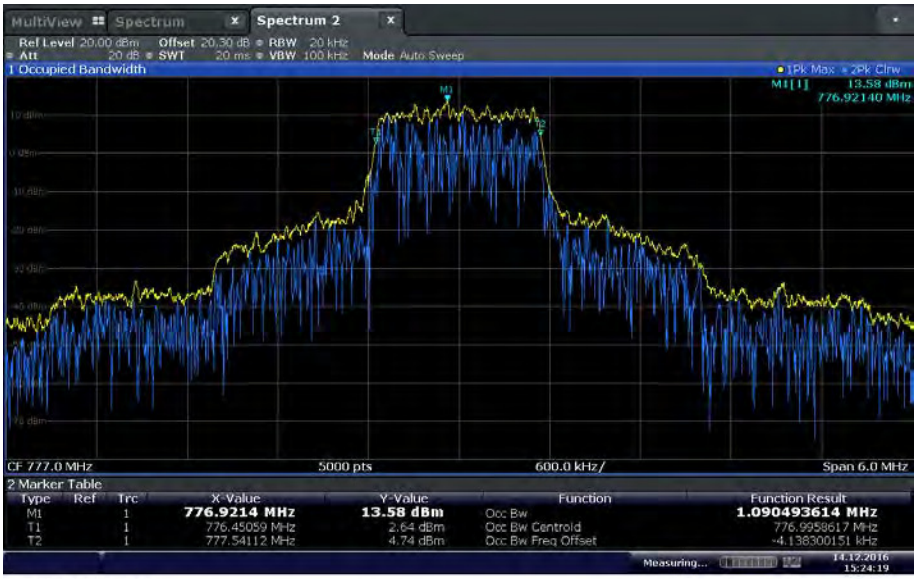
2.3.7 Additional Observations

- This is a conducted test. Both 26dB bandwidth and 99% bandwidth presented.
- All test channels for both modulations verified.
- The span is between two and five times the anticipated OBW.
- The RBW is set to 1% of the OBW while the VBW is ≥3X RBW (20kHz used, SA limitation for 14kHz).

- The detector is peak and the trace mode is max hold.
- The SA built-in emission bandwidth measurement feature is utilized. The power level setting is set to 99%
- For 26 dB BW, the "n dB down' feature of the SA was used as a marker function.

2.3.8 Test Results (Reporting Purposes Only)

Band	Modulation	Channel	Frequency (MHz)	OBW (MHz)	-26dB BW (MHz)
LTE Band 13	QPSK	23180	777.0	1.09	1.27
		23230	782.0	1.09	1.27
		23279	786.9	1.09	1.28
	16-QAM	23180	777.0	1.09	1.27
		23230	782.0	1.09	1.32
		23279	786.9	1.09	1.26

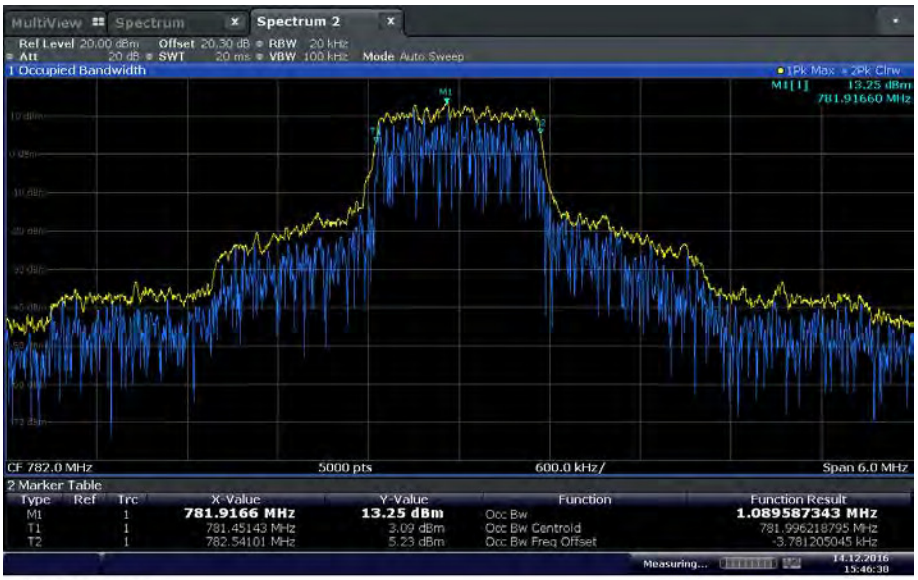
Low Channel 99% OBW QPSK


15:24:20 14.12.2016

Low Channel 26 dB BW QPSK


15:23:26 14.12.2016

Mid Channel 99% OBW QPSK



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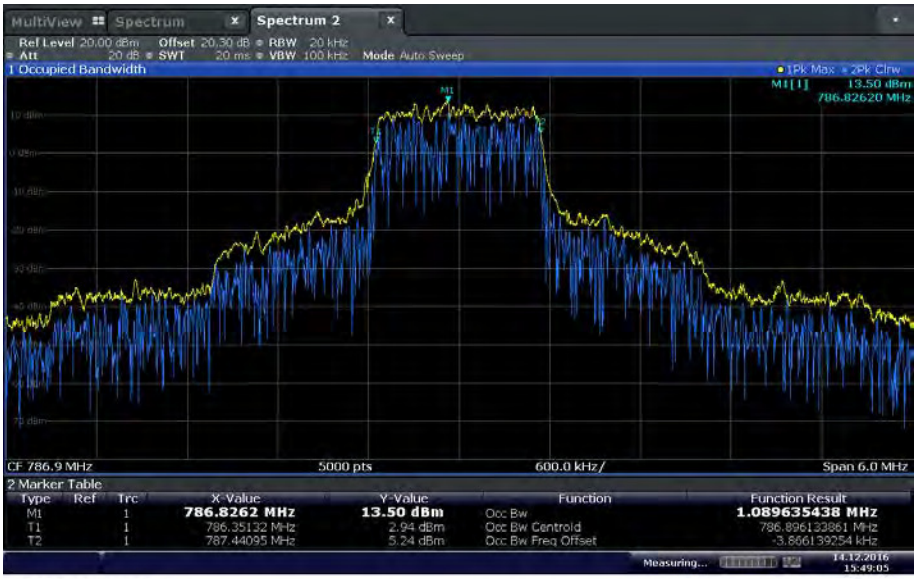
Mid Channel 26 dB BW QPSK

15:46:08 14.12.2016

High Channel 99% OBW QPSK


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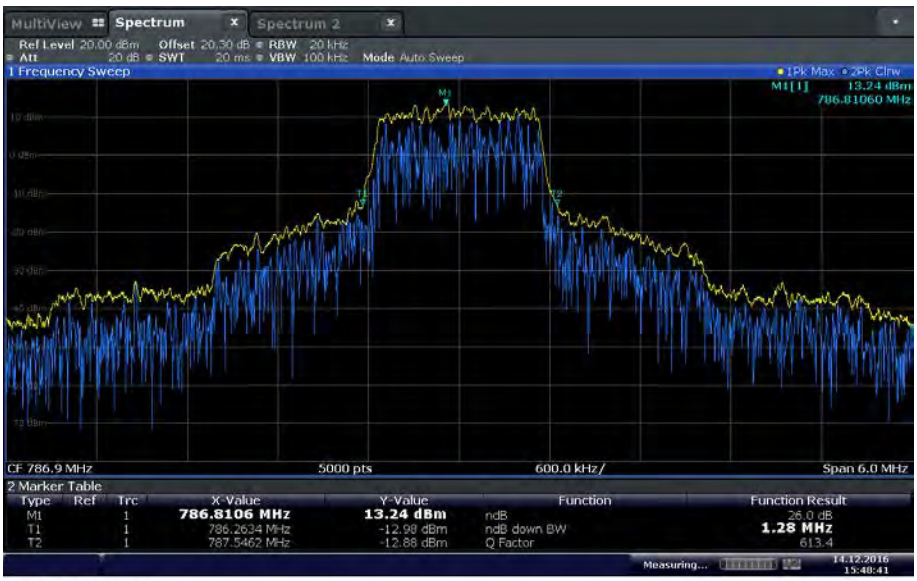
High Channel 26 dB BW QPSK


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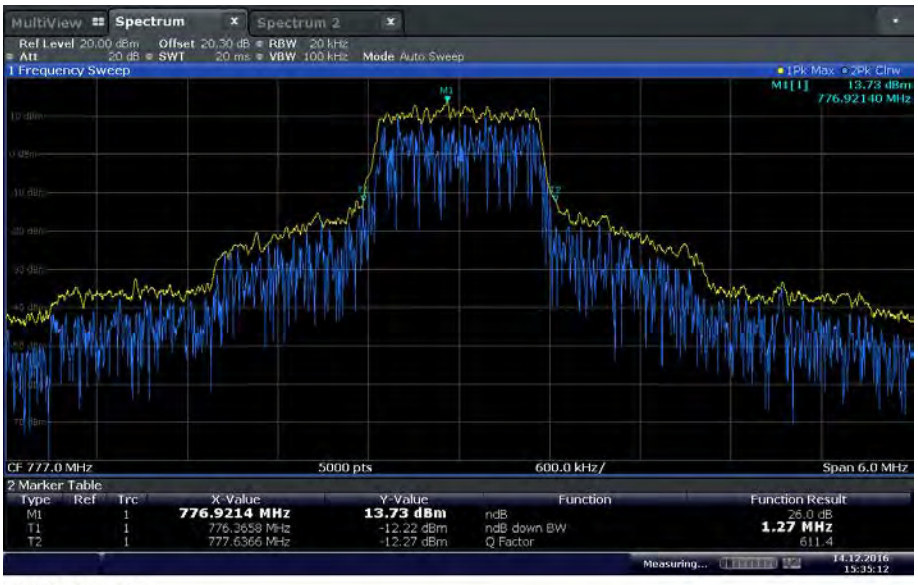
Low Channel 99% OBW 16-QAM

15:35:42 14.12.2016

Low Channel 26 dB BW 16-QAM



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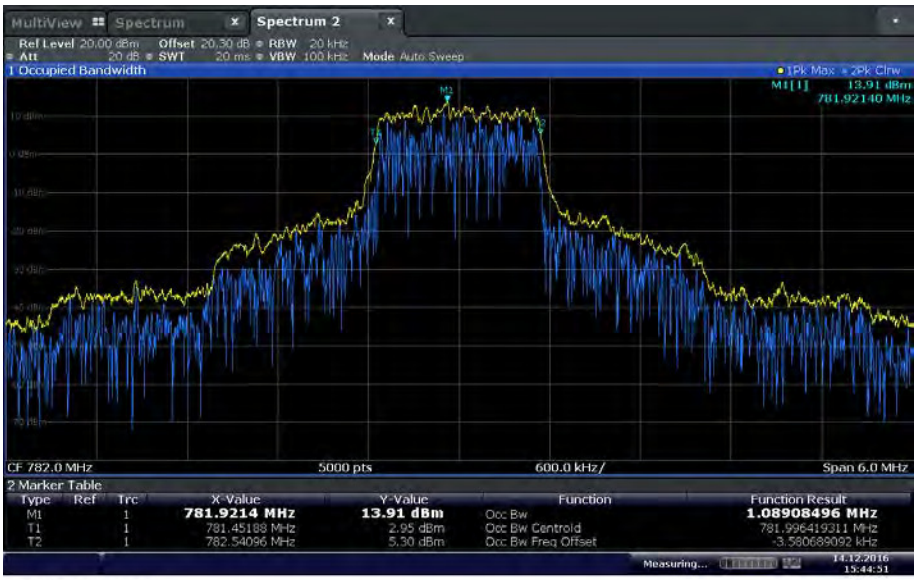
Mid Channel 99% OBW 16-QAM



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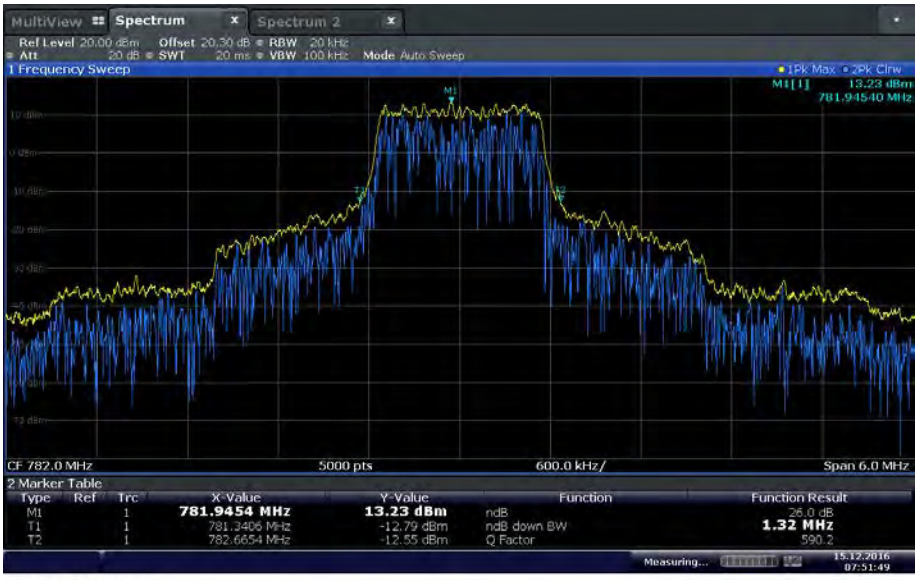
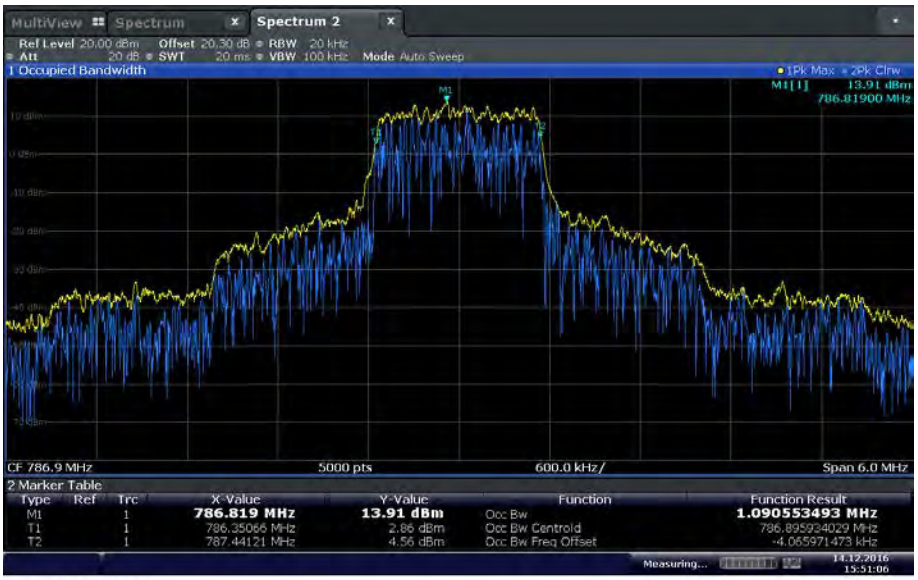
Mid Channel 26 dB BW 16-QAM



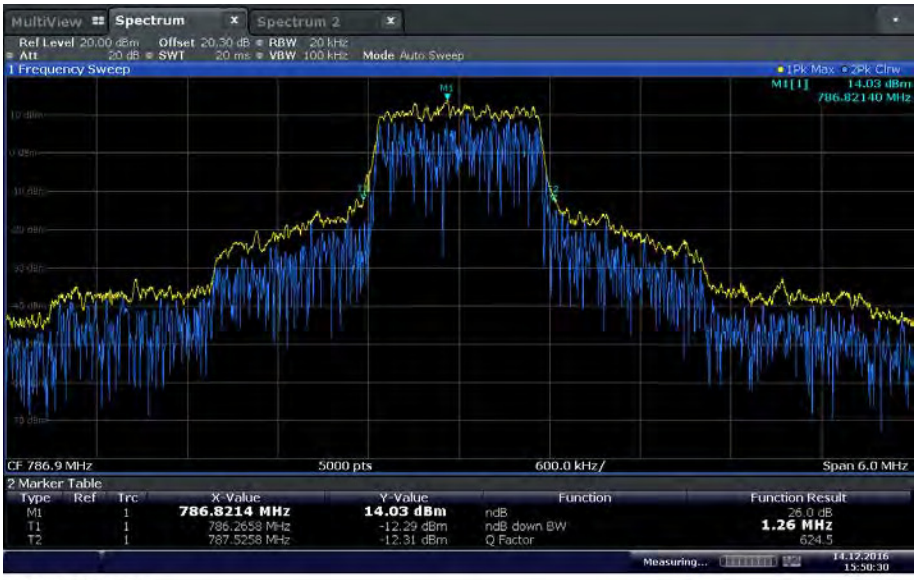
07:51:50 15.12.2016

High Channel 99% OBW 16-QAM



15:51:06 14.12.2016

High Channel 26 dB BW 16-QAM



15:50:30 14.12.2016

2.4 PEAK-AVERAGE RATIO

2.4.1 Specification Reference

FCC 47 CFR Part 27, Clause 27.50 (d)(5)
RSS-130, Clause 4.4

2.4.2 Standard Applicable

RSS-130, Clause 4.4
In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for morethan 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

FCC 47 CFR Part 27, Clause 27.50 (d)(5)
Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

2.4.3 Equipment Under Test and Modification State

Serial No: 004402090412515/ Default Test Configuration

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

December 15, 2016/FSC

2.4.5 Test Equipment Used

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

2.4.6 Environmental Conditions

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

Ambient Temperature	22.7 °C
Relative Humidity	28.4 %
ATM Pressure	99.8 kPa

2.4.7 Additional Observations

- This is a conducted test. Guidance is per Section 5.7 of KDB971168 (D01 Power Meas License Digital Systems v02r02).
- Procedure is per Section 5.7.1 of KDB971168.
- RBW was set to maximum the SA can support (minimum requirement is ≥ signal's occupied bandwidth of 1.4 MHz)
- Measurement interval was set to 1ms (10000 samples).

- Measurement was done using the Spectrum Analyzer's Complementary Cumulative Distribution Function (CCDF) measurement profile. The built-in function is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth (crest factor or peak-to-average ratio) The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signals spends at or above the level defines the probability for that particular power level.
- The maximum PAPR level associated with a probability of 0.1% was recorded.
- There are no measured PAR levels greater than 13dB. EUT complies.

2.4.8 Test Results

Band	Modulation	Channel	Frequency (MHz)	PAR (dB)
LTE Band 13 (1.4 MHz BW)	QPSK	23180	777.0	3.30
		23230	782.0	3.36
		23279	786.9	3.32
	16-QAM	23180	777.0	3.32
		23230	782.0	3.26
		23279	786.9	3.30

2.4.9 Sample Test Plots

LTE Band 13 1.4MHz Bandwidth QPSK Low Channel -PAR


LTE Band 13 1.4MHz Bandwidth 16-QAM High Channel -PAR


2.5 BAND EDGE

2.5.1 Specification Reference

FCC 47 CFR Part 27, Clause 27.53(c)(2) and (5)
RSS-130, Clause 4.6.1

2.5.2 Standard Applicable

FCC 47 CFR Part 27, Clause 27.53(c)(2) and (5)
(c)(2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
(c)(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use 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 at least 30 kHz may be employed.

RSS-130, Clause 4.6.1
The power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside thefrequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside the equipment's operating frequency range, a resolution bandwidth of 30 kHz may be employed.

2.5.3 Equipment Under Test and Modification State

Serial No: 004402090412515/ Default Test Configuration

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

December 15, 2016/FSC

2.5.5 Test Equipment Used

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

2.5.6 Environmental Conditions

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

Ambient Temperature	22.7 °C
Relative Humidity	28.4 %
ATM Pressure	99.8 kPa

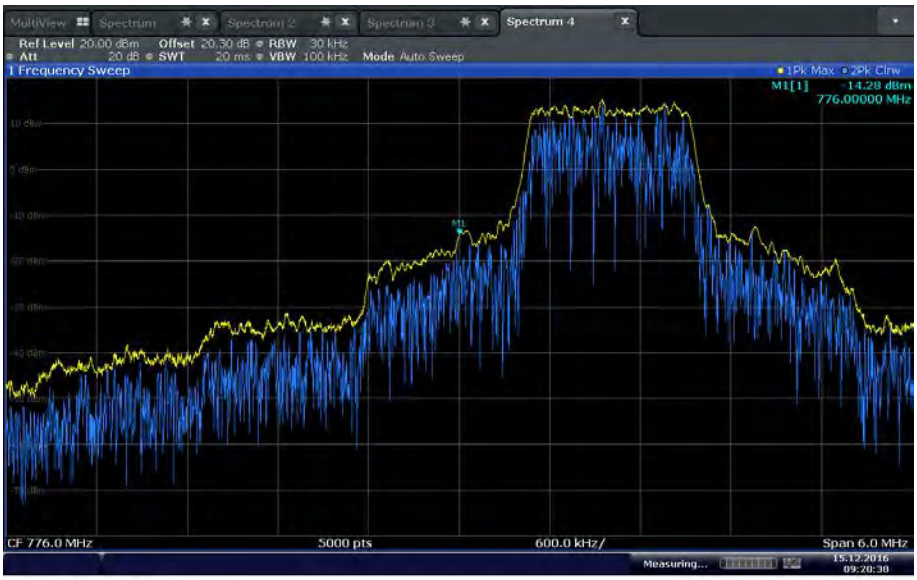
2.5.7 Additional Observations

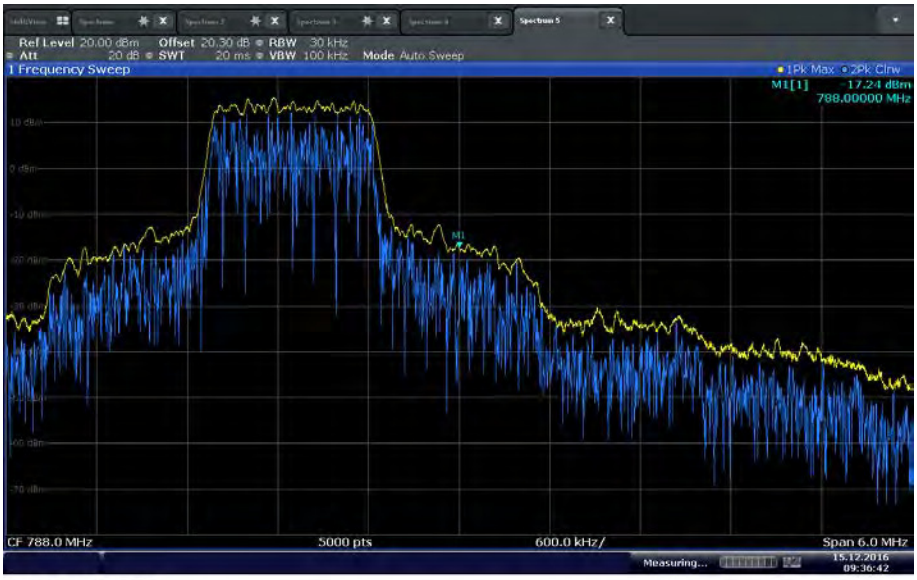
- This is a conducted test. Test guidance is per Section 6.0 of KDB971168 (D01 Power Meas License Digital Systems v02r02).
- Corresponding offset was used for the external attenuator and cable used (20.3 dB).

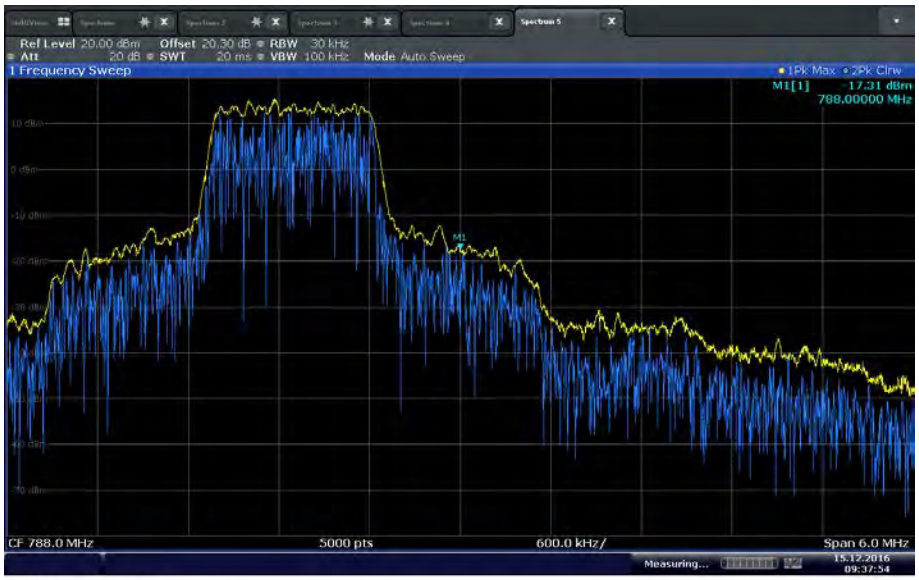
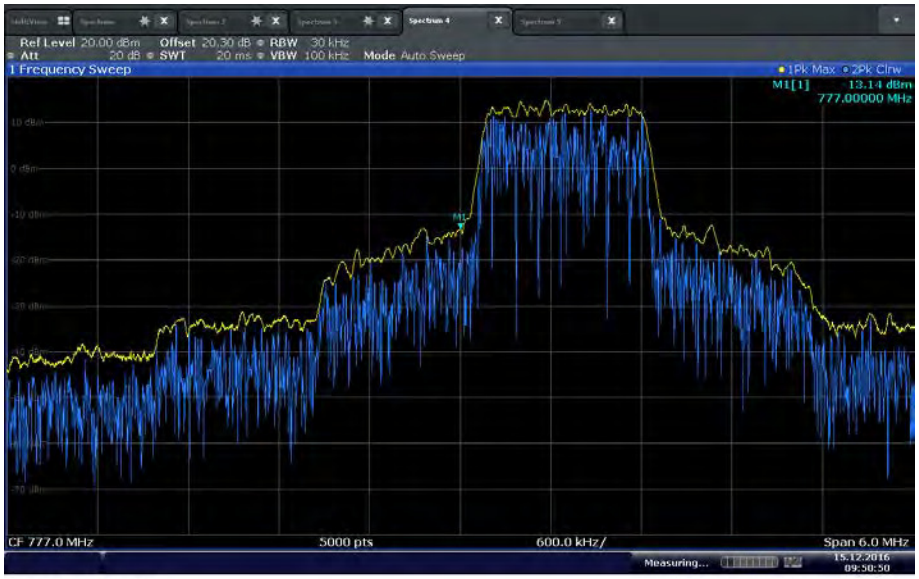
- The center frequency of the spectrum is the band edge frequency (777 MHz -787 MHz for ISED and 776 MHz – 788 MHz for FCC).
- Worst case Peak Detector with Max Hold was used for this test.
- Worst case number of RB/RBs and Start RB Index presented.
- RBW was set to 30 kHz and VBW to 3X RBW (approx. due to SA limitation).

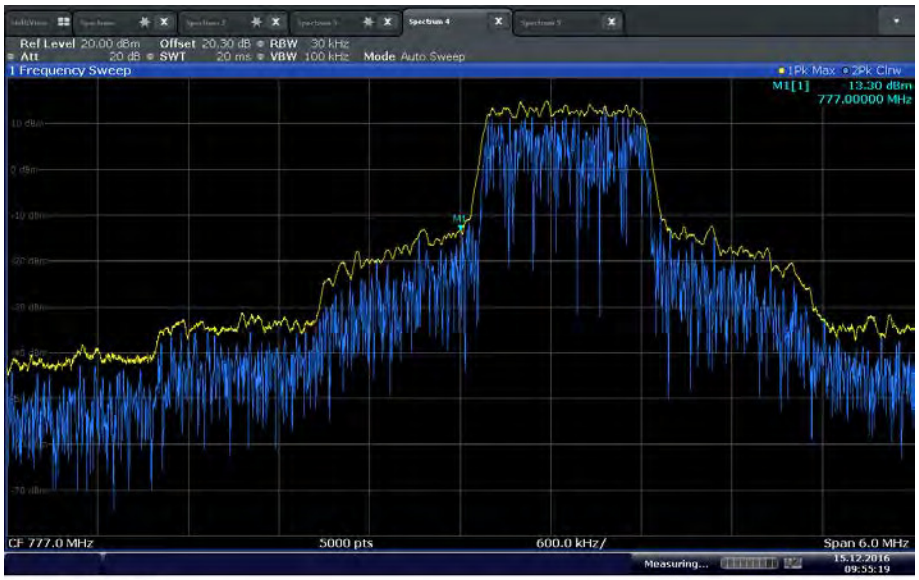
2.5.8 Test Results

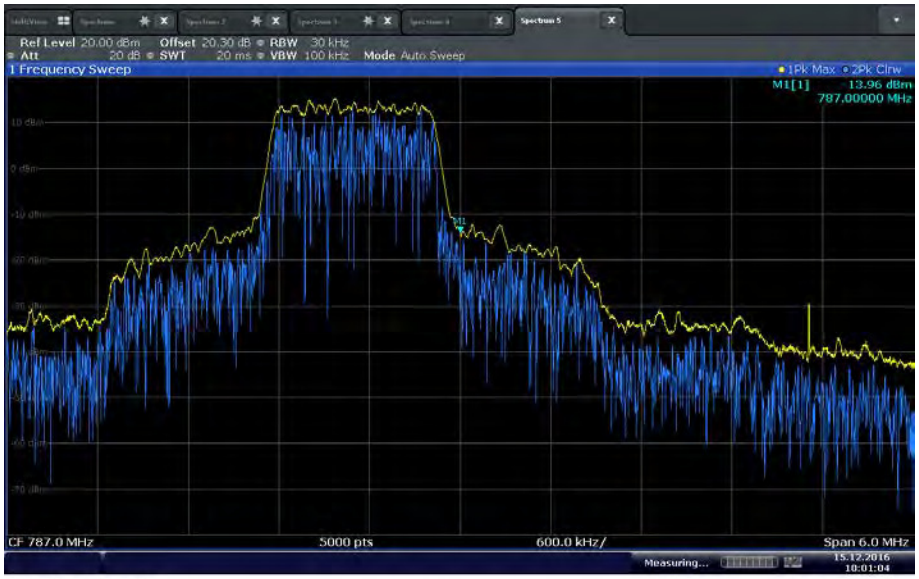
Low Channel QPSK

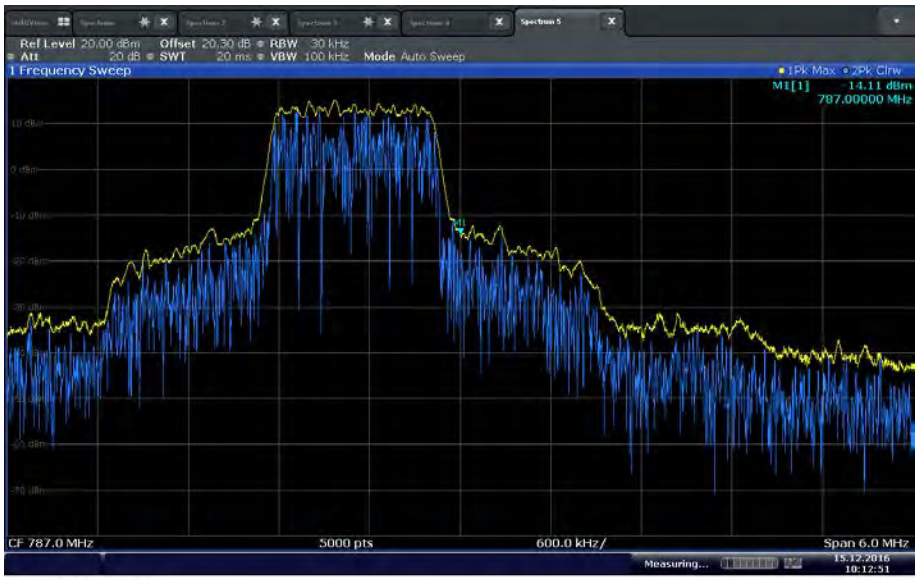

Low Channel 16-QAM
 09:20:39 15.12.2016

High Channel QPSK
 09:36:43 15.12.2016

High Channel 16-QAM
 09:37:54 15.12.2016
Low Channel QPSK (ISED Low Channel 777.7 MHz UL23187)
 09:50:52 15.12.2016

Low Channel 16-QAM (ISED Low Channel 777.7 MHz UL23187)
 09:55:20 15.12.2016

High Channel QPSK (ISED High Channel 786.3 MHz UL23273)
 10:01:05 15.12.2016

High Channel 16-QAM (ISED High Channel 786.3 MHz UL23273)


2.6 CONDUCTED SPURIOUS EMISSIONS

2.6.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1051
FCC 47 CFR Part 27, Clause 27.53(c)(1),(2),(4),(5),(6) and (f)
RSS-130, Clause 4.6

2.6.2 Standard Applicable

FCC 47 CFR Part 27, Clause 27.53 (c)
For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
(2) (2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
(3) (4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;
(4) (5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use 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 at least 30 kHz may be employed;
(5) (6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) 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 spectral energy in a 6.25 kHz segment.

FCC 47 CFR Part 27, Clause 27.53 (f)
For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions 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.

2.6.3 Equipment Under Test and Modification State

Serial No: 004402090412515/ Default Test Configuration

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

December 15, 2016/FSC

2.6.5 Test Equipment Used

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

2.6.6 Environmental Conditions

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

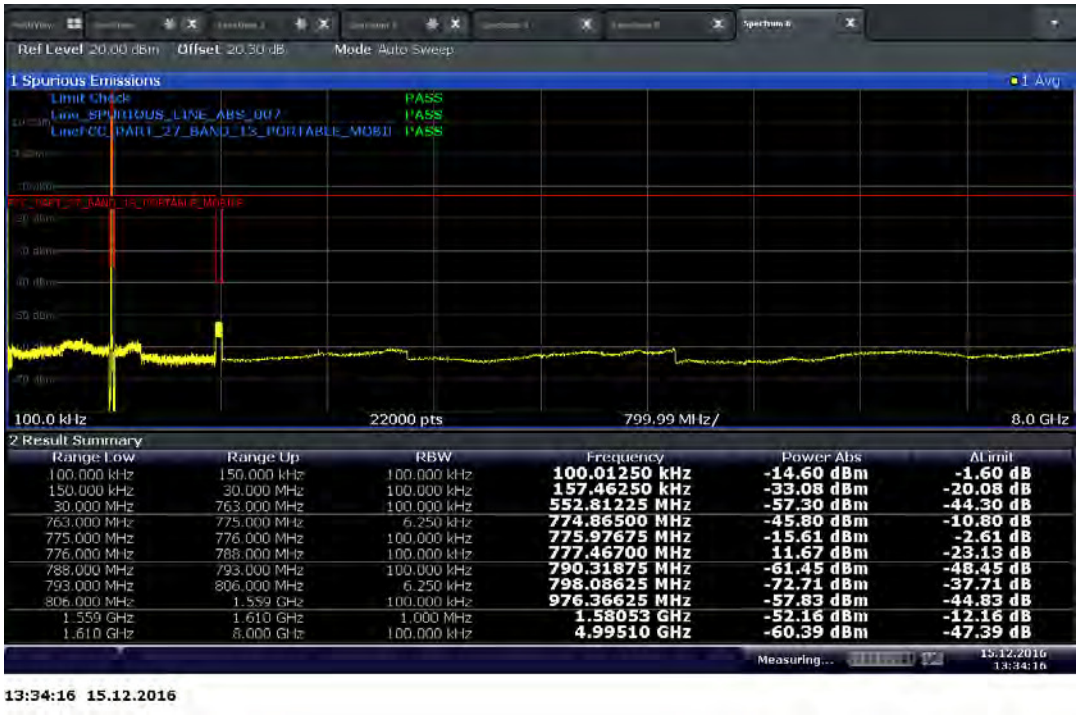
Ambient Temperature	22.7 °C
Relative Humidity	28.4 %
ATM Pressure	99.8 kPa

2.6.7 Additional Observations

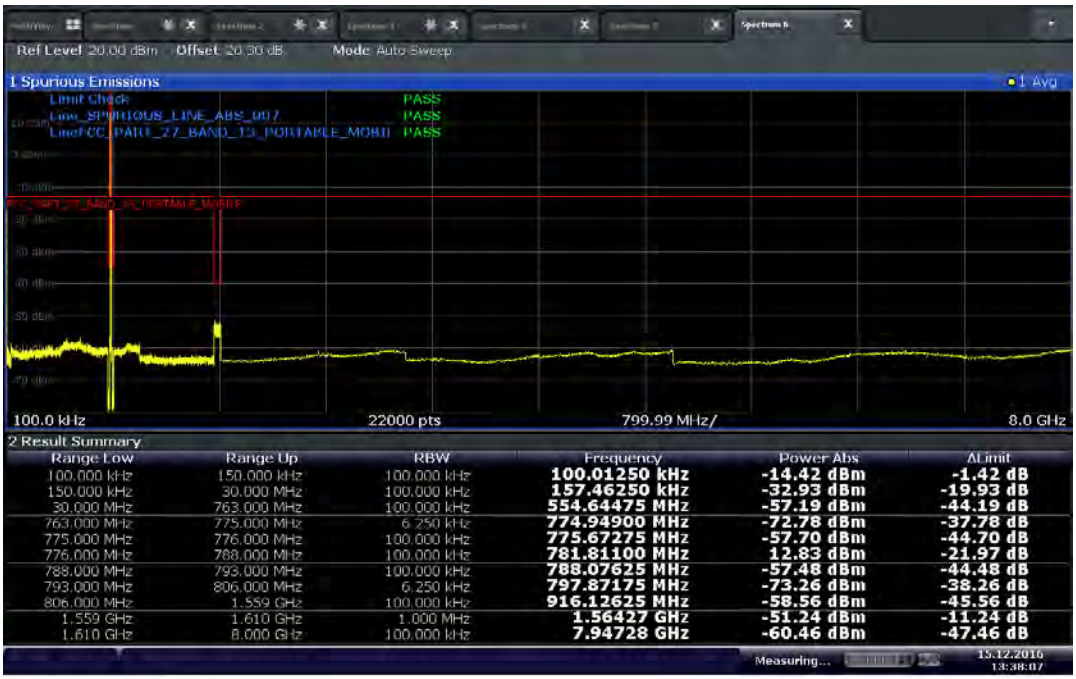
- This is a conducted test.
- Corresponding offset was used for the external attenuator and cable used (20.3 dB).
- The spectrum was searched from 9 kHz to 8GHz.
- The Spurious Emissions Measurement function of the SA was used for this test.
- Measurement guidance is per Clause 6 of KDB971168 D01 v02r02.

2.6.8 Test Results

QPSK Low Channel



QPSK Mid Channel

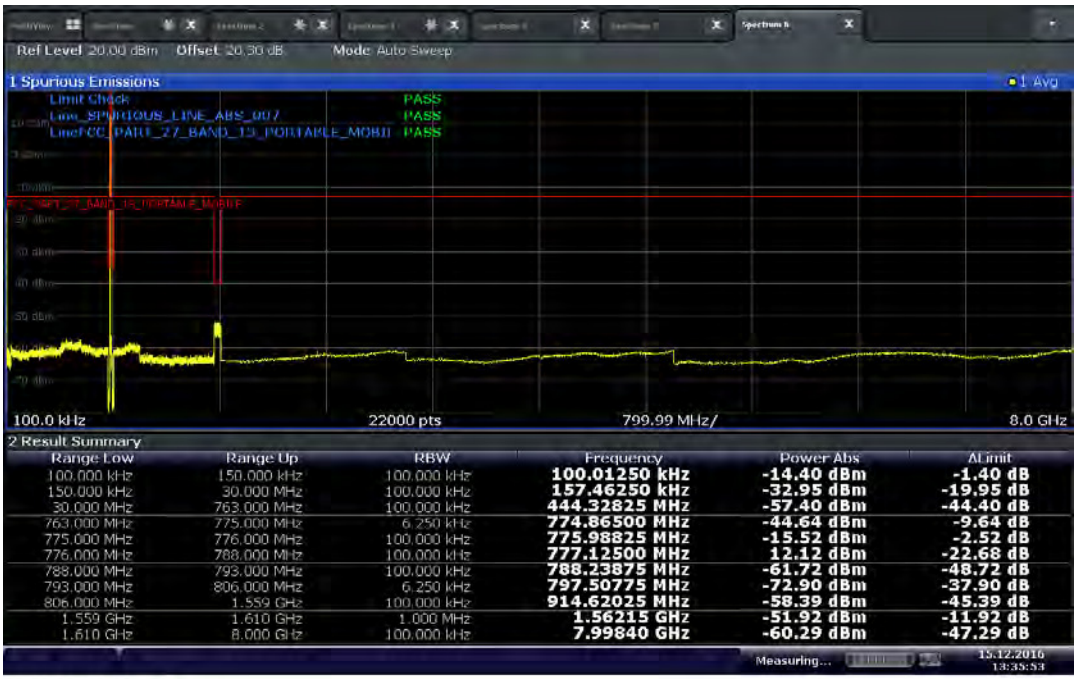


13:38:07 15.12.2016

QPSK High Channel

13:56:23 15.12.2016

16-QAM Low Channel

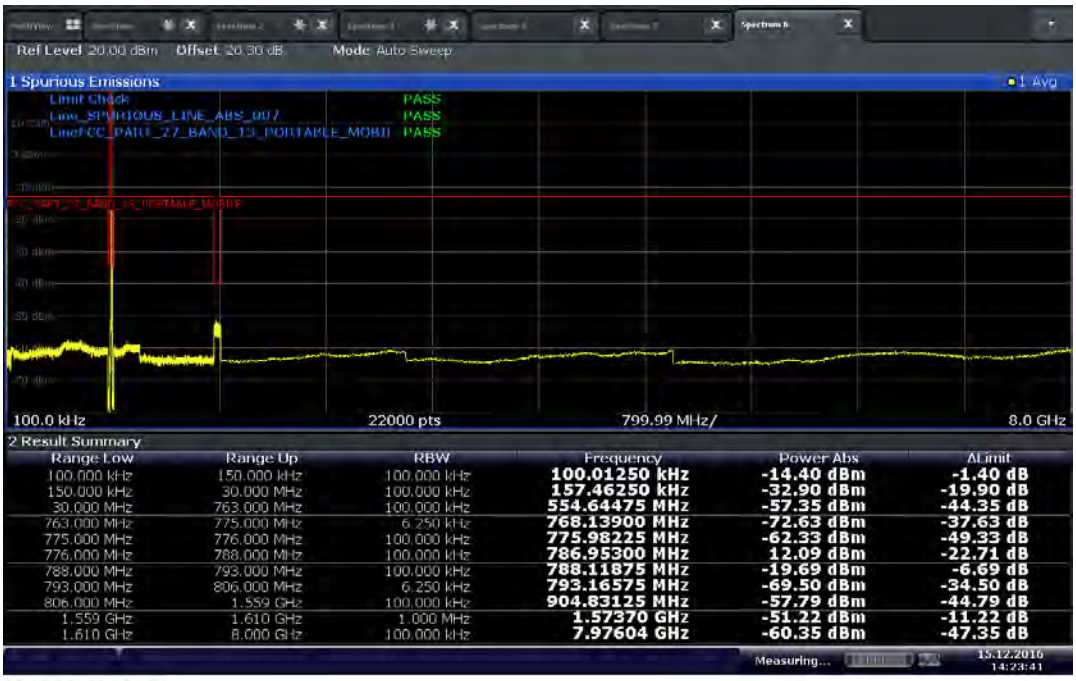


13:35:54 15.12.2016

16-QAM Mid Channel

13:49:29 15.12.2016

16-QAM High Channel

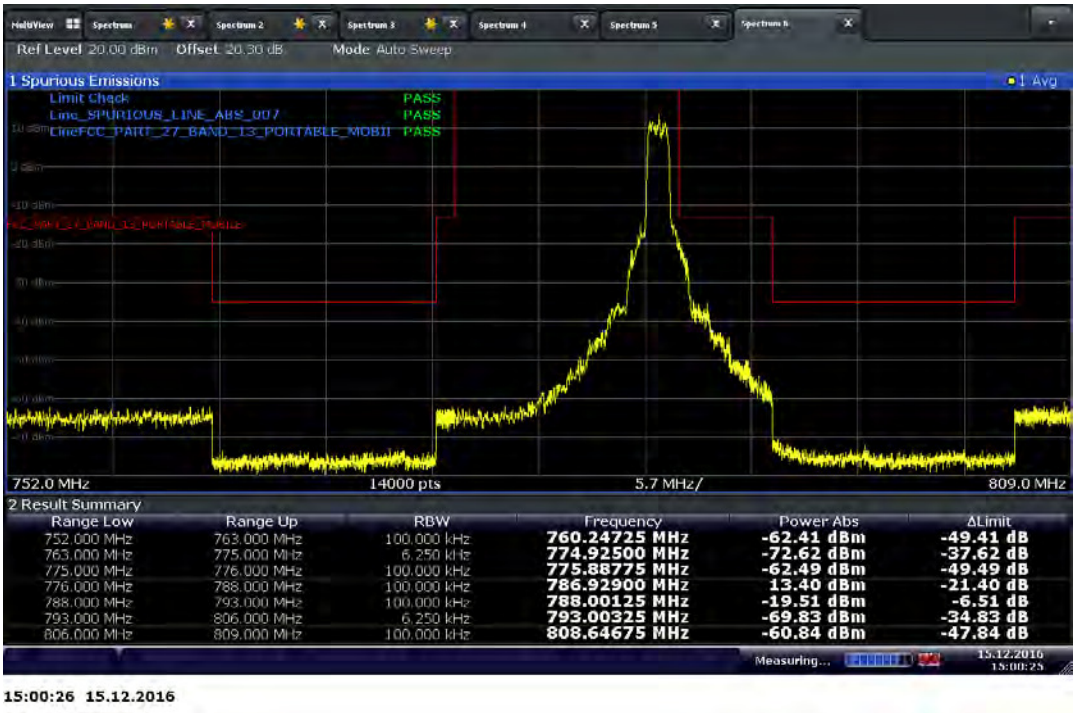


14:23:41 15.12.2016

Worst Case Configuration for 1559 MHz – 1610 MHz band

14:51:01 15.12.2016

Typical In-Band Verification (Worst Case Configuration : High Channel QPSK)



2.7 FIELD STRENGTH OF SPURIOUS RADIATION

2.7.1 Specification Reference

Clause 7of KDB971168 D01 v02r02

2.7.2 Standard Applicable

When antenna-port conducted measurements are performed to demonstrate compliance to the applicable unwanted emission limits, a separate radiated measurement is required to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Note that when radiated measurements are performed to demonstrate compliance to the unwanted emission limits (e.g., an EUT with integral transmit antenna), this measurement is not required.

These measurements may be performed with the transmit antenna port(s) terminated. Unless otherwise specified in the applicable rule section, the same limits applicable to spurious (unwanted) emissions at the antenna terminals also apply to radiated spurious emissions..

2.7.3 Equipment Under Test and Modification State

Serial No: 004402090412515/ Default Test Configuration

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

December 13, 2016/FSC

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	26.4 °C
Relative Humidity	32.8 %
ATM Pressure	99.7 kPa

2.7.7 Additional Observations

- This is a radiated measurement to detect spurious emissions that may be radiated directly from the cabinet of the EUT.
- Only the worst case channel presented to show compliance (High Channel / QPSK full RB).
- Antenna port of the EUT was terminated with a suitable 50Ω load.
- Any emissions within 6db of the limit will be proven by substitution method as per Unwanted Emissions: Radiated Spurious method of measurement of ANSI/TIA/EIA-603-C 2004, August 17, 2004. However no such emissions observed.

- 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 2.7.8 for sample computation.

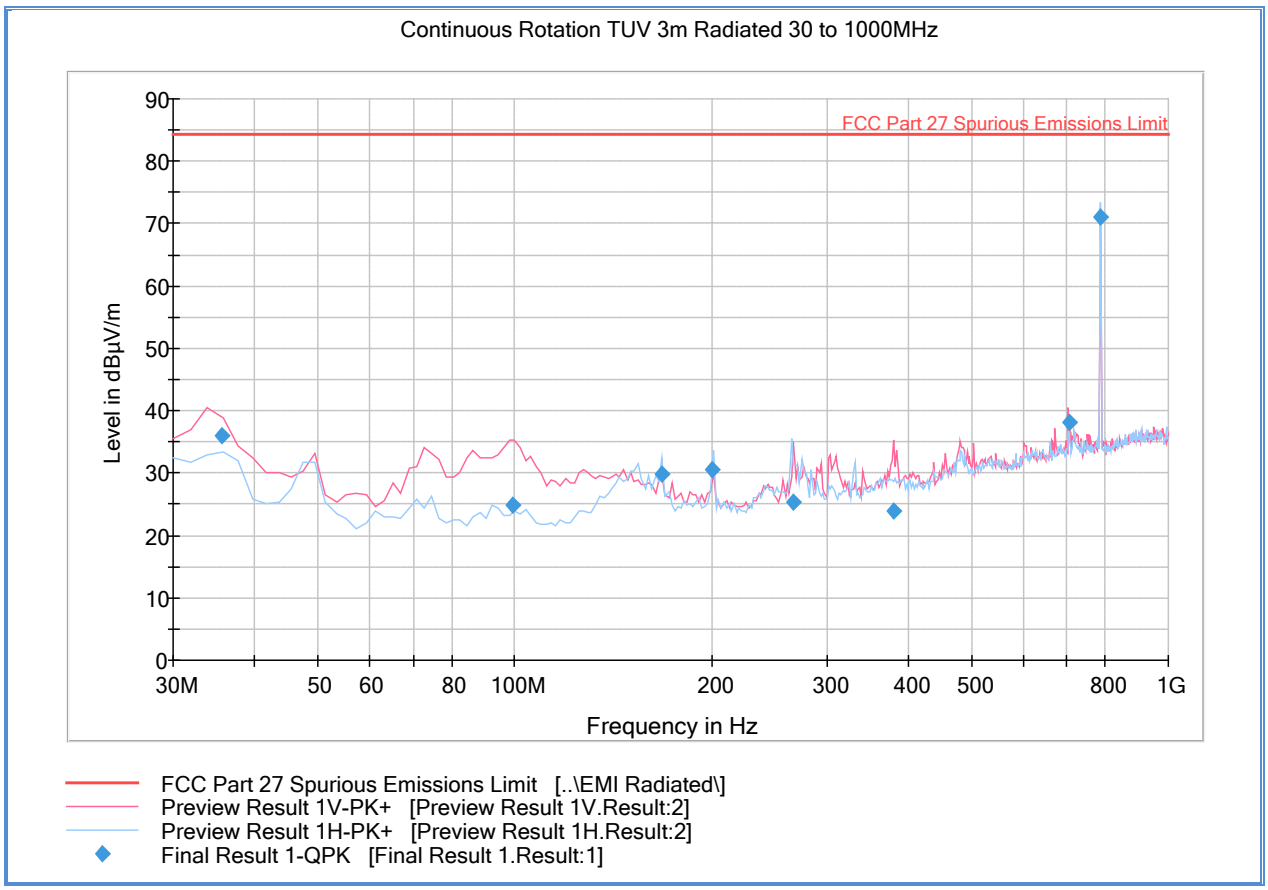
2.7.8 Sample Computation (Radiated Emission)

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# 1033 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.7.9 Test Results

See attached plots.

2.7.10 Test Results Below 1GHz (Worst Case Configuration)

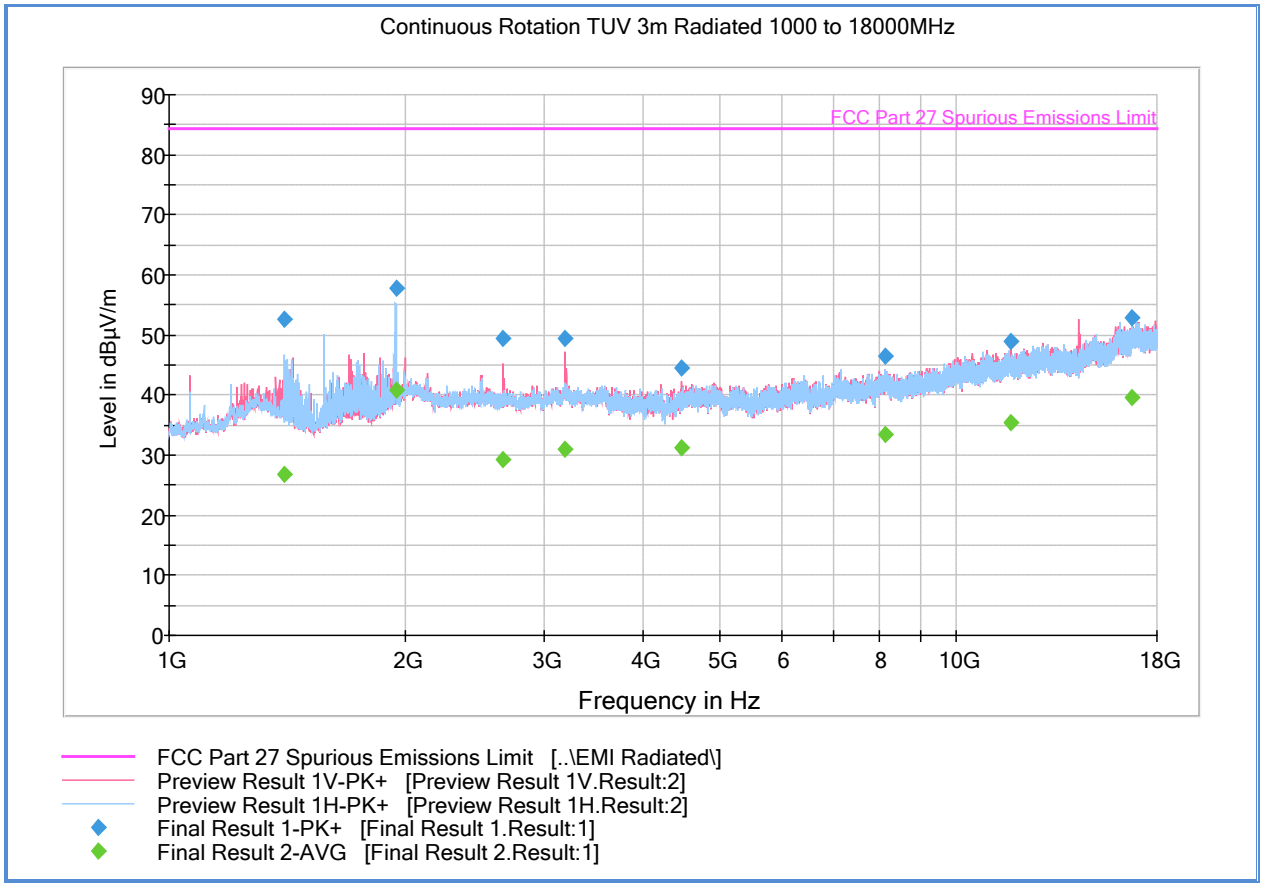


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
35.687776	36.0	1000.0	120.000	100.0	V	92.0	-8.8	48.4	84.4
99.436072	24.8	1000.0	120.000	100.0	V	1.0	-13.2	59.6	84.4
167.976032	29.8	1000.0	120.000	183.0	H	138.0	-10.8	54.6	84.4
200.582124	30.6	1000.0	120.000	100.0	H	91.0	-10.5	53.8	84.4
266.370421	25.3	1000.0	120.000	100.0	H	130.0	-7.0	59.1	84.4
378.979800	24.0	1000.0	120.000	250.0	V	0.0	-2.3	60.4	84.4
704.745170	38.2	1000.0	120.000	183.0	V	128.0	4.9	46.2	84.4
786.476232	71.1	1000.0	120.000	100.0	H	157.0	6.1	Fundamental	

Test Notes: Only worst case channel presented for cabinet spurious emissions verification.

2.7.11 Test Results Above 1GHz (Worst Case Configuration)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1402.933333	52.7	1000.0	1000.000	100.0	H	139.0	-5.6	31.7	84.4
1941.466667	57.7	1000.0	1000.000	349.0	H	4.0	-0.6	26.7	84.4
2654.666667	49.5	1000.0	1000.000	136.0	V	0.0	-0.9	34.9	84.4
3183.933333	49.5	1000.0	1000.000	100.0	V	350.0	1.1	34.9	84.4
4484.966667	44.5	1000.0	1000.000	130.0	V	304.0	2.7	39.9	84.4
8124.133333	46.5	1000.0	1000.000	162.0	V	220.0	7.7	37.9	84.4
11721.700000	48.9	1000.0	1000.000	359.0	V	321.0	13.8	35.5	84.4
16745.966667	52.8	1000.0	1000.000	220.0	H	277.0	19.9	31.6	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)
1402.933333	26.7	1000.0	1000.000	100.0	H	139.0	-5.6	57.7	84.4
1941.466667	40.8	1000.0	1000.000	349.0	H	4.0	-0.6	43.6	84.4
2654.666667	29.2	1000.0	1000.000	136.0	V	0.0	-0.9	55.2	84.4
3183.933333	31.0	1000.0	1000.000	100.0	V	350.0	1.1	53.4	84.4
4484.966667	31.1	1000.0	1000.000	130.0	V	304.0	2.7	53.3	84.4
8124.133333	33.4	1000.0	1000.000	162.0	V	220.0	7.7	51.0	84.4
11721.700000	35.4	1000.0	1000.000	359.0	V	321.0	13.8	49.0	84.4
16745.966667	39.6	1000.0	1000.000	220.0	H	277.0	19.9	44.8	84.4

Substitution Data

Frequency (MHz)	Field Strength @ 3 meters (dbµV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

Test Notes: Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.8 FREQUENCY STABILITY

2.8.1 Specification Reference

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

2.8.2 Standard Applicable

FCC 47 CFR Part 27, Clause 27.54
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-130, Clause 4.3
The transmitter frequency stability limit shall be determined as follows:

(a) The frequency offset shall be measured according to the procedure described in RSS-Gen and recorded;
(b) Using a resolution bandwidth of 1% of the occupied bandwidth, a reference point at the unwanted emission level which complies with the attenuation of 43 + 10 log10 p (watts) on the emission mask of the lowest and highest channel shall be selected, and the frequency at these points shall be recorded as f_L and f_H respectively.

The applicant shall ensure frequency stability by showing that f_L minus the frequency offset and f_H plus the frequency offset shall be within the frequency range in which the equipment is designed to operate.

2.8.3 Equipment Under Test and Modification State

Serial No: 004402090412515/ Default Test Configuration

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

December 16, 2016/FSC

2.8.5 Test Equipment Used

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

2.8.6 Environmental Conditions

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

Ambient Temperature	23.5 °C
Relative Humidity	35.4 %
ATM Pressure	99.9 kPa

2.8.7 Additional Observations

- This is a conducted test.
- The EUT was operated at 3.8VDC nominal voltage and was placed in the temperature chamber for the series of evaluations performed.
- The waveform was stopped during normal operation resulting in CW signal. The Signal Count function of the SA was used to measure frequency deviation.
- The Temperature was set to 50°C and allowed to sit for 1 hour to allow the equipment and chamber temperature to stabilize. Once stabilized, the EUT was turned on and the measurement performed. The temperature was then decreased by 10°C steps and allowed to settle before taking the next set of measurements.
- Voltage variation was also performed at 85% and 115% of the nominal voltage.
- Frequency offsets were calculated based from the reference carrier tone @ 20°C nominal voltage.
- Once the worst case frequency offset was determined, the offset was applied to F_L and F_H to verify compliance.
- F_L and F_H are reference points at the unwanted emission level which complies with the attenuation of 43 + 10 $\log_{10}$ p (watts) on the emission mask of the lowest and highest channel.
- Frequency stability compliance is determined by showing that f_L minus the frequency offset and f_H plus the frequency offset is within the frequency range in which the equipment is designed to operate.

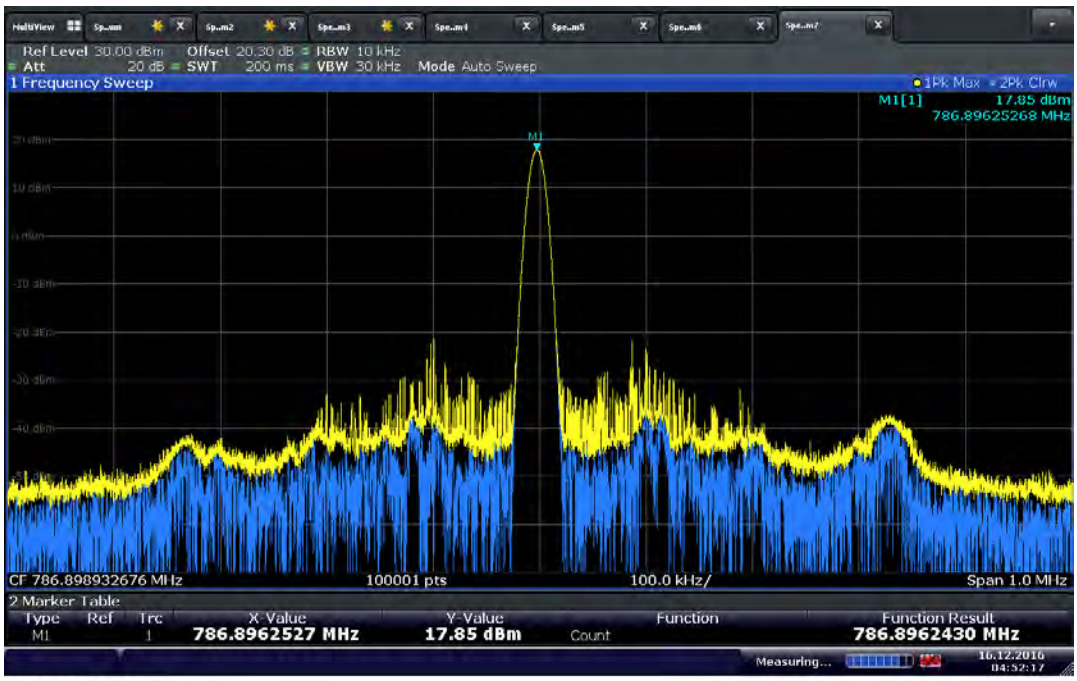
2.8.8 Frequency Offsets Summary

Input Voltage (VDC)	*Temperature (°C)*	*Frequency Offset (MHz)*
3.8	***+50***	***-0.0043462***
	+40	-0.0034999
	+30	-0.0020202
	+20	Reference
	+10	0.0020549
	0	0.0034894
	-10	0.0039273
	-20	0.0027529
	-30	-0.0004971

Temperature (°C)	*Input Voltage (VDC)*	*Frequency Offset (MHz)*
20	4.37	-0.0001095
	3.23	0.0000513

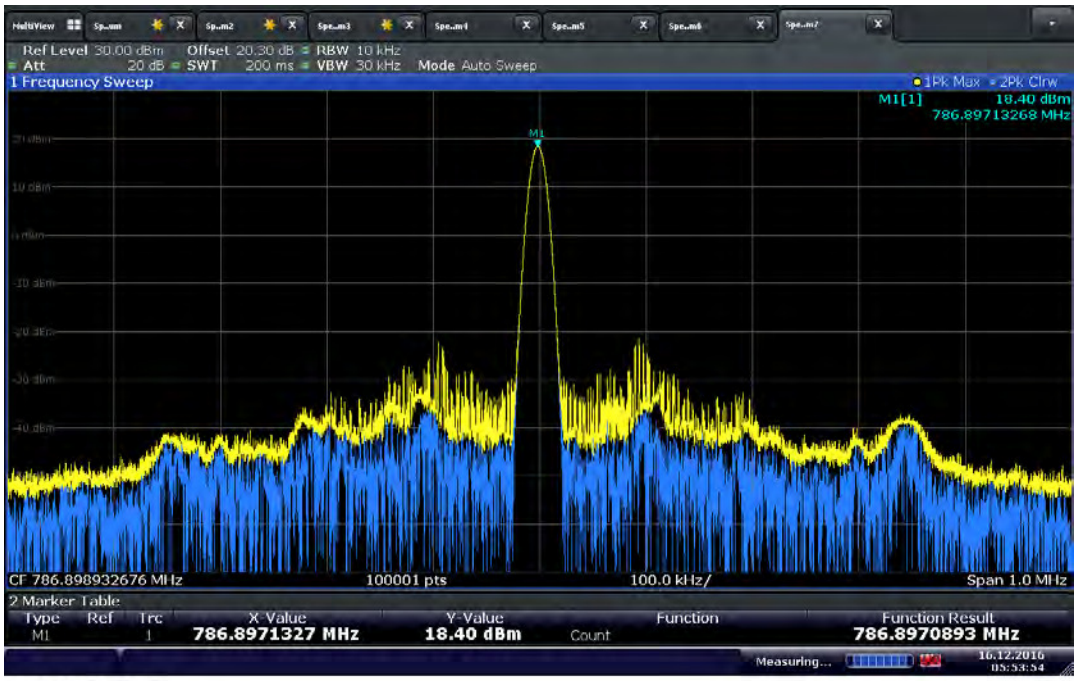
2.8.9 Frequency Offset Test Plots

Worst Case Configuration @ 50°C



04:52:17 16.12.2016

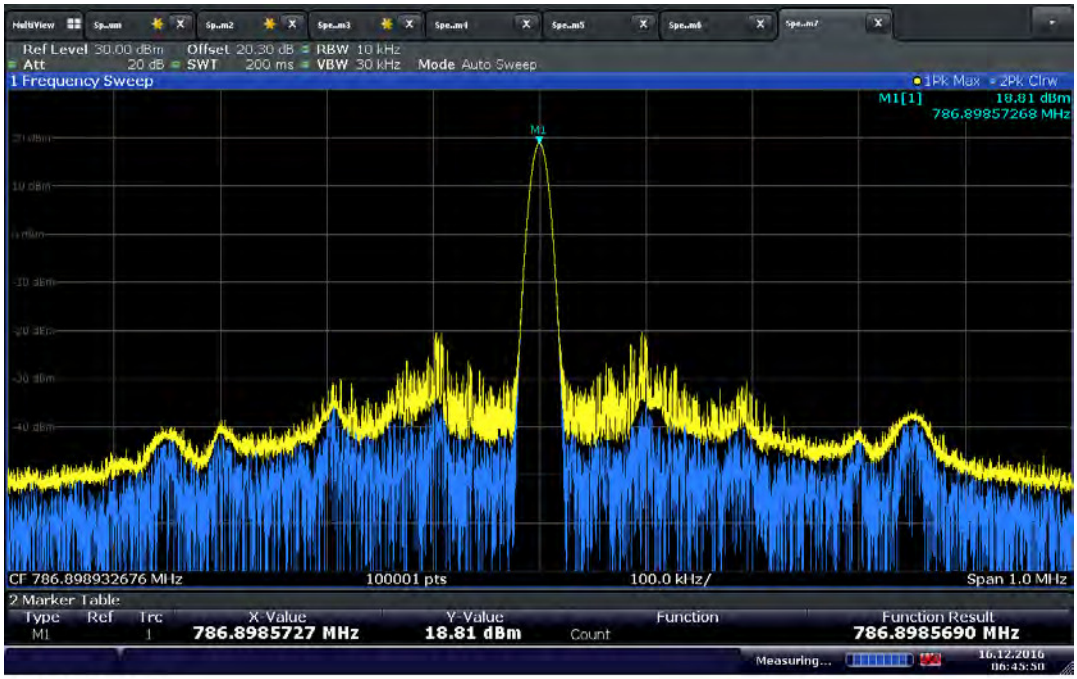
Worst Case Configuration @ 40°C



05:53:55 16.12.2016

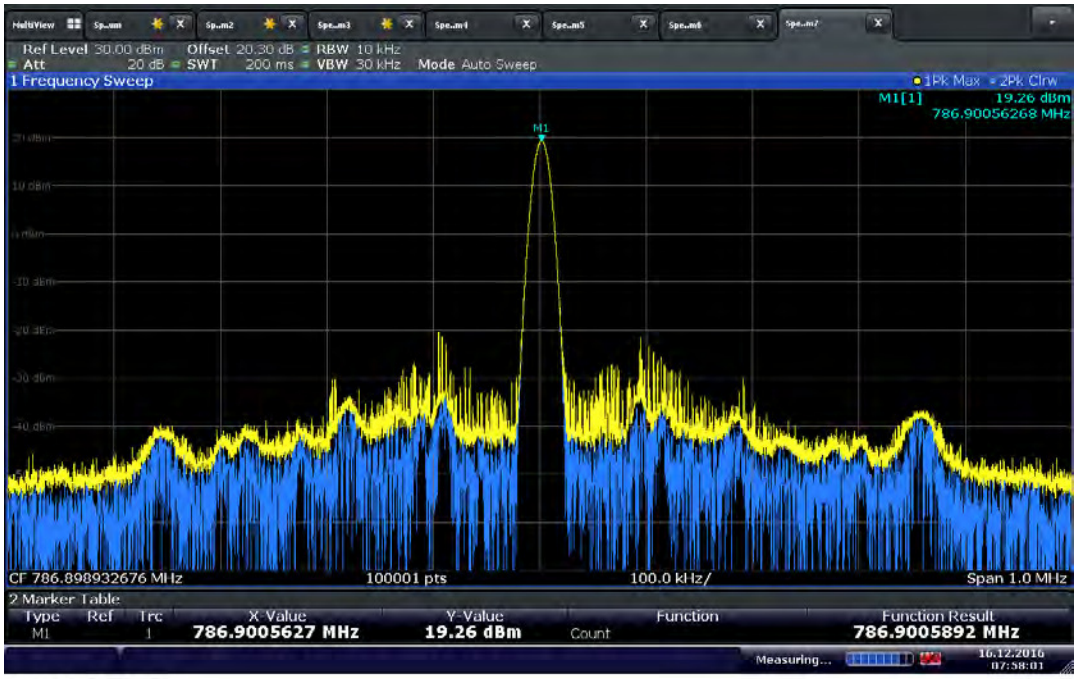
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

Worst Case Configuration @ 30°C



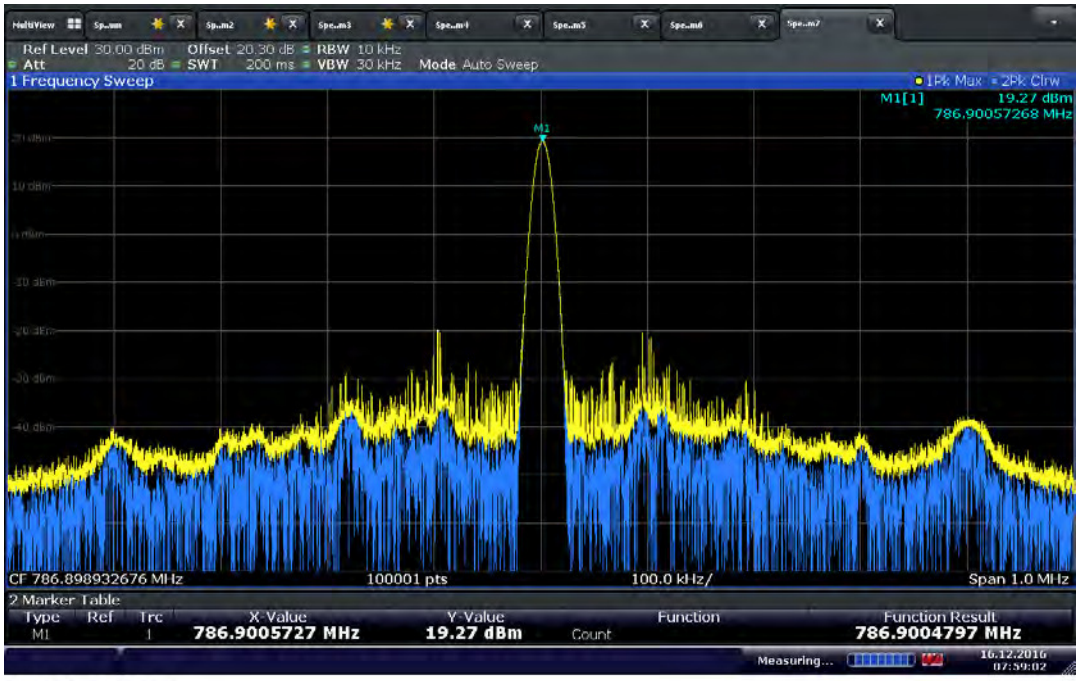
06:45:50 16.12.2016

Worst Case Configuration @ 20°C Nominal Voltage of 3.8VDC



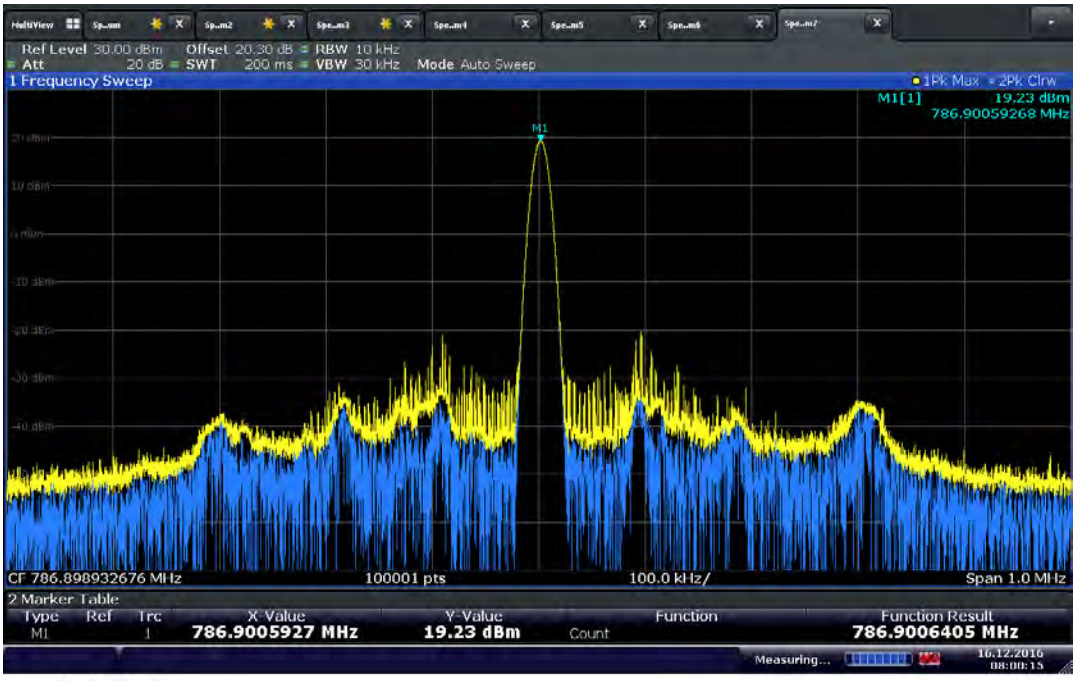
07:58:02 16.12.2016

Worst Case Configuration @ 20°C Input Voltage of 4.27VDC



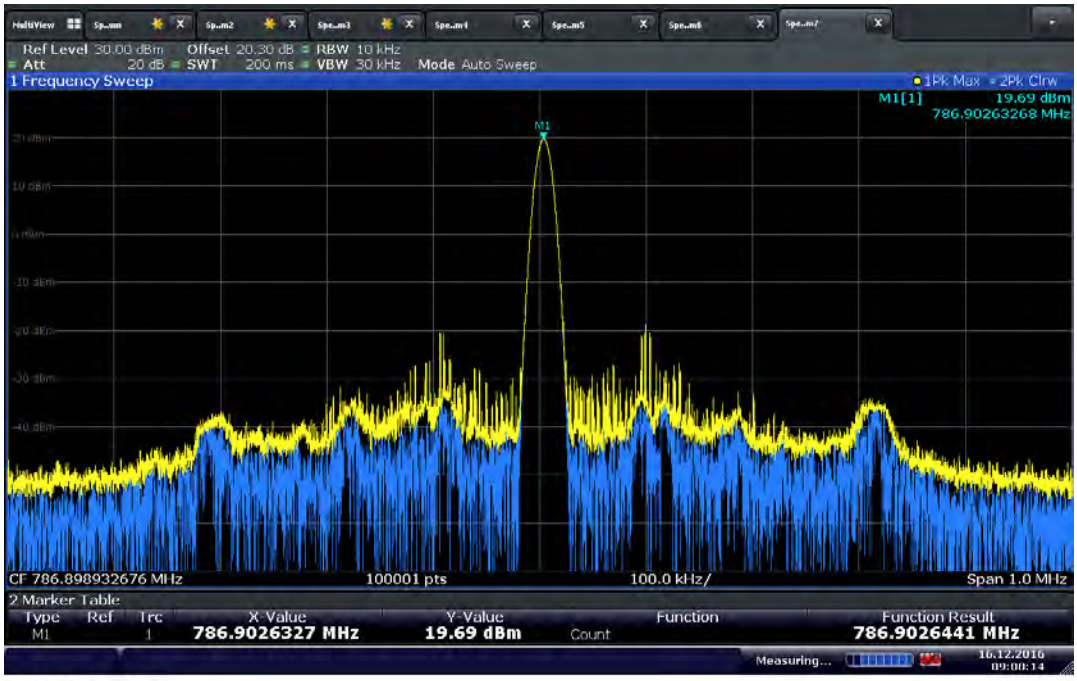
07:59:02 16.12.2016

Worst Case Configuration @ 20°C Input Voltage of 3.23VDC



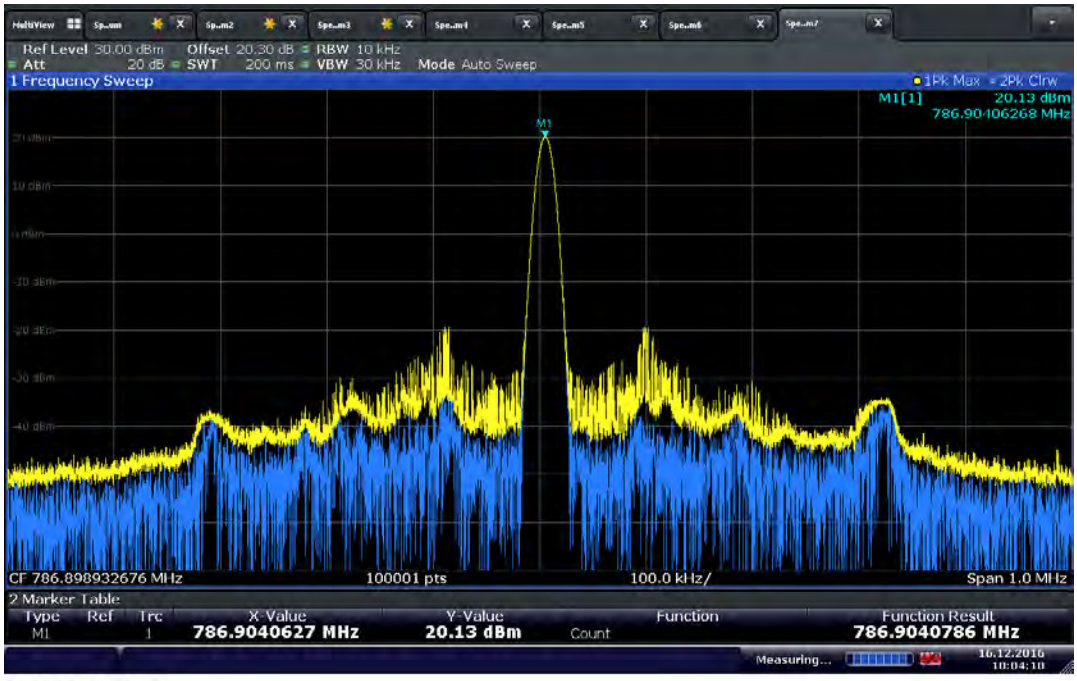
08:00:15 16.12.2016

Worst Case Configuration @ 10°C



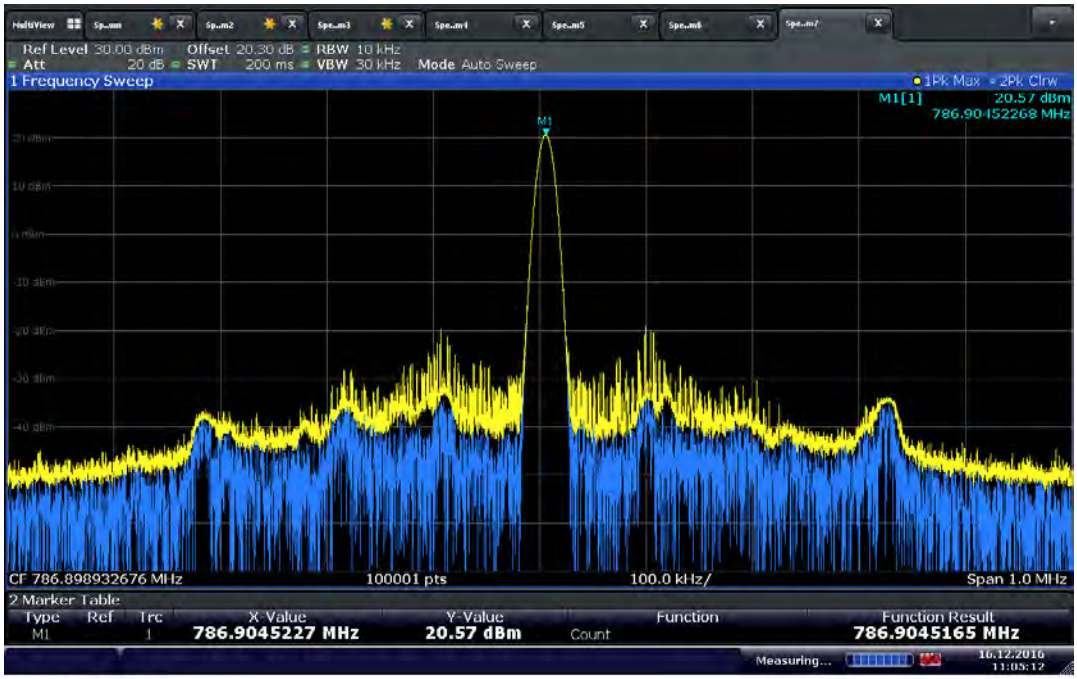
09:00:15 16.12.2016

Worst Case Configuration @ 0°C



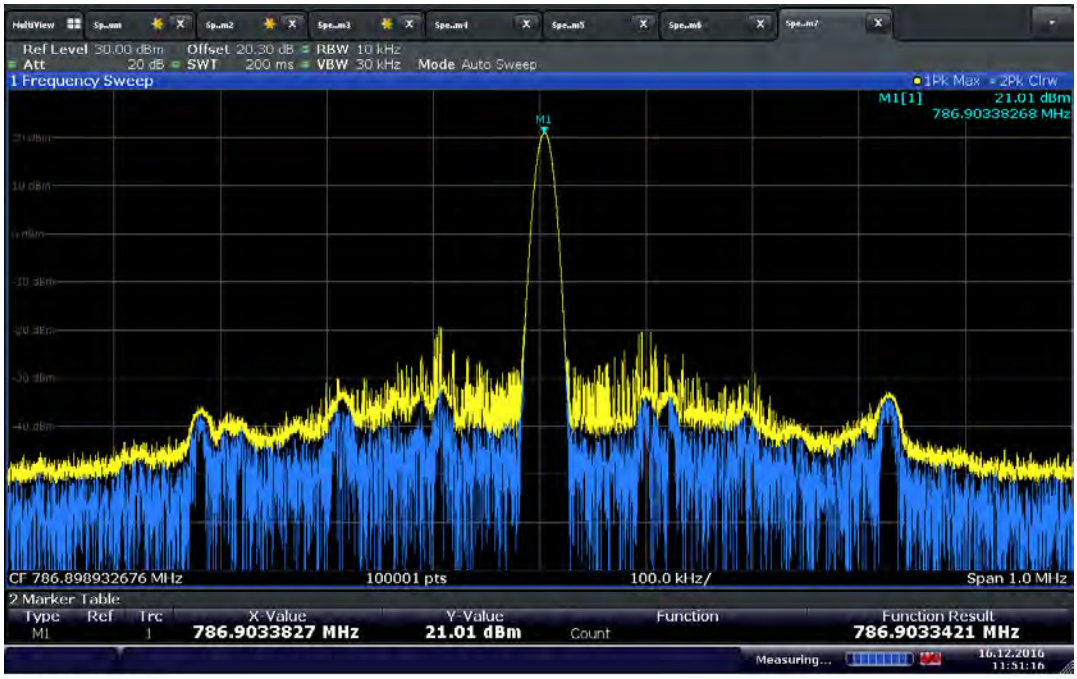
10:04:11 16.12.2016

Worst Case Configuration @ -10°C



11:05:13 16.12.2016

Worst Case Configuration @ -20°C



11:51:16 16.12.2016

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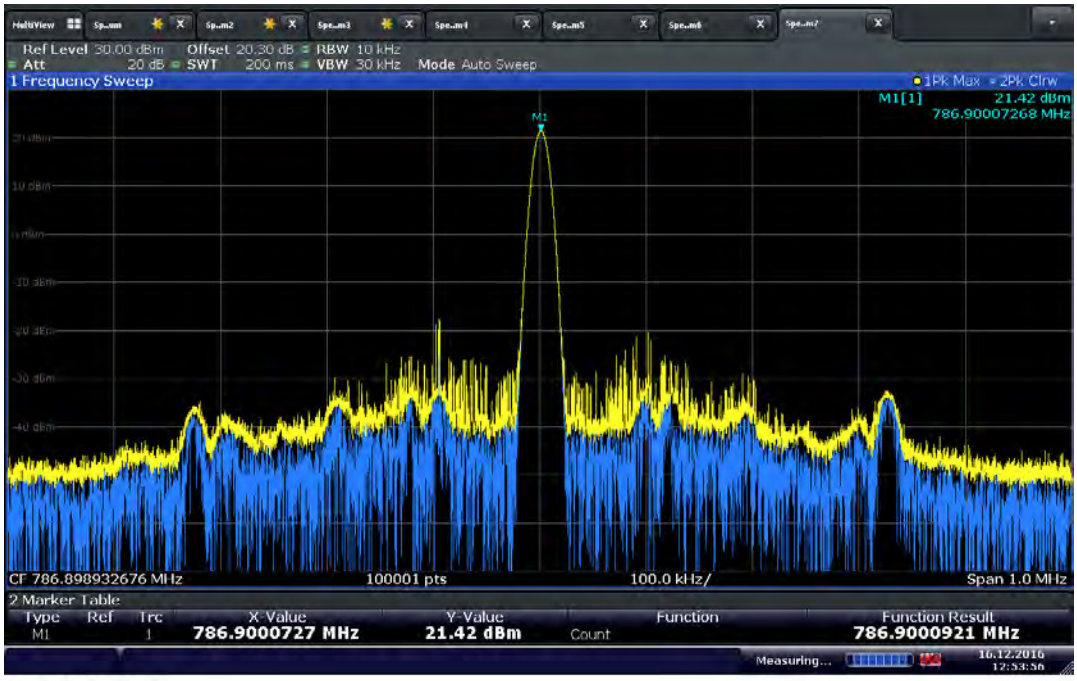
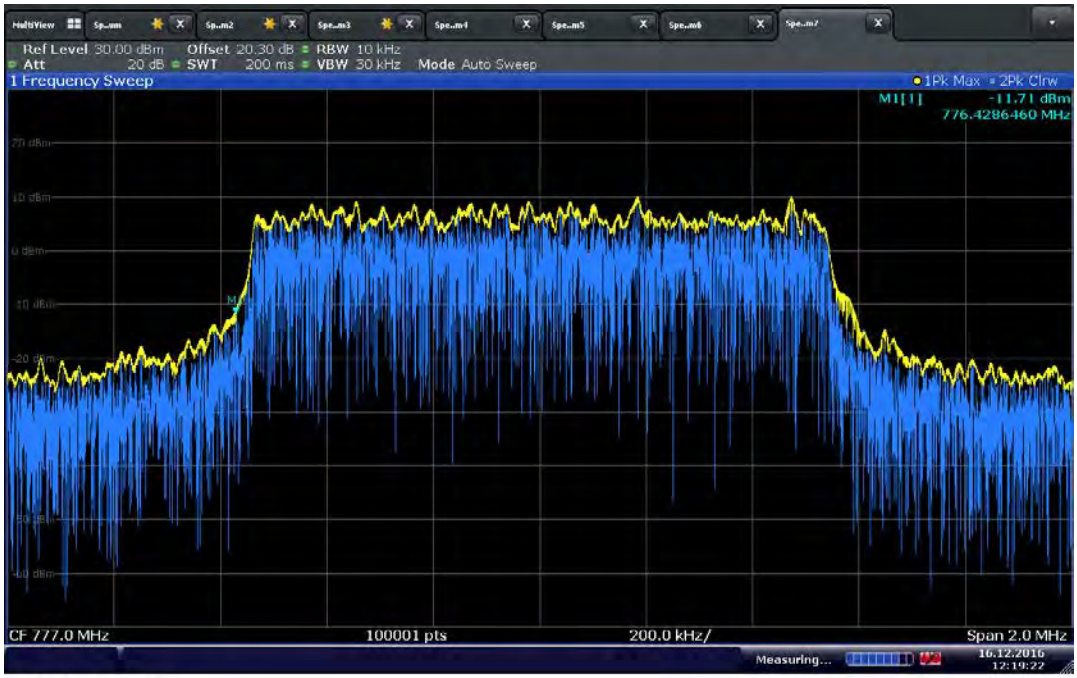
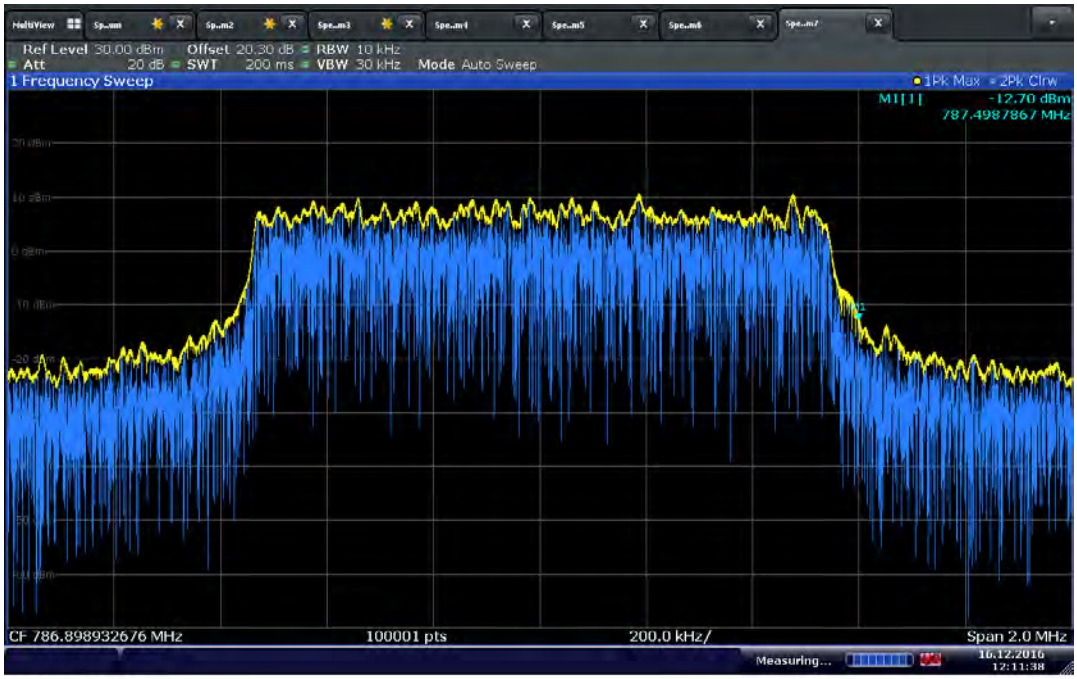
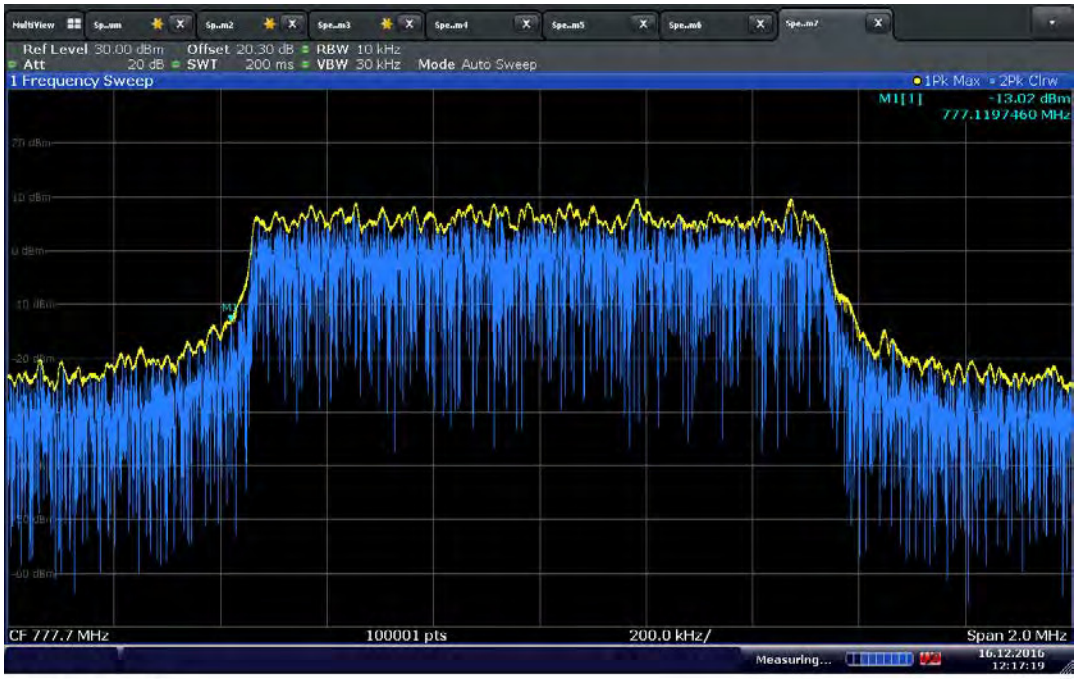
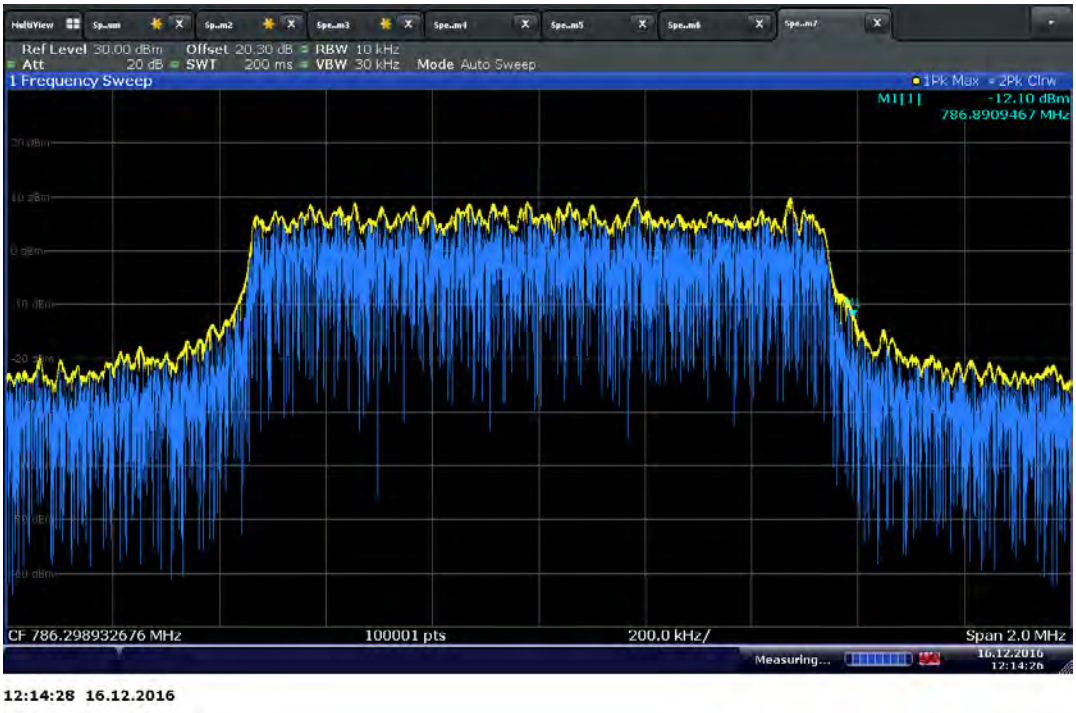
Worst Case Configuration @ -30°C
 12:53:56 16.12.2016
F_L FCC (Worst Case Configuration Low Channel)
 12:19:22 16.12.2016

F_H FCC (Worst Case Configuration High Channel)
 12:11:39 16.12.2016
F_L ISED (Worst Case Configuration Low Channel)
 12:17:19 16.12.2016

F_H ISED (Worst Case Configuration High Channel)


2.8.10 Test Results

FCC Frequency Stability Verification

Worst Case F_L = 776.4286460 MHz
Worst Case F_H = 787.4987867 MHz
Worst Case Frequency Off Set = 0.0043462 MHz

F_L – Frequency Off Set = 776.424 MHz (within frequency band 776 MHz to 788 MHz, Complies)
F_H + Frequency Off Set = 787.503 MHz (within frequency band 776 MHz to 788 MHz, Complies)

ISED Frequency Stability Verification

Worst Case F_L = 777.1197460 MHz
Worst Case F_H = 786.8909467 MHz
Worst Case Frequency Off Set = 0.0043462 MHz

F_L – Frequency Off Set = 777.115 MHz (within frequency band 777 MHz to 787 MHz, Complies)
F_H + Frequency Off Set = 786.895 MHz (within frequency band 777 MHz to 787 MHz, Complies)

2.9 POWER LINE CONDUCTED EMISSIONS

2.9.1 Specification Reference

RSS-Gen 8.8

2.9.2 Standard Applicable

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

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

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average**
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

* *The level decreases linearly with the logarithm of the frequency.*
** *A linear average detector is required.*

2.9.3 Equipment Under Test and Modification State

Serial No: 004402090412515/ Default Test Configuration

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

December 16, 2016/FSC

2.9.5 Test Equipment Used

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

2.9.6 Environmental Conditions

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

Ambient Temperature	23.5 °C
Relative Humidity	35.4 %
ATM Pressure	99.9 kPa

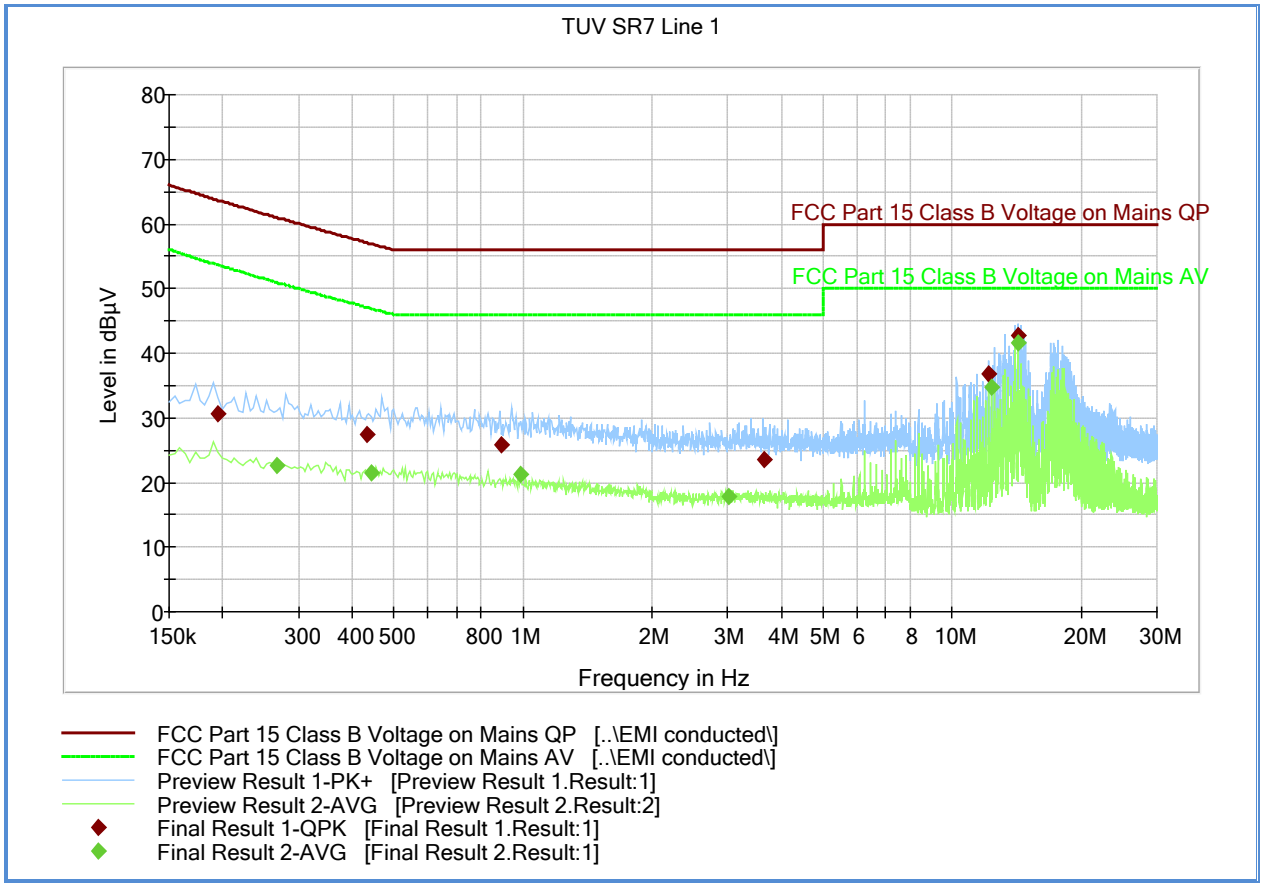
2.9.7 Additional Observations

- The EUT is a module. Test was performed to show general compliance to RSS-Gen Power Line Conducted Emissions requirements. As a general rule, the EUT should be verified in the final host. It is the responsibility of the module integrator to verify compliance of the final host.
- EUT was verified using the test configuration provided by the manufacturer (EUT on a development board powered by a support programmable power supply).
- The EUT was transmitting worst case configuration while the antenna port terminated to a suitable 50Ω load.
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.9.8 for sample computation.

2.9.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (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# 7567 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbµV) @ 150kHz			**26.2**

2.9.9 Test Results - Conducted Emissions Line 1



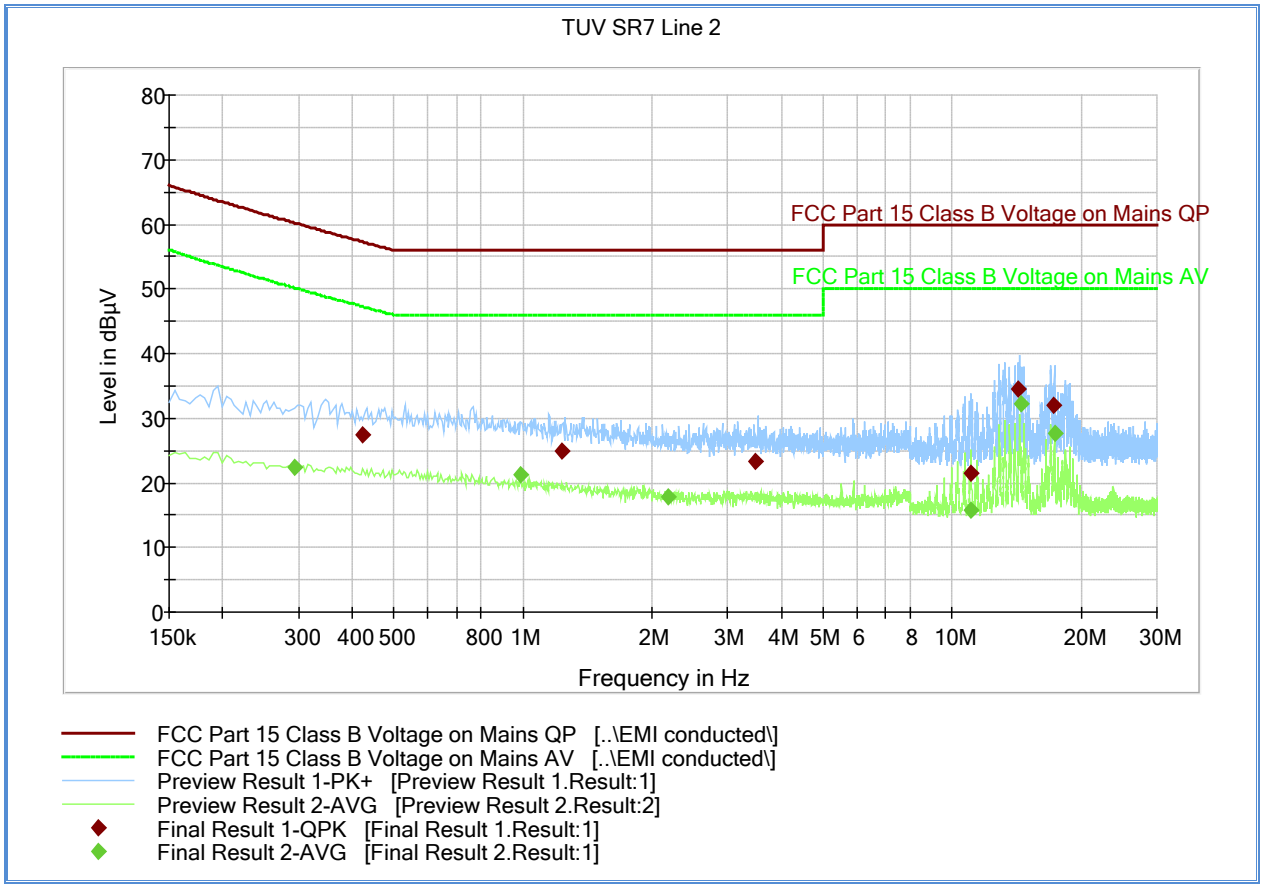
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.195000	30.6	1000.0	9.000	Off	L1	20.1	33.1	63.7
0.433500	27.3	1000.0	9.000	Off	L1	20.0	29.8	57.1
0.892500	25.8	1000.0	9.000	Off	L1	20.0	30.2	56.0
3.651000	23.6	1000.0	9.000	Off	L1	20.1	32.4	56.0
12.165000	36.9	1000.0	9.000	Off	L1	20.2	23.1	60.0
14.253000	42.8	1000.0	9.000	Off	L1	20.3	17.2	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.267000	22.6	1000.0	9.000	Off	L1	20.0	28.4	51.0
0.442500	21.6	1000.0	9.000	Off	L1	20.0	25.4	46.9
0.987000	21.3	1000.0	9.000	Off	L1	20.0	24.7	46.0
3.021000	17.7	1000.0	9.000	Off	L1	20.1	28.3	46.0
12.349500	34.7	1000.0	9.000	Off	L1	20.2	15.3	50.0
14.253000	41.5	1000.0	9.000	Off	L1	20.3	8.5	50.0

2.9.10 Test Results - Conducted Emissions Line 2



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.424500	27.4	1000.0	9.000	Off	N	20.0	29.8	57.3
1.234500	25.0	1000.0	9.000	Off	N	20.0	31.0	56.0
3.475500	23.4	1000.0	9.000	Off	N	20.1	32.6	56.0
11.044500	21.4	1000.0	9.000	Off	N	20.2	38.6	60.0
14.298000	34.5	1000.0	9.000	Off	N	20.2	25.5	60.0
17.295000	31.9	1000.0	9.000	Off	N	20.3	28.1	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.294000	22.4	1000.0	9.000	Off	N	20.0	27.7	50.2
0.987000	21.2	1000.0	9.000	Off	N	20.0	24.8	46.0
2.184000	17.7	1000.0	9.000	Off	N	20.1	28.3	46.0
11.076000	15.8	1000.0	9.000	Off	N	20.2	34.2	50.0
14.437500	32.3	1000.0	9.000	Off	N	20.2	17.7	50.0
17.313000	27.6	1000.0	9.000	Off	N	20.4	22.4	50.0

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

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

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Antenna Conducted Port Setup						
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	10/26/16	10/26/17
8607	20dB Attenuator	CAT-20	N/A	MCL HAT-20	10/10/16	10/10/17
7579	Temperature Chamber	115	151617	TestQuity	08/25/16	08/25/17
7604	P-Series Power Meter	N1912A	SG45100273	Agilent	07/27/16	07/27/17
7605	50MHz-18GHz Wideband Power Sensor	N1921A	MY51100054	Agilent	04/19/16	04/19/17
Radiated Emissions						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/06/15	11/06/17
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
1016	Pre-amplifier	PAM-0202	187	PAM	10/17/16	10/17/17
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	03/21/16	03/21/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	01/11/16	01/11/17
1150	Horn antenna	3160-09	012054-004	ETS	07/16/15	07/16/17
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	02/01/16	02/01/17
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/02/16	09/02/17
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	Verified by 7608 and 7611	
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 7608 and 7611	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 7608 and 7611	
Conducted Emissions						
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	11/05/16	11/05/17
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/29/16	02/28/17
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/29/16	02/28/17

Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/29/16	08/29/17
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	08/22/16	08/22/17
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Conducted Measurements

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

3.2.2 Radiated Measurements (Below 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.78
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.57

3.2.3 Radiated Emission Measurements (Above 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.78
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.56

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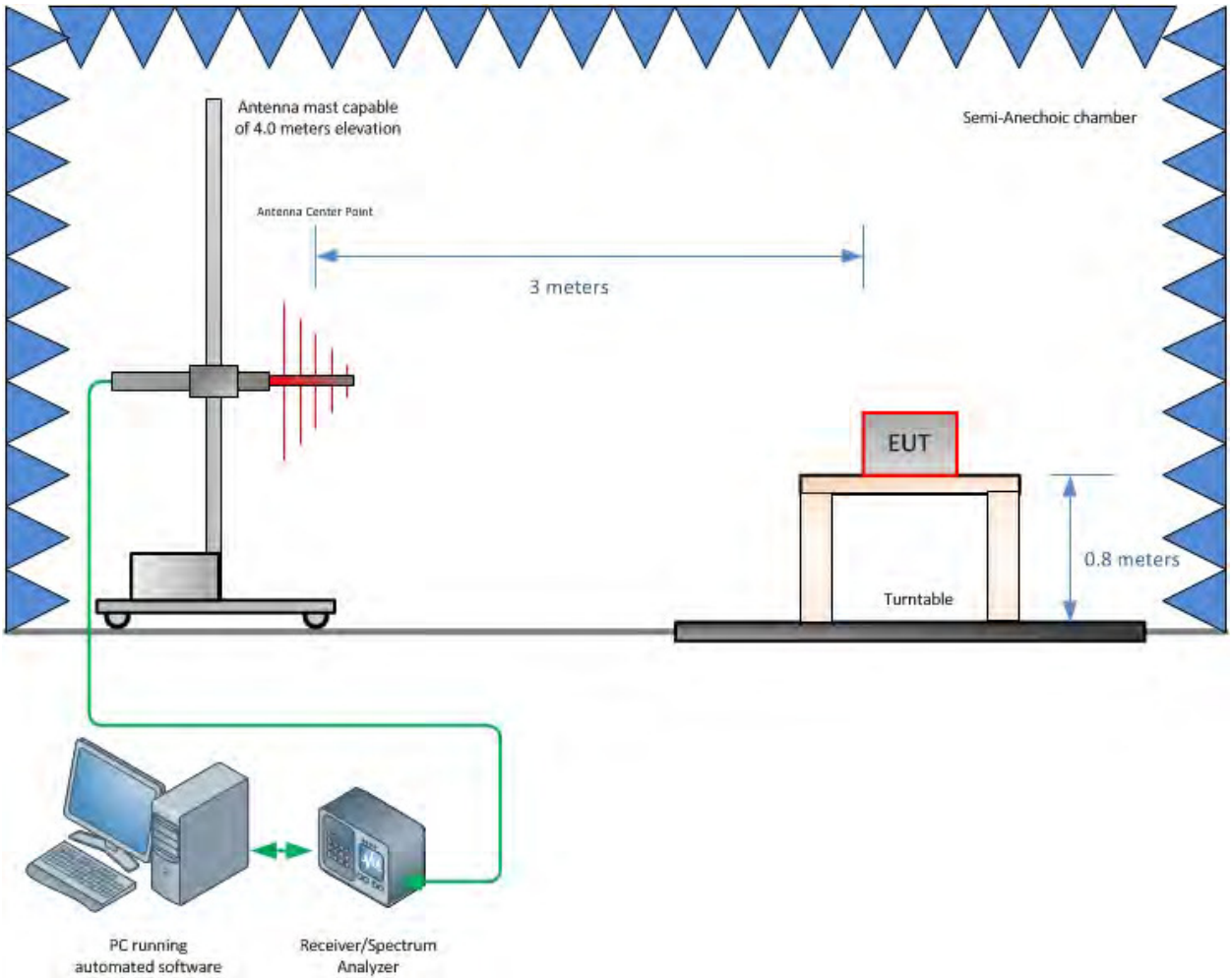
3.2.4 Conducted Antenna Port Measurement

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

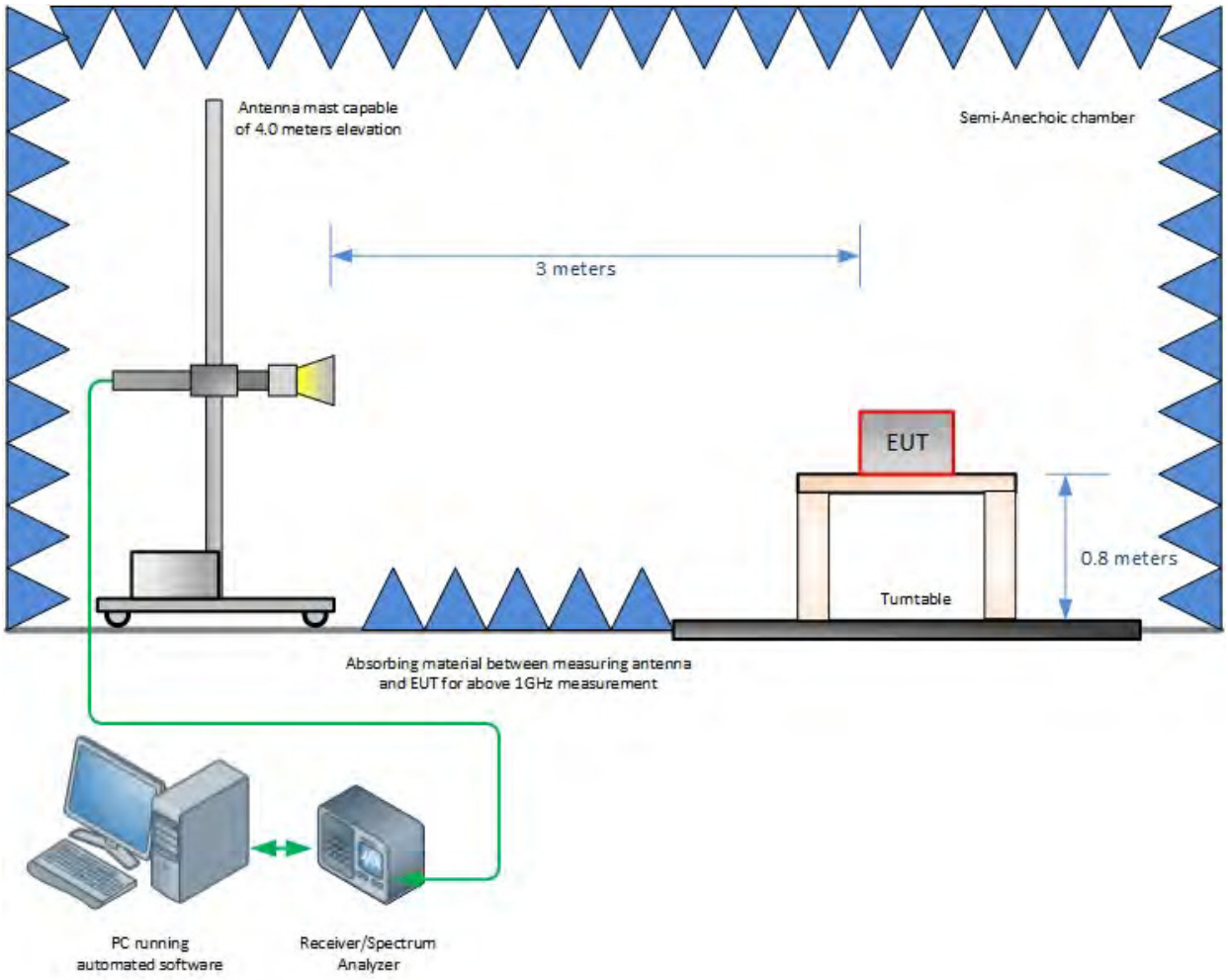
SECTION 4

DIAGRAM OF TEST SETUP

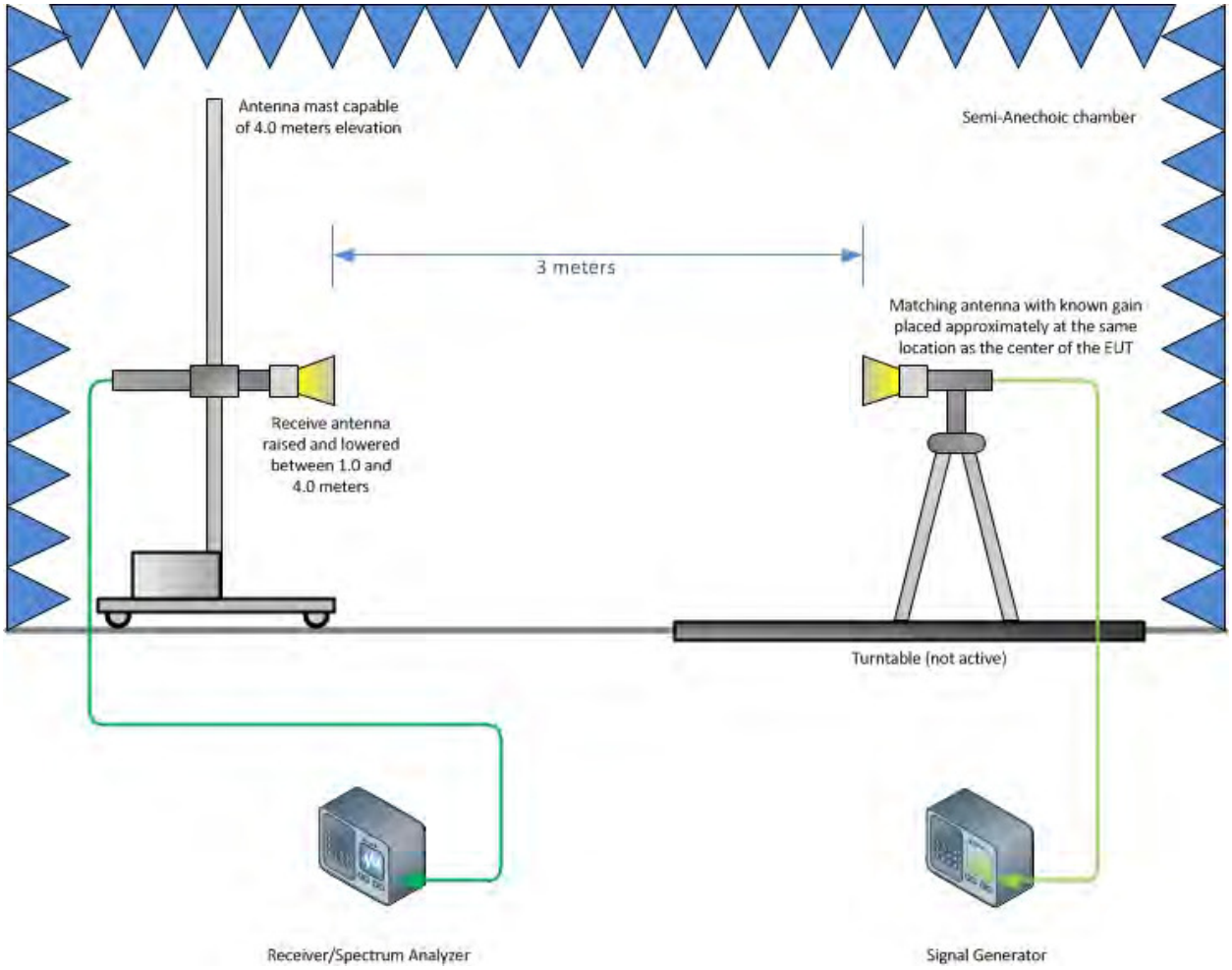
4.1 TEST SETUP DIAGRAM



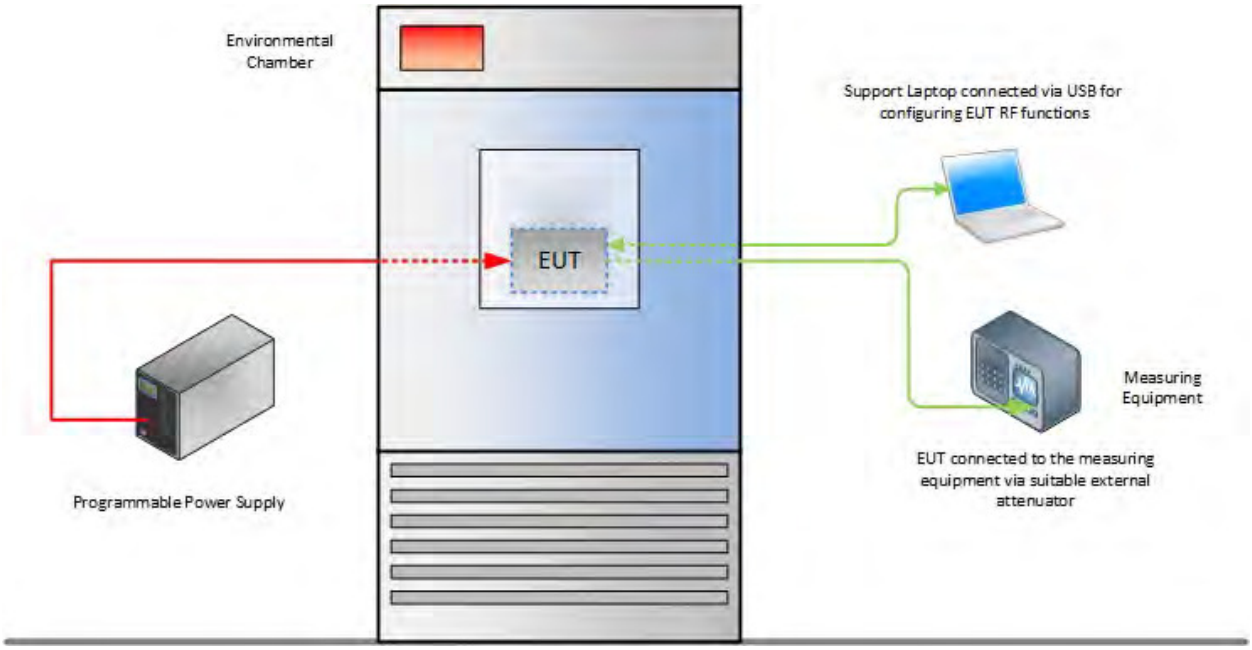
Radiated Emission Test Setup (Below 1GHz)



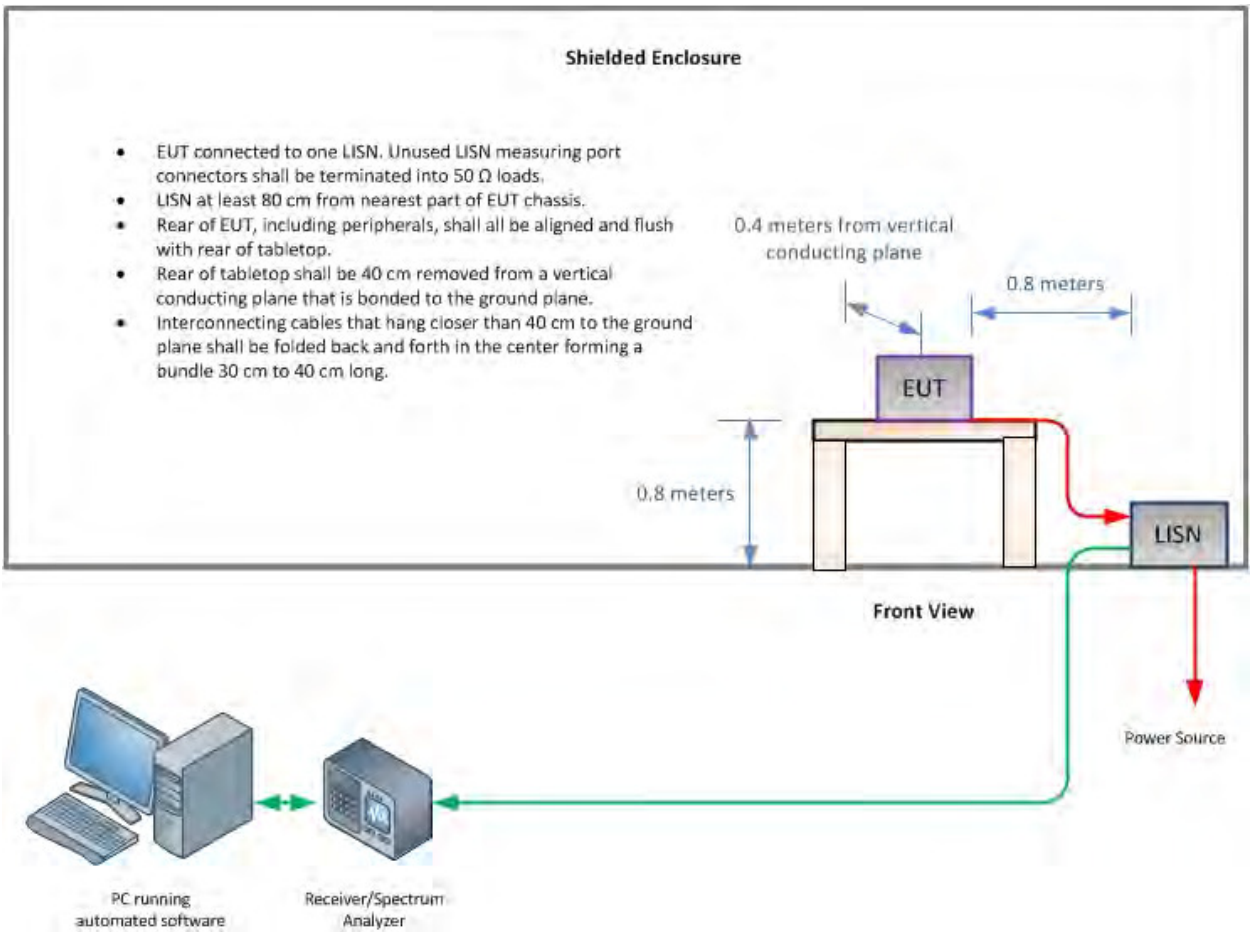
Radiated Emission Test Setup (Above 1GHz)



Substitution Test Method (Above 1GHz, if applicable)



Frequency Stability Test Configuration



Conducted Emissions Test Configuration (if applicable)

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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