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## Report On

Application for Grant of Equipment Authorization of the  
Novatel Wireless Inc.

MIFI7000 Wireless Hotspot Modem

FCC CFR 47 Part 2 and 27

RSS-130 Issue 1: 2013, RSS-139 Issue: 2015 and RSS-199 Issue 2:  
2014

Report No. SD72118338-0716B Rev. 1

September 2016



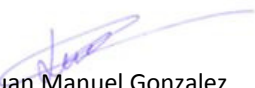
**REPORT ON** Radio Testing of the  
Novatel Wireless Inc.  
MIFI7000 Wireless Hotspot Modem

**TEST REPORT NUMBER** SD72118338-0716B Rev. 1

**PREPARED FOR** Novatel Wireless Inc.  
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**DATED** September 14, 2016



**Revision History**

SD72118338-0716B Rev. 1 Novatel Wireless Inc. MIFI7000 Wireless Hotspot Modem					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
09/14/2016	Initial Release				Juan M. Gonzalez
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## **SECTION 1**

### **REPORT SUMMARY**

Radio Testing of the  
Novatel Wireless Inc.  
MIFI7000 Wireless Hotspot Modem



## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Novatel Wireless Inc. MIFI7000 Wireless Hotspot Modem to the requirements of the following:

- FCC CFR 47 Part 2 and 27
- RSS-Gen Issue 4 November 2014
- RSS-130 Issue 1: 2013, RSS-139 Issue: 2015 and RSS-199 Issue 2: 2014.

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	Novatel Wireless Inc.
Product Marketing Name	MiFi 7000
Model Number(s)	MIFI7000
FCC ID Number	PKRNVWMIFI7000
IC Number	3229A-MIFI7000
Serial Number(s)	SZ17061900013
Number of Samples Tested	1
Test Specification/Issue/Date	<ul style="list-style-type: none"><li>• FCC CFR 47 Part 2 and 27 (October 1, 2015)</li><li>• RSS-130 Issue 1: October 2013 – Mobile Broadband Services (MBS) Equipment Operating in the Frequency Bands 698-756 MHz and 777-787</li><li>• RSS-139 Issue 3: July 2015 – Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz</li><li>• RSS-199 Issue 2: October 2014 – Broadband Radio Service (BRS) Equipment Operating in the Band 2500-2690 MHz</li><li>• RSS-Gen Issue 4: November 2014 - General Requirements for Compliance of Radio Apparatus</li></ul>
Start of Test	July 05, 2016
Finish of Test	August 02, 2016
Name of Engineer(s)	Alex Chang
Related Document(s)	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	FCC Part Sections(s)	RSS Section(s)	Test Description	Result
2.1	2.1046 (a) and (c)	RSS-130 (4.4) RSS-139 (6.5) RSS-199 (4.4)	Transmitter Conducted Output Power	Compliant
2.2	27.50 (d)(4), 27.50 (h)(2) and Part 2.1046	RSS-139 (6.5) RSS-199 (4.4)	Equivalent Isotropic Radiated Power	Compliant
2.3	27.50 (b)(10)(12)(c)(10) and Part 2.1046	RSS-130 (4.4)	Effective Radiated Power	Compliant
2.4	27.53 (c)(2)(5), 27.53 (g)(h)(1), 27.53 (m)(6) and Part 2.1049	RSS-199 (4.2) RSS-Gen (6.6)	Occupied Bandwidth	Compliant
2.5	27.50 (B), 27.50 (d)(5)	RSS-130 (4.4) RSS-139 (6.5)	Peak-Average Ratio	Compliant
2.6	27.53 (c)(2), (g)(h)(1), (m)(4) and Part 2.1053	RSS-130 (4.6.1) RSS-139 (6.6) RSS-199 (4.6)	Band Edge	Compliant
2.7	27.53 (c)(2), (g)(h)(1), (m)(4) and Part 2.1053	RSS-130 (4.6.2) RSS-139 (6.6) RSS-199 (4.6)	Conducted Spurious Emissions	Compliant
2.8	27.53 (c)(2), (g)(h)(1), (m)(4) and Part 2.1053	RSS-130 (4.6.2) RSS-139 (6.6) RSS-199 (4.6)	Field Strength Of Spurious Radiation	Compliant
2.9	27.54, Part 2.1055 (a)(1) and (d)(1)	RSS-130 (4.3) RSS-139 (6.4) RSS-199 (4.3)	Frequency Stability	Compliant
2.10		RSS-Gen 7.0	Receiver Spurious Emissions	Compliant



**1.3 PRODUCT INFORMATION**

**1.3.1 EUT General Description**

The Equipment Under Test (EUT) was a Novatel Wireless Inc. MiFi 7000 Wireless Hotspot Modem. The EUT is a Wireless USB Broadband Modem supporting 2G/3G/4G Technologies. The EUT comes with a USB Port.

**1.3.2 Technical Description**

EUT Description	Wireless Hotspot Modem
Model Number(s)	MIFI7000
Rated Voltage	3.8V, 4500mAh (Rechargeable Li-Ion battery pack) Input 100-240VAC, Output 5V (External AC-DC Power Adapter)
Mode Verified	LTE Band 4: 1710-1755 MHz LTE Band 7: 2500-2570 MHz LTE Band 12: 698-716 MHz LTE Band 13: 777-787 MHz LTE Band 17: 704-716 MHz LTE Band 66: 1710-1780 MHz
Capability	CDMA1xRTT, EvDO Rev.0/Rev.A GPRS/EGPRS WCDMA LTE
Primary Unit (EUT)	<input type="checkbox"/> Production <input checked="" type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering

(Client declaration, max. antenna gain covered under this test report)

LTE Bands	Frequency(ies)	Antenna Gains
Band 4	1710-1755 MHz	1.3 dBi
Band 7	2500-2570 MHz	0.76 dBi
Band 12	698-716 MHz	-2.2 dBi
Band 13	777-787 MHz	-1.0 dBi
Band 17	704-716 MHz	-2.2 dBi
Band 66	1710-1780 MHz	1.3 dBi





**1.3.3 Transmit Frequency Table**

LTE Band 4					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	EIRP	
				Max Power (dBm)	Max Power (Watts)
QPSK	1.4	1710-1750	1M09G7D	23.41	0.219
	3		2M68G7D	23.43	0.220
	5		4M46G7D	23.56	0.227
	10		8M91G7D	23.90	0.245
	15		13M4G7D	24.32	0.270
	20		17M8G7D	23.92	0.247
16QAM	1.4		1M08W7D	22.45	0.176
	3		2M68W7D	22.63	0.183
	5		4M46W7D	22.89	0.195
	10		8M91W7D	22.99	0.199
	15		13M3W7D	23.36	0.217
	20		17M8W7D	23.02	0.200

LTE Band 7					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	EIRP	
				Max Power (dBm)	Max Power (Watts)
QPSK	5	2500-2570	4M49G7D	22.8	0.191
	10		8M97G7D	23.1	0.204
	15		13M4G7D	23.4	0.219
	20		17M9G7D	23.5	0.224
16QAM	5		4M50W7D	21.9	0.155
	10		9M00W7D	22.2	0.166
	15		13M4W7D	22.5	0.178
	20		17M9W7D	22.7	0.186



LTE Band 12					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	ERP	
				Max Power (dBm)	Max Power (Watts)
QPSK	1.4	698-716	1M08G7D	22.9	0.195
	3		2M68G7D	23.0	0.200
	5		4M46G7D	23.0	0.200
	10		8M91G7D	22.8	0.191
16QAM	1.4		1M08W7D	21.8	0.151
	3		2M68W7D	22.3	0.170
	5		4M46W7D	22.4	0.174
	10		8M91W7D	22.1	0.162

LTE Band 13					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	ERP	
				Max Power (dBm)	Max Power (Watts)
QPSK	5	777-787	4M50G7D	23.64	0.231
	10		8M94G7D	23.06	0.202
16QAM	5		4M50W7D	22.90	0.195
	10		8M97W7D	22.10	0.162

LTE Band 17					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	ERP	
				Max Power (dBm)	Max Power (Watts)
QPSK	5	704-716	4M49G7D	23.3	0.214
	10		8M94G7D	23.3	0.214
16QAM	5		4M50W7D	22.2	0.166
	10		8M94W7D	22.2	0.166



LTE Band 66					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	EIRP	
				Max Power (dBm)	Max Power (Watts)
QPSK	5	1710-1780	4M50G7D	23.4	0.219
	10		9M00G7D	23.5	0.224
	15		13M5G7D	23.7	0.234
	20		18M1G7D	23.5	0.224
16QAM	5		4M49W7D	22.5	0.178
	10		9M00W7D	22.8	0.191
	15		13M4W7D	22.9	0.195
	20		18M2W7D	22.7	0.186



**1.4 EUT TEST CONFIGURATION**

**1.4.1 Test Configuration Description**

Test Configuration	Description
A	Conducted antenna port measurement. EUT Tx at a max power and powered by the internal battery and/or USB via AC Adapter.
B	Radiated test setup/case spurious emissions. Antenna port terminated by the call box.

**1.4.2 EUT Exercise Software**

EUT is controlled by a CMW 500 Wideband Radio Communication Tester. There are no other test software used during verification.

**1.4.3 Support Equipment and I/O cables**

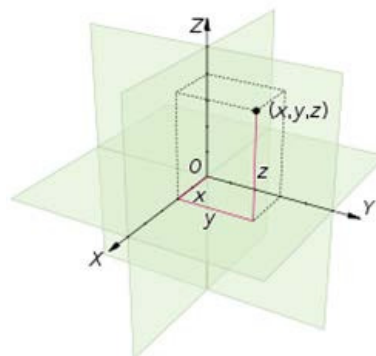
Manufacturer	Equipment/Cable	Description
Novatel Wireless	USB Cable	Micro USB Type B to Standard USB Type B
Novatel Wireless	External AC-DC Power Adapter	Model: SSW-2783, PN: 40123126.01 Input: 100-240VAC, Ouput: 5VDC

**1.4.4 Worst Case Configuration**

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

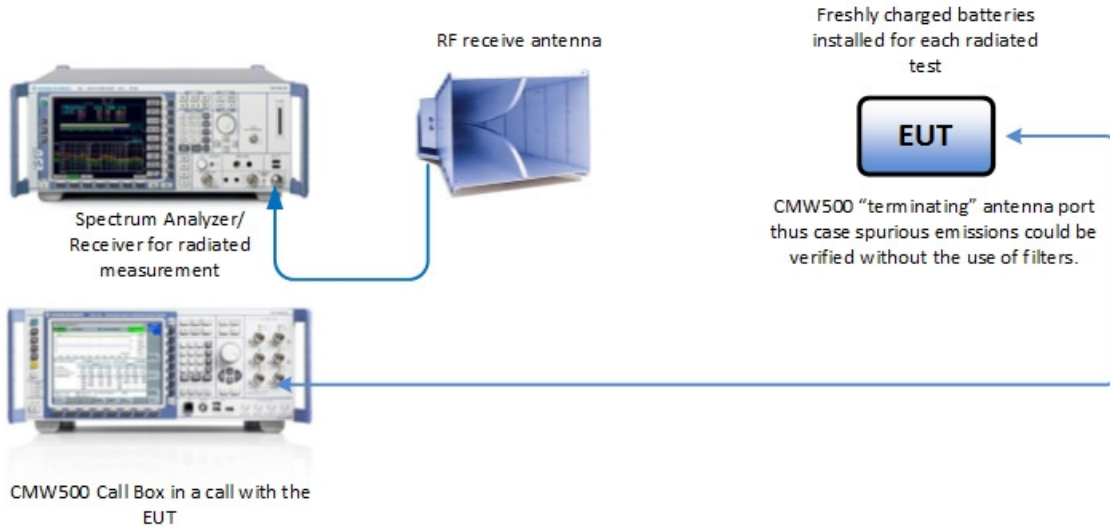
Band	Channel BW	Modulation	RB Size/Offset
Band 4	15 MHz	QPSK	1/0
Band 7	20 MHz	QPSK	1/0
Band 12	5 MHz	QPSK	1/0
Band 13	5 MHz	QPSK	1/0
Band 17	10 MHz	QPSK	1/0
Band 66	15 MHz	QPSK	1/0

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

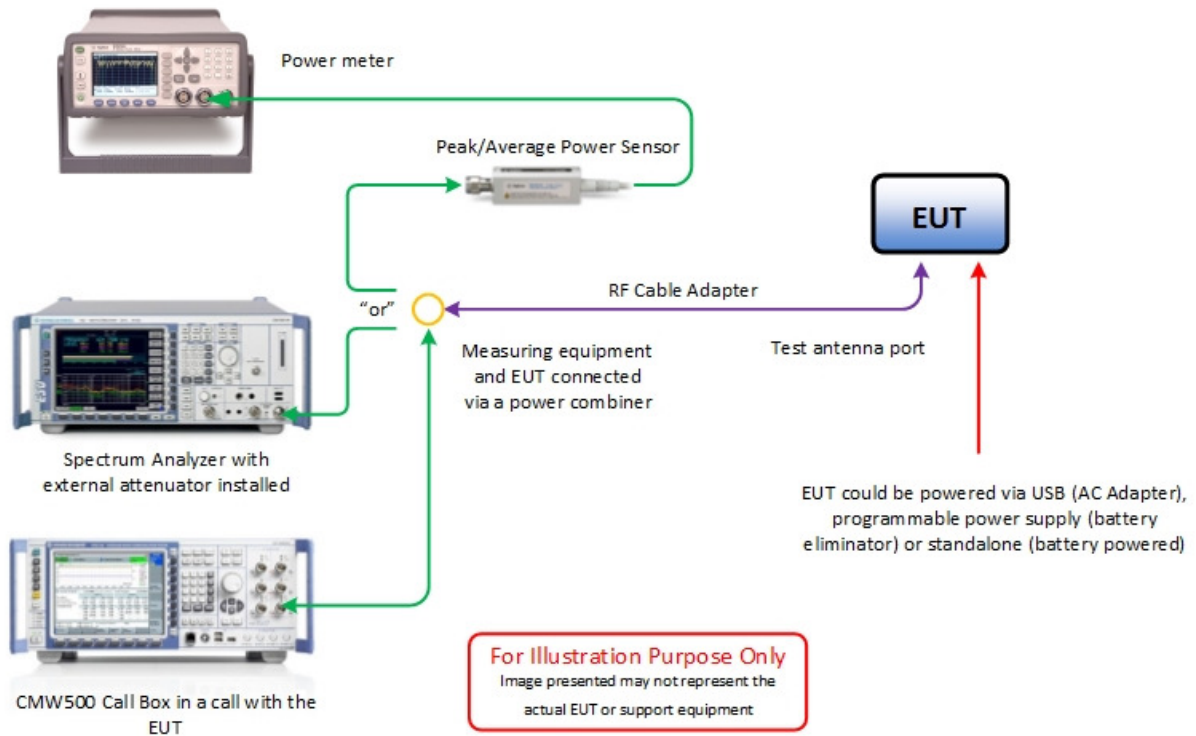


### 1.4.5 Simplified Test Configuration Diagram

#### Radiated Test Configuration



#### Conducted (Antenna Port) Test Configuration





**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 SZ17061900013		
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 and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. 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 1466 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 (ISED) Registration No.: 3067A**

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



**1.10 SAMPLE CALCULATIONS**

**1.10.1 LTE Emission Designator (QPSK)**

Emission Designator = 4M51G7D  
 G = Phase Modulation  
 7= Quantized/Digital Info  
 D = Data Transmission, telemetry, telecommand

**1.10.2 LTE Emission Designator (16QAM)**

Emission Designator = 4M50W7D  
 W = Frequency Modulation  
 7= Quantized/Digital Info  
 D = Data Transmission, telemetry, telecommand

**1.10.3 Spurious Radiated Emission (below 1GHz)**

Measuring equipment raw measurement (dbµV) @ 30 MHz		24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3
	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

**1.10.4 Spurious Radiated Emission – Substitution Method**

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

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

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





## **SECTION 2**

### **TEST DETAILS**

Radio Testing of the  
Novatel Wireless Inc.  
MIFI7000 Wireless Hotspot Modem



## **2.1 TRANSMITTER CONDUCTED POWER MEASUREMENTS**

### **2.1.1 Specification Reference**

Part 2.1046 (a) and (c)  
RSS-130 (4.4), RSS-139 (6.5) and RSS-199 (4.4)

### **2.1.2 Standard Applicable**

(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: SZ17061900013 / Test Configuration A

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

July 07 and 12, 2016 / XYZ and AC

### **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	25.8 °C
Relative Humidity	41.8 %
ATM Pressure	99.2 kPa

### **2.1.7 Additional Observations**

- This is a conducted test using a high speed average power sensor.
- The path loss for LTE Band 4, 7, 12, 13, 17 and Band 66 were measured and entered as a level offset.
- Only worst case of RB size and RB offset presented and recorded in this test report.

### **2.1.8 Test Results**

See attached table.



LTE Band 4						
Modulation	Bandwidth	RB Size	RB Offset	Channels	Frequency (MHz)	Tx Average (dBm)
QPSK	1.4 MHz	1	0	19957	1710.7	23.38
		1	0	20175	1732.5	23.41
	3 MHz	1	0	20393	1754.3	23.17
		1	0	19965	1711.5	23.42
		1	0	20175	1732.5	23.10
	5 MHz	1	0	20385	1753.5	23.43
		1	0	19975	1712.5	23.47
		1	0	20175	1732.5	23.24
	10 MHz	1	0	20375	1752.5	23.56
		1	0	20000	1715.0	23.51
		1	0	20175	1732.5	23.84
	15 MHz	1	0	20350	1750.0	23.90
		1	0	20025	1717.5	23.98
		1	0	20175	1732.5	23.32
	20 MHz	1	0	20325	1747.5	24.32
		1	0	20050	1720.0	23.92
1		0	20175	1732.5	23.42	
1		0	20300	1745.0	23.59	
16QAM	1.4 MHz	1	0	19957	1710.7	22.45
		1	0	20175	1732.5	22.40
		1	0	20393	1754.3	22.32
	3 MHz	1	0	19965	1711.5	22.63
		1	0	20175	1732.5	22.33
		1	0	20385	1753.5	22.36
	5 MHz	1	0	19975	1712.5	22.89
		1	0	20175	1732.5	22.29
		1	0	20375	1752.5	22.68
	10 MHz	1	0	20000	1715.0	22.72
		1	0	20175	1732.5	22.99
		1	0	20350	1750.0	22.80
	15 MHz	1	0	20025	1717.5	23.05
		1	0	20175	1732.5	22.54
		1	0	20325	1747.5	23.36
	20 MHz	1	0	20050	1720.0	23.02
1		0	20175	1732.5	22.59	
1		0	20300	1745.0	22.67	



LTE Band 7						
Modulation	Bandwidth	RB Size	RB Offset	Channels	Frequency (MHz)	Tx Average (dBm)
QPSK	5 MHz	1	0	20775	2502.5	22.7
		<b>1</b>	<b>0</b>	<b>21100</b>	<b>2535</b>	<b>22.8</b>
		1	0	21425	2567.5	22.0
	10 MHz	1	0	20800	2505	23.1
		<b>1</b>	<b>0</b>	<b>21100</b>	<b>2535</b>	<b>23.1</b>
		1	0	21400	2565	22.6
	15 MHz	1	0	20825	2507.5	23.4
		<b>1</b>	<b>0</b>	<b>21100</b>	<b>2535</b>	<b>23.4</b>
		1	0	21375	2562.5	23.4
	20 MHz	1	0	20850	2510	23.5
		<b>1</b>	<b>0</b>	<b>21100</b>	<b>2535</b>	<b>23.5</b>
		1	0	21350	2560	23.5
	16QAM	5 MHz	1	0	20775	2502.5
<b>1</b>			<b>0</b>	<b>21100</b>	<b>2535</b>	<b>21.9</b>
1			0	21425	2567.5	21.0
10 MHz		1	0	20800	2505	22.1
		<b>1</b>	<b>0</b>	<b>21100</b>	<b>2535</b>	<b>22.2</b>
		1	0	21400	2565	21.9
15 MHz		1	0	20825	2507.5	22.3
		<b>1</b>	<b>0</b>	<b>21100</b>	<b>2535</b>	<b>22.5</b>
		1	0	21375	2562.5	22.5
20 MHz		1	0	20850	2510	22.5
		<b>1</b>	<b>0</b>	<b>21100</b>	<b>2535</b>	<b>22.7</b>
		1	0	21350	2560	22.6



LTE Band 12						
Modulation	Bandwidth	RB Size	RB Offset	Channels	Frequency (MHz)	Tx Average (dBm)
QPSK	1.4MHz	1	0	23017	699.7	22.3
		1	0	23095	707.5	22.9
		1	0	23173	715.3	22.6
	3MHz	1	0	23025	700.5	22.4
		1	0	23095	707.5	23.0
		1	0	23165	714.5	23.0
	5 MHz	1	0	23035	701.5	22.5
		1	0	23095	707.5	23.0
		1	0	23155	713.5	23.0
	10 MHz	1	0	23060	704.0	22.5
		1	0	23095	707.5	22.8
		1	0	23130	711.0	22.8
16QAM	1.4MHz	1	0	23017	699.7	21.3
		1	0	23095	707.5	21.8
		1	0	23173	715.3	21.8
	3MHz	1	0	23025	700.5	21.7
		1	0	23095	707.5	22.0
		1	0	23165	714.5	22.3
	5 MHz	1	0	23035	701.5	21.9
		1	0	23095	707.5	22.3
		1	0	23155	713.5	22.4
	10 MHz	1	0	23060	704.0	21.7
		1	0	23095	707.5	22.1
		1	0	23130	711.0	21.9

LTE Band 13						
Modulation	Bandwidth	RB Size	RB Offset	Channels	Frequency (MHz)	Tx Average (dBm)
QPSK	5 MHz	1	0	23205	779.5	23.02
		1	0	23230	782.0	23.30
		1	0	23255	784.5	23.64
	10 MHz	—	—	—	—	—
		1	0	23230	782.0	23.06
16QAM	5 MHz	1	0	23205	779.5	22.22
		1	0	23230	782.0	22.81
		1	0	23255	784.5	22.90
	10 MHz	—	—	—	—	—
		1	0	23230	782.0	22.10
		—	—	—	—	—
		—	—	—	—	—

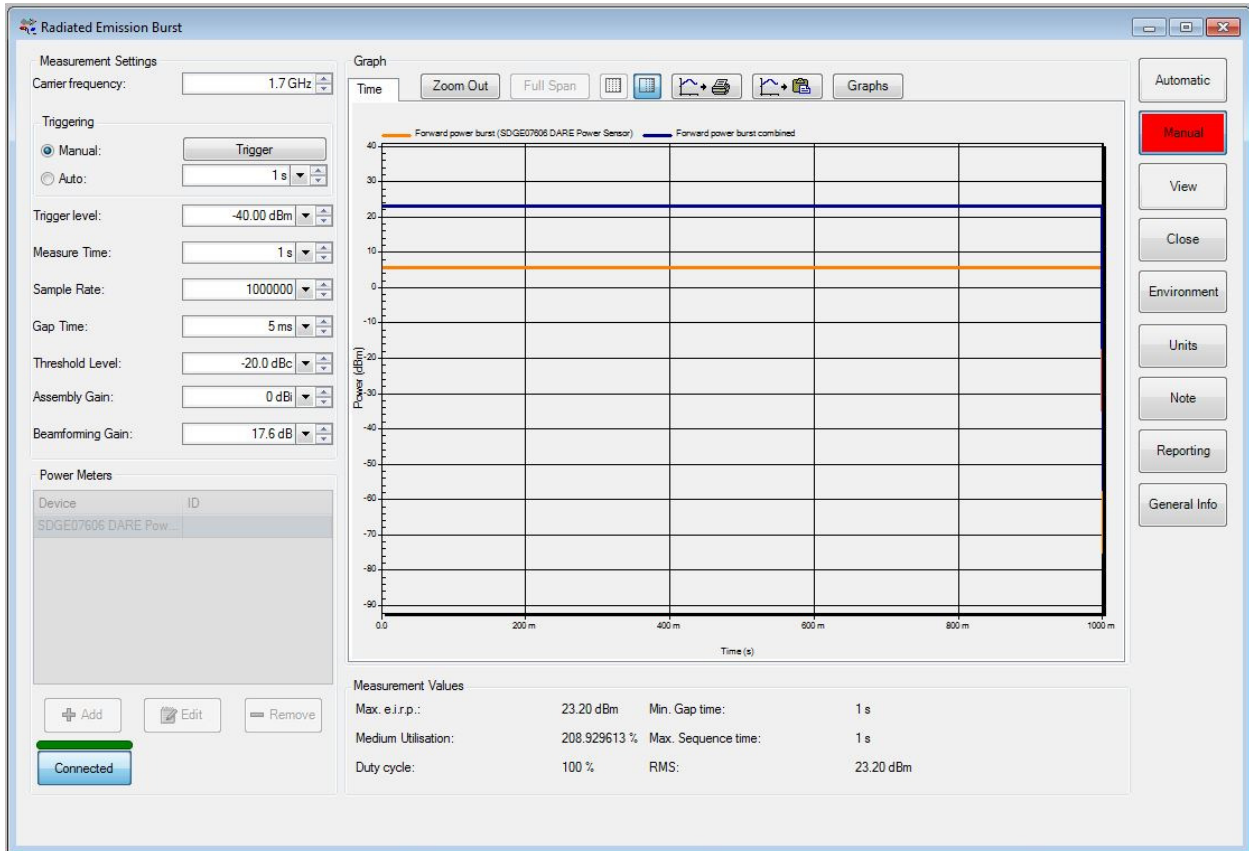


LTE Band 17						
Modulation	Bandwidth	RB Size	RB Offset	Channels	Frequency (MHz)	Tx Average (dBm)
QPSK	5 MHz	1	0	23755	706.5	23.3
		1	0	23790	710	23.0
		1	0	23825	713.5	23.0
	10 MHz	1	0	23780	709	23.3
		1	0	23790	710	23.2
		1	0	23800	711	23.1
16QAM	5 MHz	1	0	23755	706.5	22.0
		1	0	23790	710	21.9
		1	0	23825	713.5	22.2
	10 MHz	1	0	23780	709	22.1
		1	0	23790	710	22.2
		1	0	23800	711	22.1

LTE Band 66						
Modulation	Bandwidth	RB Size	RB Offset	Channels	Frequency (MHz)	Tx Average (dBm)
QPSK	5 MHz	1	0	131997	1712.5	22.7
		1	0	132322	1745	23.4
		1	0	132647	1777.5	22.9
	10 MHz	1	0	132022	1715	22.4
		1	0	132322	1745	23.5
		1	0	132622	1775	23.1
	15 MHz	1	0	132047	1717.5	22.2
		1	0	132322	1745	23.7
		1	0	132597	1772.5	23.5
	20 MHz	1	0	132072	1720	22.0
		1	0	132322	1745	23.4
		1	0	132572	1770	23.5
16QAM	5 MHz	1	0	131997	1712.5	21.9
		1	0	132322	1745	22.5
		1	0	132647	1777.5	22.0
	10 MHz	1	0	132022	1715	21.4
		1	0	132322	1745	22.8
		1	0	132622	1775	22.3
	15 MHz	1	0	132047	1717.5	21.4
		1	0	132322	1745	22.9
		1	0	132597	1772.5	22.8
	20 MHz	1	0	132072	1720	21.1
		1	0	132322	1745	22.7
		1	0	132572	1770	22.7



2.1.9 Sample Test Measurement Screen





## 2.2 EQUIVALENT ISOTROPIC RADIATED POWER

### 2.2.1 Specification Reference

27.50 (d)(4), 27.50 (h)(2) Part 2.1046  
RSS-139 (6.4) and RSS-199 (4.4)

### 2.2.2 Standard Applicable

(d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

The average equivalent isotropically radiated power (e.i.r.p.) for fixed, mobile and portable transmitters in the 1710-1755 MHz shall not exceed 1 watt.

(h) The following power limits shall apply in the BRS and EBS:

(2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

### 2.2.3 Equipment Under Test

Serial No: SZ17061900013, Test Configuration (N/A, calculation only)

### 2.2.4 Date of Verification/Initial of test personnel who performed the calculation

August 02. 2016 / AC

### 2.2.5 Additional Observations

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

$$\text{EIRP} = P_T + G_T - L_C$$

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)

$L_C$  = signal attenuation in the connecting cable between the transmitter and antenna, in dB (Power measurement performed directly at the primary antenna port. The loss between the LTE module and the primary antenna port is considered negligible).

### 2.2.6 Test Results

See attached table.





LTE Band 4									
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (Watt)	Limit (Watt)
QPSK	1.4	1 / 0	19957	1710.7	23.38	1.3	24.68	0.29	1
		1 / 0	20175	1732.5	23.41	1.3	24.71	0.30	1
		1 / 0	20393	1754.3	23.17	1.3	24.47	0.28	1
	3	1 / 0	19965	1711.5	23.42	1.3	24.72	0.30	1
		1 / 0	20175	1732.5	23.10	1.3	24.4	0.28	1
		1 / 0	20385	1753.5	23.43	1.3	24.73	0.30	1
	5	1 / 0	19975	1712.5	23.47	1.3	24.77	0.30	1
		1 / 0	20175	1732.5	23.24	1.3	24.54	0.28	1
		1 / 0	20375	1752.5	23.56	1.3	24.86	0.31	1
	10	1 / 0	20000	1715.0	23.51	1.3	24.81	0.30	1
		1 / 0	20175	1732.5	23.84	1.3	25.14	0.33	1
		1 / 0	20350	1750.0	23.90	1.3	25.2	0.33	1
	15	1 / 0	20025	1717.5	23.98	1.3	25.28	0.34	1
		1 / 0	20175	1732.5	23.32	1.3	24.62	0.29	1
		1 / 0	20325	1747.5	24.32	1.3	25.62	0.36	1
	20	1 / 0	20050	1720.0	23.92	1.3	25.22	0.33	1
		1 / 0	20175	1732.5	23.42	1.3	24.72	0.30	1
		1 / 0	20300	1745.0	23.59	1.3	24.89	0.31	1



<b>LTE Band 4</b>									
<b>Modulation</b>	<b>Bandwidth (MHz)</b>	<b>RB Size/Offset</b>	<b>Channels</b>	<b>Frequency (MHz)</b>	<b>Tx Average Power (dBm)</b>	<b>Antenna Gain (dBi)</b>	<b>EIRP (dBm)</b>	<b>EIRP (Watt)</b>	<b>Limit (Watt)</b>
16QAM	1.4	1/0	19957	1710.7	22.45	1.3	23.75	0.24	1
		1/0	20175	1732.5	22.40	1.3	23.7	0.23	1
		1/0	20393	1754.3	22.32	1.3	23.62	0.23	1
	3	1/0	19965	1711.5	22.63	1.3	23.93	0.25	1
		1/0	20175	1732.5	22.33	1.3	23.63	0.23	1
		1/0	20385	1753.5	22.36	1.3	23.66	0.23	1
	5	1/0	19975	1712.5	22.89	1.3	24.19	0.26	1
		1/0	20175	1732.5	22.29	1.3	23.59	0.23	1
		1/0	20375	1752.5	22.68	1.3	23.98	0.25	1
	10	1/0	20000	1715.0	22.72	1.3	24.02	0.25	1
		1/0	20175	1732.5	22.99	1.3	24.29	0.27	1
		1/0	20350	1750.0	22.80	1.3	24.1	0.26	1
	15	1/0	20025	1717.5	23.05	1.3	24.35	0.27	1
		1/0	20175	1732.5	22.54	1.3	23.84	0.24	1
		1/0	20325	1747.5	23.36	1.3	24.66	0.29	1
	20	1/0	20050	1720.0	23.02	1.3	24.32	0.27	1
		1/0	20175	1732.5	22.59	1.3	23.89	0.24	1
		1/0	20300	1745.0	22.67	1.3	23.97	0.25	1



LTE Band 7									
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (Watt)	Limit (Watt)
QPSK	5	1/0	20775	2502.5	22.7	0.76	23.46	0.22	2
		1/0	21100	2535	22.8	0.76	23.56	0.23	2
		1/0	21425	2567.5	22.0	0.76	22.76	0.19	2
	10	1/0	20800	2505	23.1	0.76	23.86	0.24	2
		1/0	21100	2535	23.1	0.76	23.86	0.24	2
		1/0	21400	2565	22.6	0.76	23.36	0.22	2
	15	1/0	20825	2507.5	23.4	0.76	24.16	0.26	2
		1/0	21100	2535	23.4	0.76	24.16	0.26	2
		1/0	21375	2562.5	23.4	0.76	24.16	0.26	2
	20	1/0	20850	2510	23.5	0.76	24.26	0.27	2
		1/0	21100	2535	23.5	0.76	24.26	0.27	2
		1/0	21350	2560	23.5	0.76	24.26	0.27	2
16QAM	5	1/0	20775	2502.5	21.9	0.76	22.66	0.18	2
		1/0	21100	2535	21.9	0.76	22.66	0.18	2
		1/0	21425	2567.5	21.0	0.76	21.76	0.15	2
	10	1/0	20800	2505	22.1	0.76	22.86	0.19	2
		1/0	21100	2535	22.2	0.76	22.96	0.20	2
		1/0	21400	2565	21.9	0.76	22.66	0.18	2
	15	1/0	20825	2507.5	22.3	0.76	23.06	0.20	2
		1/0	21100	2535	22.5	0.76	23.26	0.21	2
		1/0	21375	2562.5	22.5	0.76	23.26	0.21	2
	20	1/0	20850	2510	22.5	0.76	23.26	0.21	2
		1/0	21100	2535	22.7	0.76	23.46	0.22	2
		1/0	21350	2560	22.6	0.76	23.36	0.22	2



LTE Band 66									
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (Watt)	Limit (Watt)
QPSK	5	1/0	131997	1712.5	22.7	1.3	24	0.25	1
		1/0	132322	1745	23.4	1.3	24.7	0.30	1
		1/0	132647	1777.5	22.9	1.3	24.2	0.26	1
	10	1/0	132022	1715	22.4	1.3	23.7	0.23	1
		1/0	132322	1745	23.5	1.3	24.8	0.30	1
		1/0	132622	1775	23.1	1.3	24.4	0.28	1
	15	1/0	132047	1717.5	22.2	1.3	23.5	0.22	1
		1/0	132322	1745	23.7	1.3	25	0.32	1
		1/0	132597	1772.5	23.5	1.3	24.8	0.30	1
	20	1/0	132072	1720	22.0	1.3	23.3	0.21	1
		1/0	132322	1745	23.4	1.3	24.7	0.30	1
		1/0	132572	1770	23.5	1.3	24.8	0.30	1
16QAM	5	1/0	131997	1712.5	21.9	1.3	23.2	0.21	1
		1/0	132322	1745	22.5	1.3	23.8	0.24	1
		1/0	132647	1777.5	22.0	1.3	23.3	0.21	1
	10	1/0	132022	1715	21.4	1.3	22.7	0.19	1
		1/0	132322	1745	22.8	1.3	24.1	0.26	1
		1/0	132622	1775	22.3	1.3	23.6	0.23	1
	15	1/0	132047	1717.5	21.4	1.3	22.7	0.19	1
		1/0	132322	1745	22.9	1.3	24.2	0.26	1
		1/0	132597	1772.5	22.8	1.3	24.1	0.26	1
	20	1/0	132072	1720	21.1	1.3	22.4	0.17	1
		1/0	132322	1745	22.7	1.3	24	0.25	1
		1/0	132572	1770	22.7	1.3	24	0.25	1



## 2.3 EFFECTIVE RADIATED POWER OUTPUT DATA

### 2.3.1 Specification Reference

27.50 (b)(10)(12)(c)(10) and Part 2.1046  
RSS-130 (4.4)

### 2.3.2 Standard Applicable

(b) The following power and antenna height limits apply to transmitters operating in the 746–758 MHz, 775–788 MHz and 805–806 MHz bands:

(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.

(12) For transmissions in the 746–757, 758–763, 776–787, and 788–793 MHz bands, licensees may employ equipment operating in compliance with either the measurement techniques described in paragraph (b)(11) of this section or a Commission-approved average power technique. In both instances, equipment employed must be authorized in accordance with the provisions of §27.51.

(c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz and the 698-746 MHz band:

(10) Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

### 2.3.3 Equipment Under Test

Serial No: SZ17061900013, Test Configuration (N/A, calculation only)

### 2.3.4 Date of Verification/Initial of test personnel who performed the calculation

August 03, 2016 / AC

### 2.3.5 Additional Observations

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

$$\text{ERP} = P_T + G_T - L_C - 2.15\text{dB}$$

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 (Power measurement performed directly at the primary antenna port. The loss between the LTE module and the primary antenna port is considered negligible).

### 2.3.6 Test Results

See attached table.



LTE Band 12									
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain (dBi)	ERP (dBm)	ERP (Watt)	Limit (Watt)
QPSK	1.4	1/0	23017	699.7	22.3	-2.2	17.95	0.06	3
		1/0	23095	707.5	22.9	-2.2	18.55	0.07	3
		1/0	23173	715.3	22.6	-2.2	18.25	0.07	3
	3	1/0	23025	700.5	22.4	-2.2	18.05	0.06	3
		1/0	23095	707.5	23.0	-2.2	18.65	0.07	3
		1/0	23165	714.5	23.0	-2.2	18.65	0.07	3
	5	1/0	23035	701.50	22.5	-2.2	18.15	0.07	3
		1/0	23095	707.50	23.0	-2.2	18.65	0.07	3
		1/0	23155	713.50	23.0	-2.2	18.65	0.07	3
	10	1/0	23060	704.00	22.5	-2.2	18.15	0.07	3
		1/0	23095	707.50	22.8	-2.2	18.45	0.07	3
		1/0	23130	711.00	22.8	-2.2	18.45	0.07	3
16QAM	1.4	1/0	23017	699.7	21.3	-2.2	16.95	0.05	3
		1/0	23095	707.5	21.8	-2.2	17.45	0.06	3
		1/0	23173	715.3	21.8	-2.2	17.45	0.06	3
	3	1/0	23025	700.5	21.7	-2.2	17.35	0.05	3
		1/0	23095	707.5	22.0	-2.2	17.65	0.06	3
		1/0	23165	714.5	22.3	-2.2	17.95	0.06	3
	5	1/0	23035	701.50	21.9	-2.2	17.55	0.06	3
		1/0	23095	707.50	22.3	-2.2	17.95	0.06	3
		1/0	23155	713.50	22.4	-2.2	18.05	0.06	3
	10	1/0	23060	704.00	21.7	-2.2	17.35	0.05	3
		1/0	23095	707.50	22.1	-2.2	17.75	0.06	3
		1/0	23130	711.00	21.9	-2.2	17.55	0.06	3



LTE Band 13										
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain (dBi)	ERP (dBm)	ERP (Watt)	Limit (Watt)	
QPSK	5	1 / 0	23205	779.5	23.02	-1.0	19.87	0.10	3	
		1 / 0	23230	782.0	23.30	-1.0	20.15	0.10	3	
		1 / 0	23255	784.5	23.64	-1.0	20.49	0.11	3	
	10	—	—	—	—	—	—	—	—	—
		1 / 0	23230	782.0	23.06	-1.0	19.91	0.10	3	
		—	—	—	—	—	—	—	—	—
16QAM	5	1 / 0	23205	779.5	22.22	-1.0	19.07	0.08	3	
		1 / 0	23230	782.0	22.81	-1.0	19.66	0.09	3	
		1 / 0	23255	784.5	22.90	-1.0	19.75	0.09	3	
	10	—	—	—	—	—	—	—	—	—
		1 / 0	23230	782.0	22.10	-1.0	18.95	0.08	3	
		—	—	—	—	—	—	—	—	—

LTE Band 17									
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain (dBi)	ERP (dBm)	ERP (Watt)	Limit (Watt)
QPSK	5	1 / 0	23755	706.5	23.3	-2.2	18.95	0.08	3
		1 / 0	23790	710	23.0	-2.2	18.65	0.07	3
		1 / 0	23825	713.5	23.0	-2.2	18.65	0.07	3
	10	1 / 0	23780	709	23.3	-2.2	18.95	0.08	3
		1 / 0	23790	710	23.2	-2.2	18.85	0.08	3
		1 / 0	23800	711	23.1	-2.2	18.75	0.07	3
16QAM	5	1 / 0	23755	706.5	22.0	-2.2	17.65	0.06	3
		1 / 0	23790	710	21.9	-2.2	17.55	0.06	3
		1 / 0	23825	713.5	22.2	-2.2	17.85	0.06	3
	10	1 / 0	23780	709	22.1	-2.2	17.75	0.06	3
		1 / 0	23790	710	22.2	-2.2	17.85	0.06	3
		1 / 0	23800	711	22.1	-2.2	17.75	0.06	3



## **2.4 OCCUPIED BANDWIDTH**

### **2.4.1 Specification Reference**

27.53 (c)(2)(5), 27.53 (g)(h)(1), 27.53 (m)(6) and Part 2.1049  
RSS-199 (4.2) and RSS-Gen (6.6)

### **2.4.2 Standard Applicable**

The transmitted signal bandwidth shall be reported as the 99% emission bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. 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 measurement function in the spectrum analyzer, the 99% occupied bandwidth was measured.

In addition, the 26dB bandwidth was measured in accordance 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.

### **2.4.3 Equipment Under Test and Modification State**

Serial No: SZ17061900013 / Test Configuration A

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

July 12 to 20, 2016 / AC

### **2.4.5 Test Equipment Used**

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

### **2.4.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.4°C
Relative Humidity	51.7%
ATM Pressure	98.7 kPa





#### **2.4.7 Additional Observations**

- This is a conducted test. Test procedure is per Section 4.0 of KDB971168 D01 (Power Meas License Digital Systems v02 DR02-41372).
- Both relative 26dB BW and 99% OBW presented.
- All channels per each channel bandwidth/band were verified. No significant difference observed. Only the worst channel presented.

#### **2.4.8 Test Results**

See attached table and Sample test plots.



LTE Band 4							
Modulation	Bandwidth (MHz)	RB Size	RB Offset	Channel	Frequency (MHz)	99% OBW (MHz)	26dB BW (MHz)
QPSK	1.4	6	0	20175	1732.5	1.09	1.22
	3	15	0	20385	1753.5	2.68	2.89
	5	25	0	20375	1752.5	4.46	4.73
	10	50	0	20350	1750.0	8.91	9.29
	15	75	0	20325	1747.5	13.37	13.92
	20	100	0	20050	1720.0	17.80	18.45
16QAM	1.4	6	0	19957	1710.7	1.08	1.22
	3	15	0	19965	1711.5	2.68	2.89
	5	25	0	19975	1712.5	4.46	4.72
	10	50	0	20175	1732.5	8.91	9.26
	15	75	0	20325	1747.5	13.34	13.84
	20	100	0	20050	1720.0	17.80	18.45

LTE Band 7							
Modulation	Bandwidth (MHz)	RB Size	RB Offset	Channel	Frequency (MHz)	99% OBW (MHz)	26dB BW (MHz)
QPSK	5	25	0	21100	2535	4.49	4.99
	10	50	0	21100	2535	8.97	9.93
	15	75	0	21100	2535	13.43	14.64
	20	100	0	21100	2535	17.89	19.23
16QAM	5	25	0	21100	2535	4.50	5.01
	10	50	0	21100	2535	9.00	9.78
	15	75	0	21100	2535	13.43	14.56
	20	100	0	21100	2535	17.93	19.45

LTE Band 12							
Modulation	Bandwidth (MHz)	RB Size	RB Offset	Channel	Frequency (MHz)	99% OBW (MHz)	26dB BW (MHz)
QPSK	1.4	6	0	23095	707.5	1.08	1.21
	3	15	0	23095	707.5	2.68	2.88
	5	25	0	23155	713.5	4.46	4.76
	10	50	0	23130	711.0	8.91	9.23
16QAM	1.4	6	0	23095	707.5	1.08	1.22
	3	15	0	23165	714.5	2.68	2.89
	5	25	0	23155	713.5	4.46	4.75
	10	50	0	23095	707.5	8.91	9.23



LTE Band 13							
Modulation	Bandwidth (MHz)	RB Size	RB Offset	Channel	Frequency (MHz)	99% OBW (MHz)	26dB BW (MHz)
QPSK	5	25	0	23255	784.5	4.50	5.01
	10	50	0	23230	782.0	8.94	9.90
16QAM	5	25	0	23255	784.5	4.50	4.99
	10	50	0	23230	782.0	8.97	9.78

LTE Band 17							
Modulation	Bandwidth (MHz)	RB Size	RB Offset	Channel	Frequency (MHz)	99% OBW (MHz)	26dB BW (MHz)
QPSK	5	25	0	23755	706.5	4.49	4.96
	10	50	0	23780	709	8.94	9.81
16QAM	5	25	0	23825	713.5	4.50	5.01
	10	50	0	23790	710	8.94	9.70

LTE Band 66							
Modulation	Bandwidth (MHz)	RB Size	RB Offset	Channel	Frequency (MHz)	99% OBW (MHz)	26dB BW (MHz)
QPSK	5	25	0	132322	1745	4.50	5.01
	10	50	0	132322	1745	9.00	9.93
	15	75	0	132322	1745	13.46	14.59
	20	100	0	132572	1770	18.09	19.61
16QAM	5	25	0	132322	1745	4.49	4.98
	10	50	0	132322	1745	9.00	9.81
	15	75	0	132322	1745	13.43	14.50
	20	100	0	132322	1745	18.16	19.75



**LTE Band 4 (15 MHz BW)/1747.5 MHz/QPSK/99%OBW**



**LTE Band 4 (15 MHz BW)/1747.5 MHz/QPSK/26dB BW**





## **2.5 PEAK-AVERAGE POWER RATIO**

### **2.5.1 Specification Reference**

27.50 (B), 27.50 (d)(5)  
RSS-130 (4.4) and RSS-139 (6.5)

### **2.5.2 Standard Applicable**

The transmitter output power shall be measured in terms of average power. For base and fixed equipment, refer to SRSP-518 for power limits. 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. In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

### **2.5.3 Equipment Under Test and Modification State**

Serial No: SZ17061900013 / Test Configuration A

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

July 13, 2016 / AC

### **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	25.6 °C
Relative Humidity	43.6 %
ATM Pressure	99.1 kPa

### **2.5.7 Additional Observations**

- This is a conducted test. Test procedure is per Section 5.7.1 of KDB971168 (D01 Power Meas License Digital Systems v02 DR02-41372).
- 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.



- All channels based from worst case configuration channel bandwidth were verified. Only the worst channel presented.
- There are no measured PAR levels greater than 13dB.

**2.5.8 Test Results**

See attached summary table and sample test plots.

LTE Band 4							
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Mean (dBm)	Peak (dBm)	0.1 % (dB)	Limit for 0.1 % (dB)
QPSK	1.4	20175	1732.5	22.66	27.54	4.81	13
	3	20385	1753.5	22.59	27.20	4.55	13
	5	20375	1752.5	22.68	27.19	4.46	13
	10	20350	1750.0	22.52	27.52	4.81	13
	15	20325	1747.5	23.03	28.14	4.78	13
	20	20050	1720.0	22.16	27.92	4.96	13
16QAM	1.4	19957	1710.7	21.66	27.18	5.42	13
	3	19965	1711.5	21.71	27.11	5.33	13
	5	19975	1712.5	21.74	27.02	5.22	13
	10	20175	1732.5	21.71	27.56	5.62	13
	15	20325	1747.5	22.18	28.03	5.54	13
	20	20050	1720.0	21.30	27.74	5.77	13

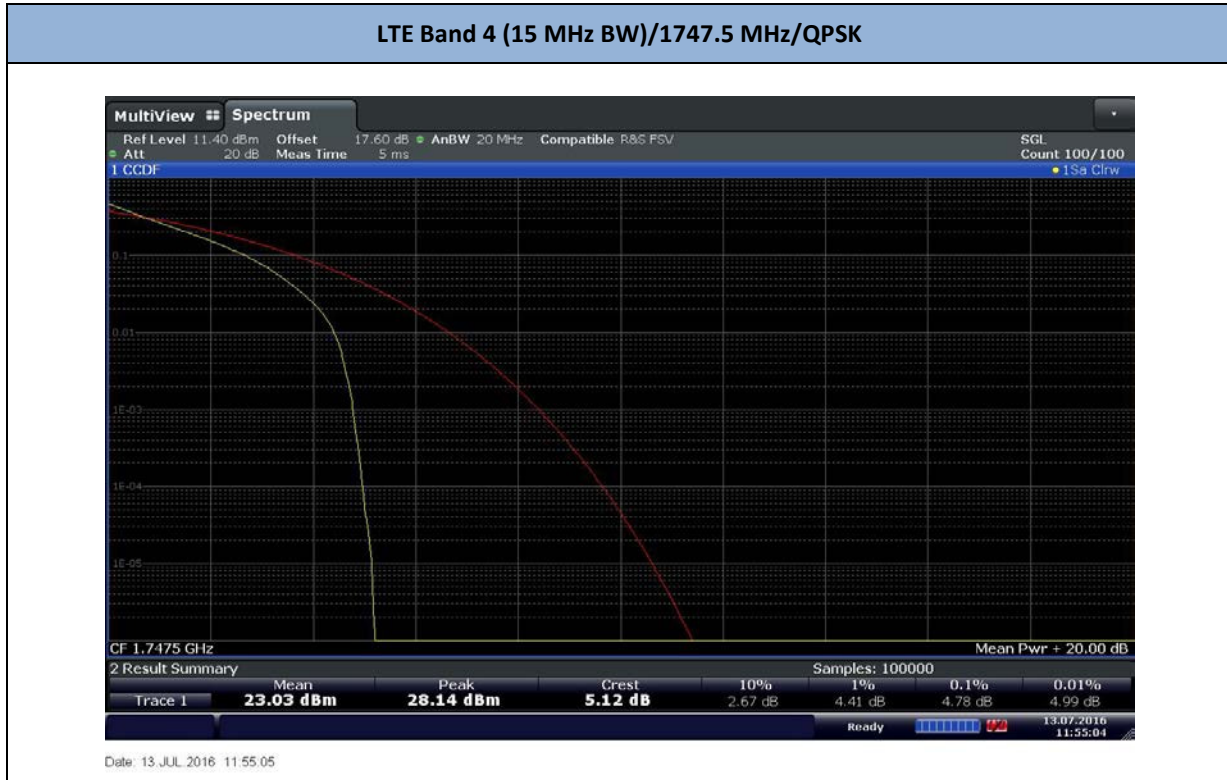
LTE Band 12							
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Mean (dBm)	Peak (dBm)	0.1 % (dB)	Limit for 0.1 % (dB)
QPSK	1.4	23095	707.5	22.76	27.99	5.19	13
	3	23095	707.5	22.36	27.88	5.39	13
	5	23155	713.5	21.38	27.68	5.91	13
	10	23130	711.0	22.49	28.44	5.30	13
16QAM	1.4	23095	707.5	21.82	28.02	6.06	13
	3	23165	714.5	21.53	27.92	6.20	13
	5	23155	713.5	20.34	27.65	6.81	13
	10	23095	707.5	21.53	28.21	6.12	13



LTE Band 13							
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Mean (dBm)	Peak (dBm)	0.1 % (dB)	Limit for 0.1 % (dB)
QPSK	5	23255	784.5	21.73	27.91	5.48	13
	10	23230	782.0	21.70	27.75	5.25	13
16QAM	5	23255	784.5	20.81	27.76	6.20	13
	10	23230	782.0	20.73	27.47	6.09	13

LTE Band 17							
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Mean (dBm)	Peak (dBm)	0.1 % (dB)	Limit for 0.1 % (dB)
QPSK	5	23755	706.5	21.54	28.27	5.80	13
	10	23780	709	21.68	28.19	5.62	13
16QAM	5	23825	713.5	14.99	21.72	6.06	13
	10	23790	710	13.64	21.28	6.96	13

LTE Band 66							
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Mean (dBm)	Peak (dBm)	0.1 % (dB)	Limit for 0.1 % (dB)
QPSK	5	132322	1745	22.69	27.58	4.81	13
	10	132322	1745	22.82	27.76	4.78	13
	15	132322	1745	22.82	28.17	5.01	13
	20	132572	1770	22.69	28.21	4.96	13
16QAM	5	132322	1745	21.65	27.59	5.83	13
	10	132322	1745	15.38	22.96	6.35	13
	15	132322	1745	15.31	22.25	5.77	13
	20	132322	1745	22.08	28.56	5.83	13







## 2.6 BAND EDGE

### 2.6.1 Specification Reference

27.53 (c)(2)(5), (g)(h)(1), (m)(4) and Part 2.1053  
RSS-130 (4.6.1), RSS-139 (6.6) and RSS-199 (4.6)

### 2.6.2 Standard Applicable

(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.

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

### 2.6.3 Equipment Under Test and Modification State

Serial No: SZ17061900013 / Test Configuration A

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

July 13, 2016 / AC

### 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	25.1 °C
Relative Humidity	42.6 %
ATM Pressure	99.0 kPa

### 2.6.7 Additional Observations

- This is a conducted test. Test guidance is per Section 6.0 of KDB971168 (D01 Power Meas License Digital Systems v02 DR02-41372).
- The center frequency of the spectrum is the band edge frequency.
- RBW is set to 100 kHz (minimum of 30kHz limited to 1% of EBW) and VBW is set to 3X RBW.



- All RB size available verified and only the worst case modulation (QPSK) for band edge verification presented in this test report.

**2.6.8 Test Results**

See attached summary table and sample test plots.

LTE Band 4					
Modulation	Bandwidth (MHz)	Channels (Low / High)	Band Edge @ Frequency (MHz)	Measured (dBm)	Limit (dBm)
QPSK	1.4	19957	1710	-23.70	-13
		20393	1755	-17.96	-13
	3	19965	1710	-20.24	-13
		20385	1755	-20.61	-13
	5	19975	1710	-26.99	-13
		20375	1755	-26.48	-13
	10	20000	1710	-29.25	-13
		20350	1755	-29.35	-13
	15	20025	1710	-32.63	-13
		20325	1755	-28.40	-13
	20	20050	1710	-32.82	-13
		20300	1755	-28.90	-13

LTE Band 7					
Modulation	Bandwidth (MHz)	Channels (Low / High)	Band Edge @ Frequency (MHz)	Measured (dBm)	Limit (dBm)
QPSK	5	20775	2500	-25.71	-13
		21425	2570	-26.80	-13
	10	20800	2500	-25.36	-13
		21400	2570	-30.85	-13
	15	20825	2500	-26.07	-13
		21375	2570	-31.35	-13
	20	20850	2500	-26.47	-13
		21350	2570	-34.27	-13

LTE Band 12					
Modulation	Bandwidth (MHz)	Channels (Low / High)	Band Edge @ Frequency (MHz)	Measured (dBm)	Limit (dBm)
QPSK	1.4	23017	698	-38.67	-13
		23173	716	-19.26	-13
	3	23025	698	-30.33	-13
		23165	716	-19.16	-13
	5	23035	698	-30.03	-13
		23155	716	-25.43	-13
	10	23060	698	-28.51	-13
		23130	716	-26.94	-13



LTE Band 13					
Modulation	Bandwidth (MHz)	Channels (Low / High)	Band Edge @ Frequency (MHz)	Measured (dBm)	Limit (dBm)
QPSK	5	23205	777	-24.45	-13
		23255	787	-27.06	-13
	10	23230	777-787	-26.25 / -24.36	-13

LTE Band 17					
Modulation	Bandwidth (MHz)	Channels (Low / High)	Band Edge @ Frequency (MHz)	Measured (dBm)	Limit (dBm)
QPSK	5	23755	704	-26.37	-13
		23825	716	-24.76	-13
	10	23780	704	-29.87	-13
		23800	716	-28.18	-13

LTE Band 66					
Modulation	Bandwidth (MHz)	Channels (Low / High)	Band Edge @ Frequency (MHz)	Measured (dBm)	Limit (dBm)
QPSK	5	131997	1710	-23.59	-13
		132647	1780	-28.41	-13
	10	132022	1710	-26.42	-13
		132622	1780	-32.94	-13
	15	132047	1710	-30.16	-13
		132597	1780	-32.89	-13
	20	132072	1710	-32.03	-13
		132572	1780	-33.39	-13



LTE Band 4 (15 MHz BW)/Low Channel (20025) Band Edge @ 1710 MHz



Date: 13 JUL 2016 13:49:29

LTE Band 4 (15 MHz BW)/High Channel (20325) Band Edge @ 1755 MHz



Date: 13 JUL 2016 13:51:30



## **2.7 CONDUCTED SPURIOUS EMISSIONS**

### **2.7.1 Specification Reference**

27.53 (c)(2), (g)(h)(1), (m)(4) and Part 2.1053  
RSS-130 (4.6.1), RSS-139 (6.6) and RSS-199 (4.6)

### **2.7.2 Standard Applicable**

(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.

4.6.2 In addition to the limit outlined in Section 4.6.1 (RSS-130 Issue 1: 2013, RSS-139 Issue: 2015 and RSS-199 Issue 2: 2014), equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

(a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

- (i)  $76 + 10 \log_{10} p(\text{watts})$ , dB, for base and fixed equipment, and
- (ii)  $65 + 10 \log_{10} p(\text{watts})$ , dB, for mobile and portable equipment.

(b) The e.i.r.p. in the band 1559-1610 MHz shall not exceed -70 dBW/MHz for wideband signal and -80 dBW for discrete emission with bandwidth less than 700 Hz.

### **2.7.3 Equipment Under Test and Modification State**

Serial No: SZ17061900013 / Test Configuration A

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

July 13, 2016 / AC

### **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 Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.8 °C
Relative Humidity	43.4 %
ATM Pressure	99.0 kPa



### **2.7.7 Additional Observations**

- This is a conducted test.
- The spectrum was searched from 30MHz to the 10<sup>th</sup> harmonic (20GHz) for Band 4. Band 12 was verified up to 20GHz.
- Low, Mid and High channels on all channel bandwidth verified. Only the worst case channel of each band and RB size/offset modulation presented.

### **2.7.8 Test Results**

Compliant. See attached summary table and sample test plots.



LTE Band 4					
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Highest Emission Measured (dBm)	Limit (dBm)
QPSK	1.4	20175	1732.5	-27.21	-13
	3	20175	1732.5	-24.52	-13
	5	20175	1732.5	-24.36	-13
	10	20175	1732.5	-23.76	-13
	15	20175	1732.5	-23.91	-13
	20	20175	1732.5	-24.31	-13

LTE Band 7					
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Highest Emission Measured (dBm)	Limit (dBm)
QPSK	5	20775	2502.5	-28.64	-25
	10	20800	2505	-27.04	-25
	15	20825	2507.5	-27.76	-25
	20	20850	2510	-27.38	-25

LTE Band 12					
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Highest Emission Measured (dBm)	Limit (dBm)
QPSK	1.4	23017	699.7	-27.95	-13
	3	23025	700.5	-28.96	-13
	5	23035	701.50	-29.96	-13
	10	23060	704.00	-29.77	-13

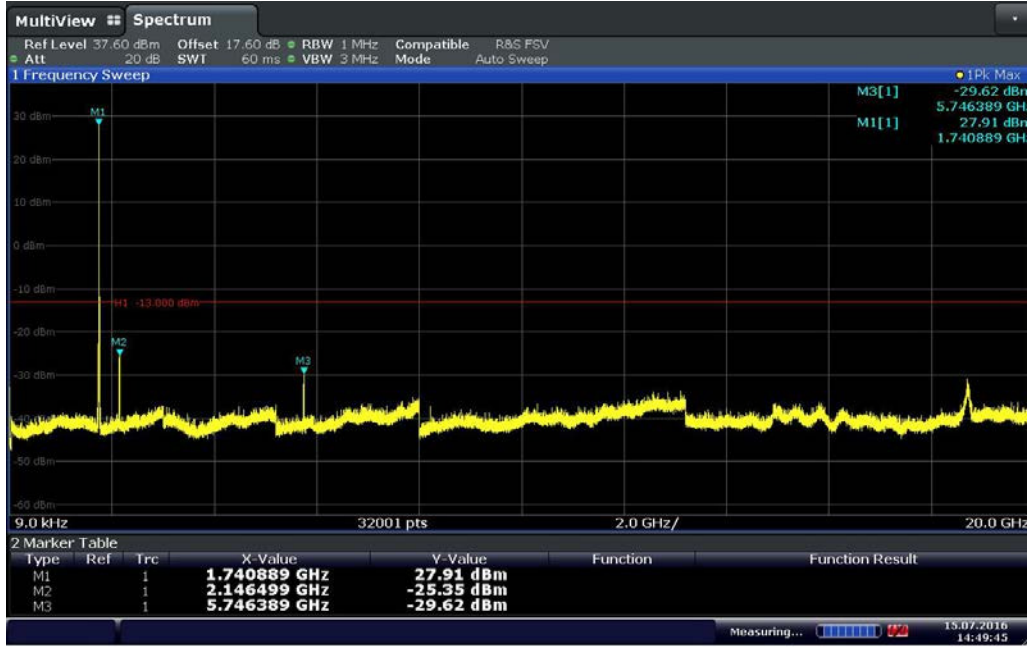
LTE Band 13					
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Highest Emission Measured (dBm)	Limit (dBm)
QPSK		23255	784.5	-40.72	-13
	10	23230	782.0	-40.92	-13

LTE Band 17					
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Highest Emission Measured (dBm)	Limit (dBm)
QPSK	5	23755	706.5	-41.35	-13
	10	23780	709	-41.15	-13

LTE Band 66					
Modulation	Bandwidth (MHz)	Channels	Frequency (MHz)	Highest Emission Measured (dBm)	Limit (dBm)
QPSK	5	132322	1745	-20.79	-13
	10	132322	1745	-19.69	-13
	15	132322	1745	-19.78	-13
	20	132572	1770	-18.09	-13



LTE Band 4\_15M BW\_QPSK\_Channel 20325 @ 1747.5MHz



Date: 15 JUL 2016 14:49:46





## **2.8 FIELD STRENGTH OF SPURIOUS RADIATION**

### **2.8.1 Specification Reference**

27.53 (c)(2), (g)(h)(1), (m)(4) and Part 2.1053  
RSS-130 (4.6.1), RSS-139 (6.6) and RSS-199 (4.6)

### **2.8.2 Standard Applicable**

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; (5) Compliance with the provisions of paragraphs (c)(1) 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.

4.6.2 In addition to the limit outlined in Section 4.6.1 (RSS-130 Issue 1: 2013, RSS-139 Issue: 2015 and RSS-199 Issue 2: 2014), equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

(a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

- (i)  $76 + 10 \log_{10} p(\text{watts})$ , dB, for base and fixed equipment, and
- (ii)  $65 + 10 \log_{10} p(\text{watts})$ , dB, for mobile and portable equipment.

6.5

(i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in watts) by at least  $43 + 10 \log_{10}(P)$ , dB.

(ii) After the first 1.0 MHz outside the equipment's operating frequency block, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in watts) by at least  $43 + 10 \log_{10}(P)$ , dB

### **2.8.3 Equipment Under Test and Modification State**

Serial No: SZ17061900013 / Test Configuration B

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

July 11 to 22, 2016 / AC and IR

### **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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.1°C
Relative Humidity	44.5%
ATM Pressure	98.7 kPa

### 2.8.7 Additional Observations

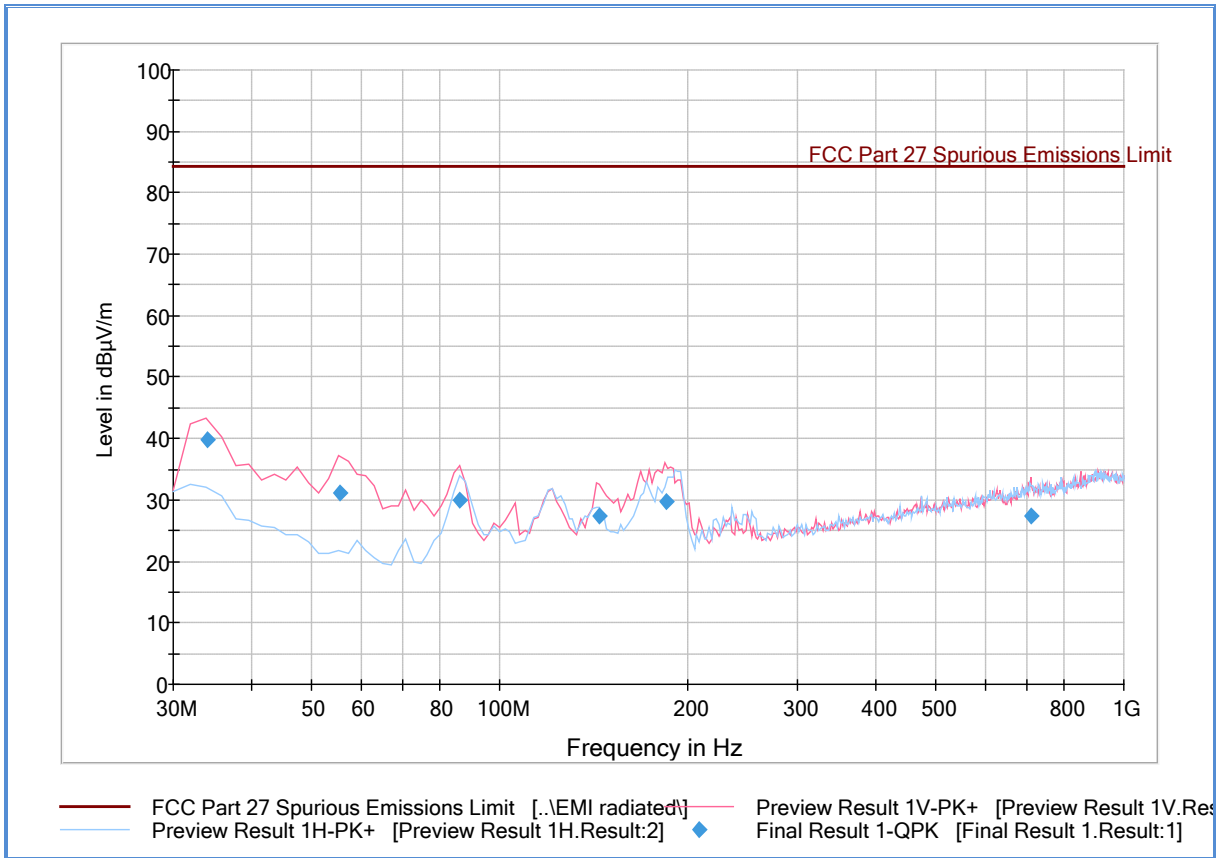
- This is a radiated test using substitution method as per Unwanted Emissions: Radiated Spurious method of measurement of ANSI/TIA/EIA-603-C 2004, August 17, 2004.
- Only the worst case configuration presented in this test report.
- There are no emissions found that doesn't comply with -13dBW limit in the 698-747 MHz frequency range. This limit corresponds to 84.4dB $\mu$ V/m @ 3 meters.
- There are no emission found that do not comply with the restricted bands defined in FCC Part 15 Subpart C, 15.205.
- 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.

### 2.8.8 Test Results

See attached plots.



**2.8.9 Radiated Emission Test Results Below 1GHz – Worst Case Band 4\_QPSK\_15MHz BW\_High Channel 20325**



**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)
34.047776	39.9	1000.0	120.000	100.0	V	236.0	-8.0	44.5	84.4
55.590541	31.0	1000.0	120.000	105.0	V	285.0	-15.5	53.4	84.4
86.332745	29.9	1000.0	120.000	110.0	V	248.0	-15.9	54.5	84.4
144.145491	27.5	1000.0	120.000	100.0	V	3.0	-14.0	56.9	84.4
185.214910	29.8	1000.0	120.000	109.0	V	162.0	-11.7	54.6	84.4
710.560721	27.5	1000.0	120.000	159.0	V	20.0	3.2	56.9	84.4

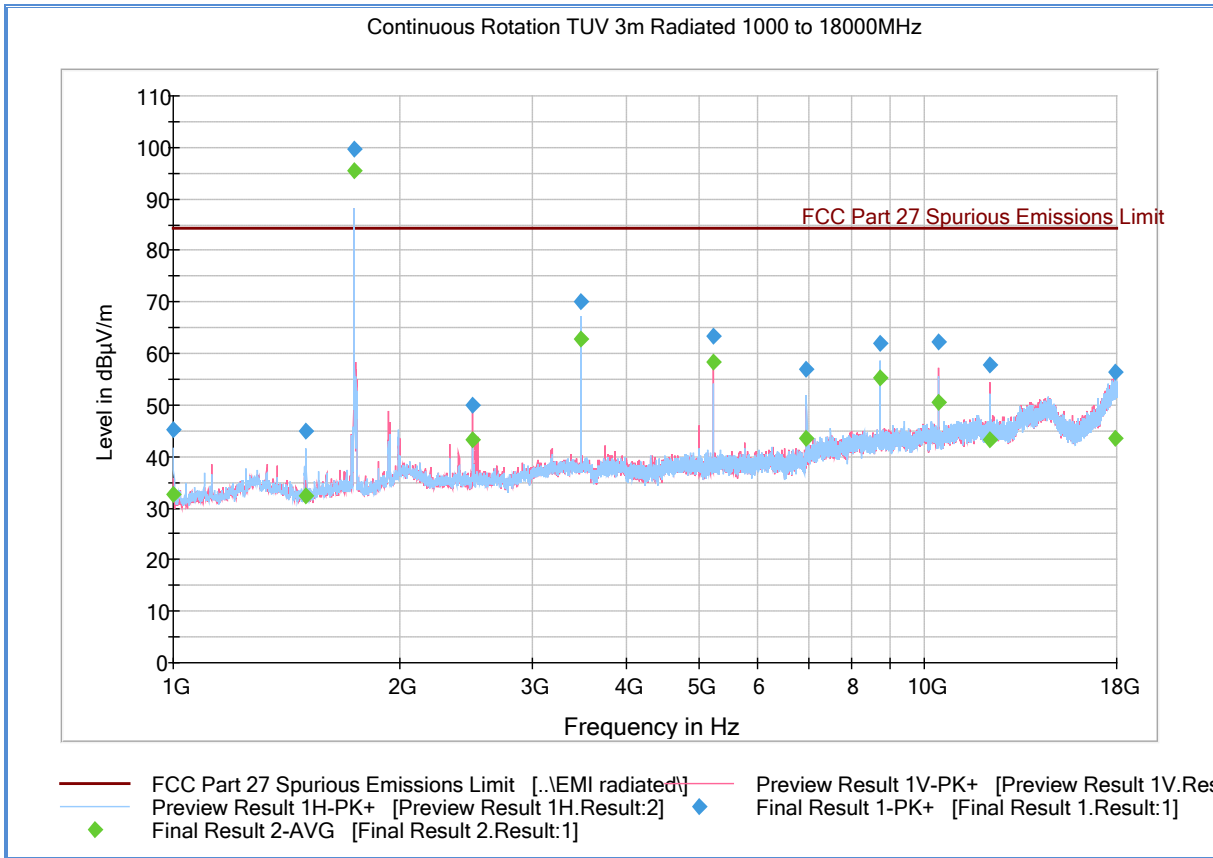
**Substitution Data**

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:** Only worst case modulation/bandwidth presented for spurious emissions below 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



**2.8.10 Radiated Emission Test Results Above 1GHz – Worst Case Band 4\_QPSK\_15MHz BW\_High Channel 20325**



**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Peak Margin (dB)	Limit (dBµV/m)
1000.000000	45.1	1000.0	1000.000	151.6	H	16.0	-11.2	39.3	84.4
1498.866667	44.8	1000.0	1000.000	103.7	H	249.0	-9.1	39.6	84.4
1740.833333	99.7	1000.0	1000.000	99.7	V	269.0	-6.7	* Fundamental Freq.	
2500.200000	50.0	1000.0	1000.000	152.6	V	347.0	-4.9	34.4	84.4
3481.633333	70.2	1000.0	1000.000	188.5	H	141.0	-1.3	14.2	84.4
5222.433333	63.4	1000.0	1000.000	263.3	V	183.0	2.9	21.0	84.4
6963.400000	57.0	1000.0	1000.000	157.6	H	231.0	6.1	27.4	84.4
8704.233333	62.0	1000.0	1000.000	122.7	H	89.0	9.9	22.4	84.4
10445.033333	62.4	1000.0	1000.000	173.5	V	207.0	12.1	22.0	84.4
12185.633333	57.7	1000.0	1000.000	182.5	V	204.0	14.0	26.7	84.4
17904.233333	56.5	1000.0	1000.000	338.1	V	339.0	24.1	27.9	84.4

**Substitution Data**

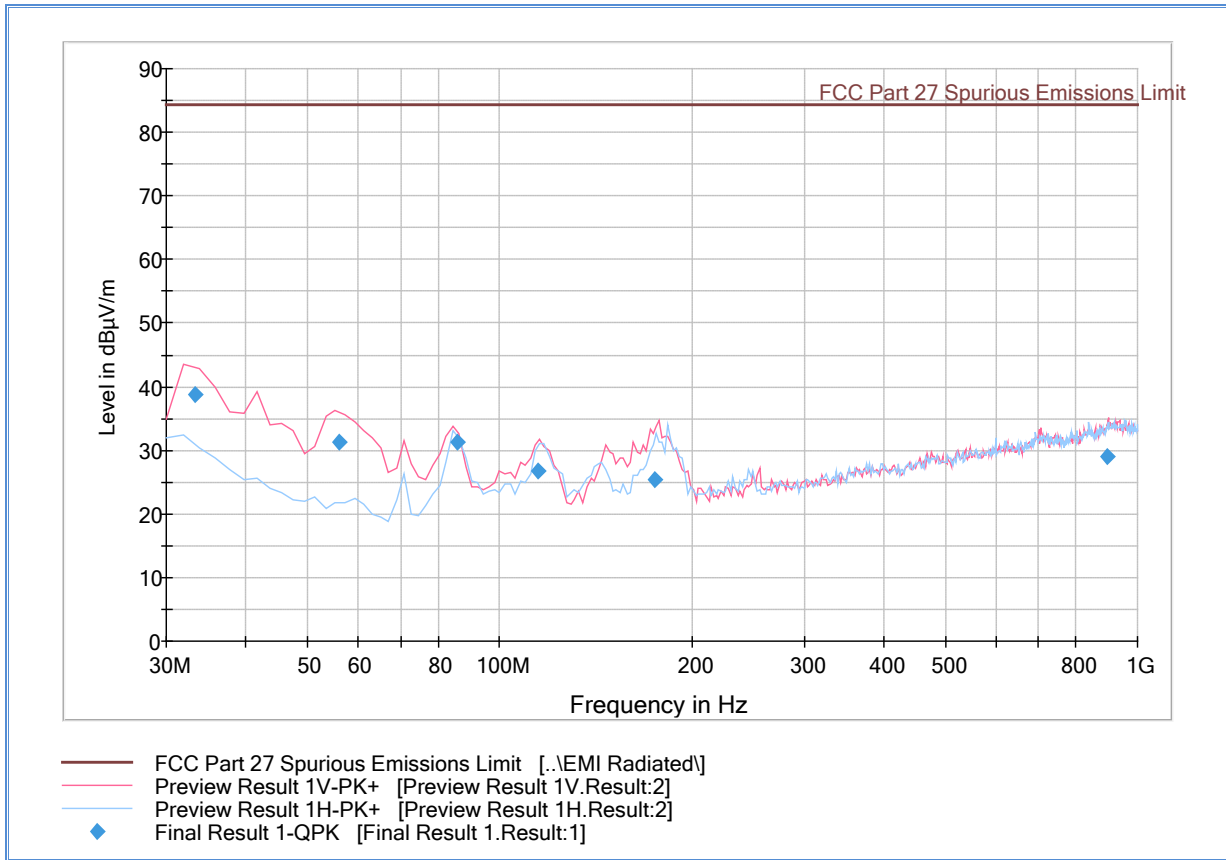
Frequency (MHz)	Field Strength @ 3 meters (dBµV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance
3481.633333	70.2	-4.2	9.82	-30.5	-24.88	-13	Complies

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

**Test Notes:** Only worst case modulation/bandwidth/channel presented for spurious emissions above 1GHz.



**2.8.11 Radiated Emission Test Results Below 1GHz – Worst Case Band 7\_QPSK\_20MHz BW\_Mid Channel 21100**



**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)
33.320000	38.8	1000.0	120.000	100.0	V	10.0	-7.6	45.6	84.4
56.070541	31.3	1000.0	120.000	100.0	V	215.0	-15.6	53.1	84.4
85.628858	31.4	1000.0	120.000	100.0	V	277.0	-16.0	53.0	84.4
114.594950	26.8	1000.0	120.000	100.0	V	37.0	-14.9	57.6	84.4
175.215471	25.3	1000.0	120.000	115.0	V	198.0	-12.7	59.1	84.4
897.277836	29.1	1000.0	120.000	179.0	V	142.0	5.7	55.3	84.4

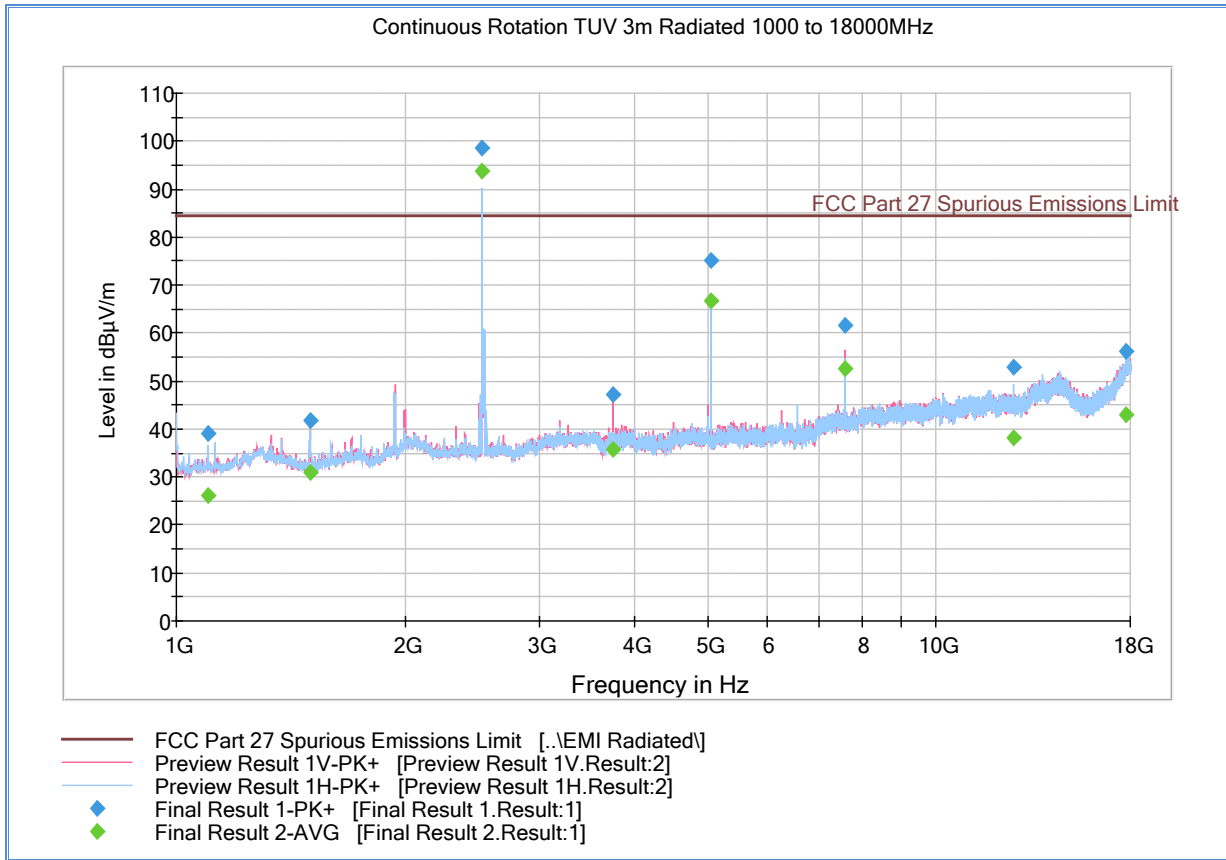
**Substitution Data**

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:** Only worst case modulation/bandwidth presented for spurious emissions below 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



**2.8.12 Radiated Emission Test Results Above 1GHz – Worst Case Band 7\_QPSK\_20MHz BW\_Mid Channel 21100**



**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Peak Margin (dB)	Limit (dBµV/m)
1099.533333	39.1	1000.0	1000.000	135.7	H	79.0	-10.1	45.3	84.4
1500.200000	41.7	1000.0	1000.000	402.7	V	-8.0	-9.1	42.7	84.4
2526.266667	98.6	1000.0	1000.000	99.7	V	32.0	-4.9	* Fundamental Freq.	
3750.233333	47.1	1000.0	1000.000	99.7	V	-7.0	0.5	37.3	84.4
5052.066667	75.3	1000.0	1000.000	102.7	H	101.0	2.3	9.1	84.4
7578.466667	61.6	1000.0	1000.000	124.7	V	79.0	8.1	22.8	84.4
12630.633333	53.0	1000.0	1000.000	262.3	H	197.0	13.8	31.4	84.4
17771.066667	56.3	1000.0	1000.000	321.1	V	10.0	23.3	28.1	84.4

**Substitution Data**

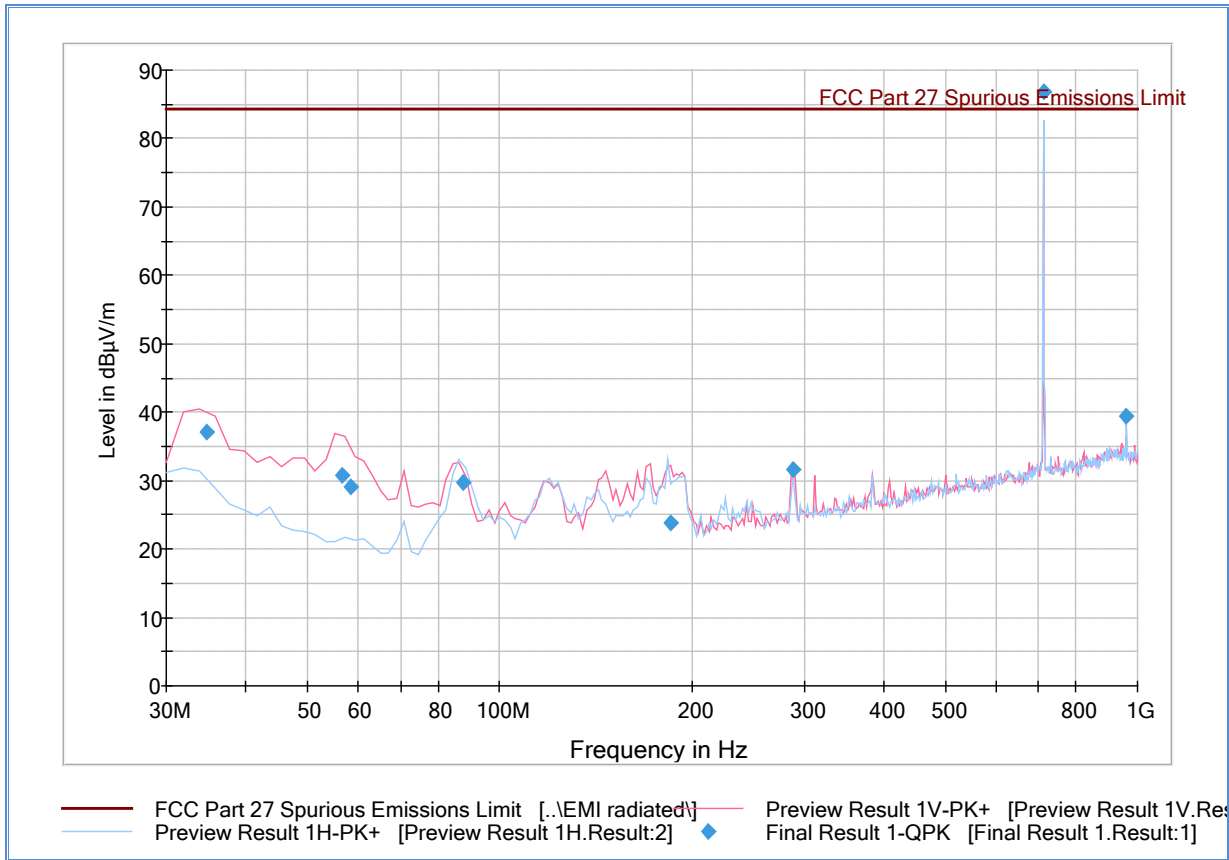
Frequency (MHz)	Field Strength @ 3 meters (dBµV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

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

**Test Notes:** Only worst case modulation/bandwidth/channel presented for spurious emissions above 1GHz.



**2.8.13 Radiated Emission Test Results Below 1GHz – Worst Case Band 12\_QPSK\_5MHz BW\_High Channel 23155**



**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)
34.687776	37.1	1000.0	120.000	100.0	V	287.0	-8.3	47.3	84.4
56.630541	30.7	1000.0	120.000	100.0	V	126.0	-15.7	53.7	84.4
58.302204	29.1	1000.0	120.000	100.0	V	208.0	-15.9	55.3	84.4
87.412745	29.7	1000.0	120.000	243.0	H	194.0	-15.8	54.7	84.4
185.087134	23.8	1000.0	120.000	208.0	H	70.0	-11.7	60.6	84.4
288.377074	31.7	1000.0	120.000	100.0	V	159.0	-7.8	52.7	84.4
711.304609	86.8	1000.0	120.000	100.0	H	130.0	3.2	* Fundamental Freq.	
960.122244	39.5	1000.0	120.000	100.0	H	102.0	6.2	44.9	84.4

**Substitution Data**

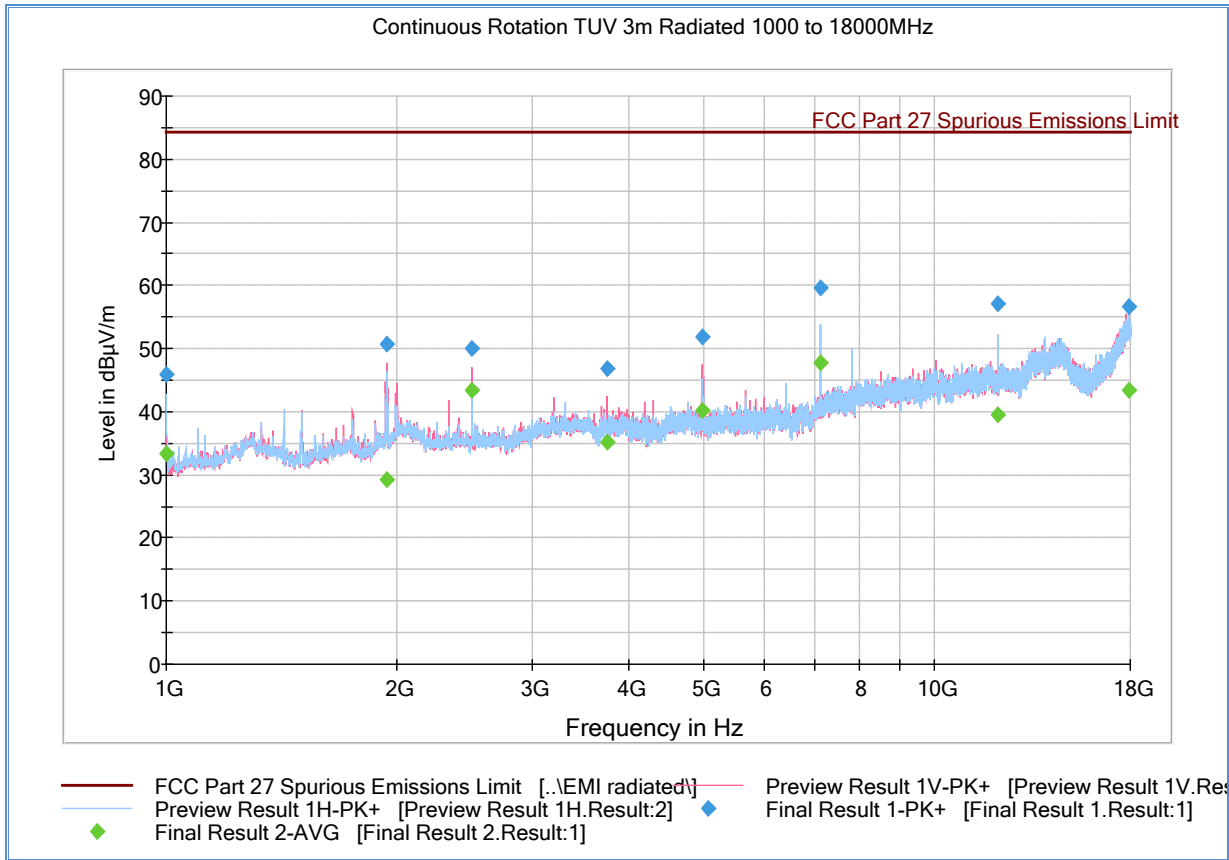
Frequency (MHz)	Field Strength @ 3 meters (dbµV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

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

**Test Notes:** Only worst case modulation/bandwidth presented for spurious emissions above 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



**2.8.14 Radiated Emission Test Results Above 1GHz – Worst Case Band 12\_QPSK\_5MHz BW\_High Channel 23155**



**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Peak Margin (dB)	Limit (dBµV/m)
1000.000000	45.9	1000.0	1000.000	119.7	H	265.0	-11.2	38.5	84.4
1935.600000	50.7	1000.0	1000.000	389.0	V	73.0	-4.6	33.7	84.4
2499.800000	49.9	1000.0	1000.000	136.6	V	352.0	-5.0	34.5	84.4
3750.233333	46.9	1000.0	1000.000	103.7	V	10.0	0.5	37.5	84.4
4979.366667	51.9	1000.0	1000.000	304.2	V	18.0	2.2	32.5	84.4
7113.400000	59.6	1000.0	1000.000	178.5	H	317.0	6.8	24.8	84.4
12092.700000	57.1	1000.0	1000.000	123.7	H	30.0	13.7	27.3	84.4
17908.033333	56.7	1000.0	1000.000	292.2	H	350.0	24.1	27.7	84.4

**Substitution Data**

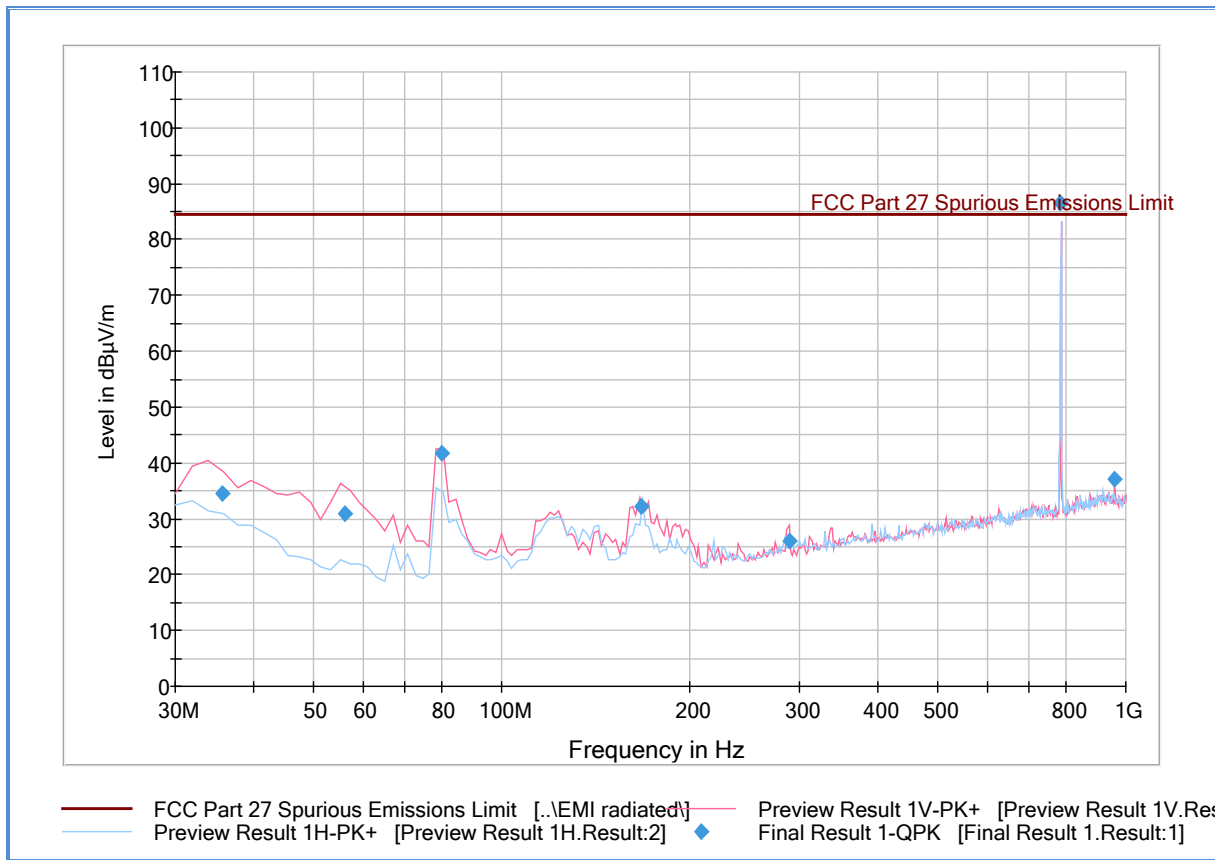
Frequency (MHz)	Field Strength @ 3 meters (dBµV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

**Test Notes:** Only worst case modulation/bandwidth/channel presented for spurious emissions above 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).





**2.8.15 Radiated Emission Test Results Below 1GHz – Worst Case Band 13\_QPSK\_5MHz BW\_High Channel 23255**



**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)
35.767776	34.6	1000.0	120.000	100.0	V	303.0	-8.9	49.8	84.4
56.030541	31.0	1000.0	120.000	100.0	V	331.0	-15.5	53.4	84.4
79.997194	41.7	1000.0	120.000	120.0	V	73.0	-16.6	42.7	84.4
167.032144	32.2	1000.0	120.000	100.0	V	174.0	-13.0	52.2	84.4
288.433186	26.0	1000.0	120.000	100.0	V	111.0	-7.8	58.4	84.4
787.076232	86.6	1000.0	120.000	121.0	H	119.0	3.8	* Fundamental Freq.	
960.082244	37.2	1000.0	120.000	100.0	V	154.0	6.2	47.2	84.4

**Substitution Data**

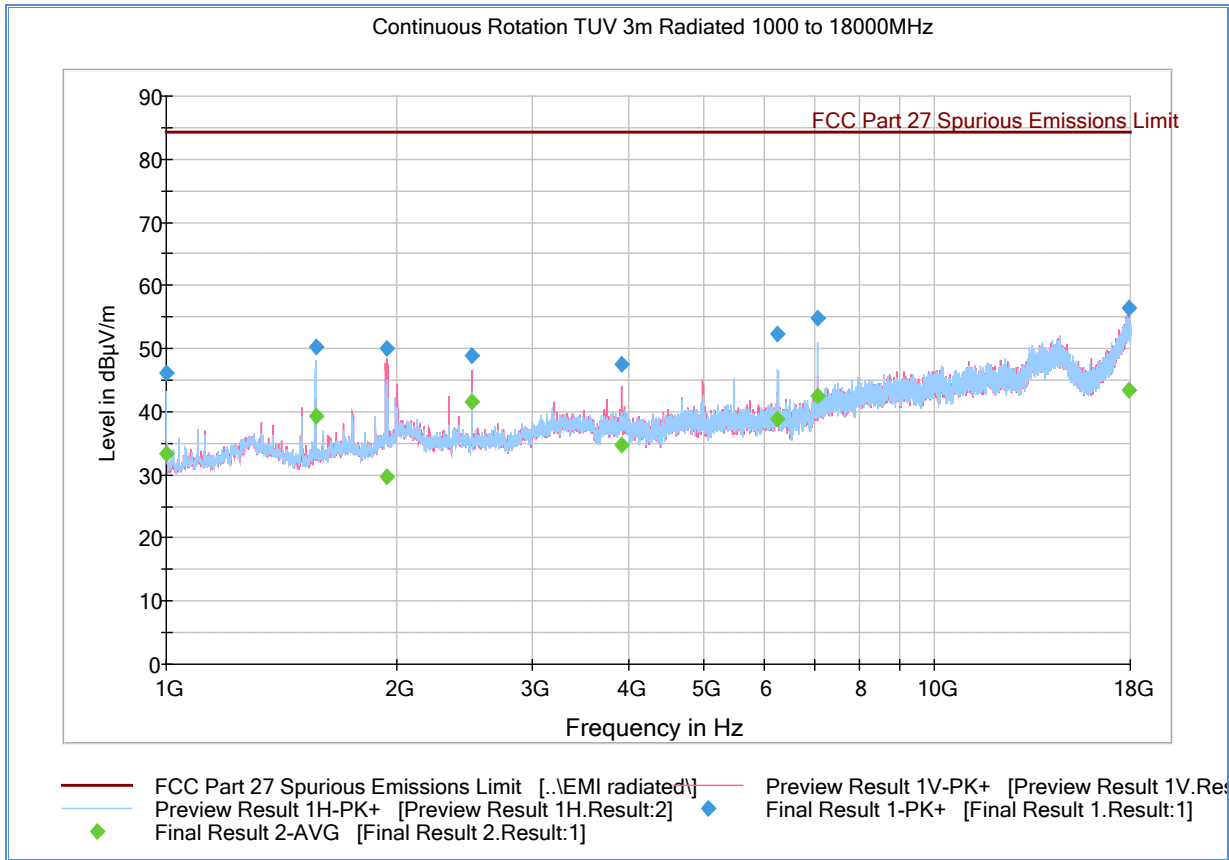
Frequency (MHz)	Field Strength @ 3 meters (dbµV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

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

**Test Notes:** Only worst case modulation/bandwidth presented for spurious emissions above 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



**2.8.16 Radiated Emission Test Results Above 1GHz – Worst Case Band 13\_QPSK\_5MHz BW\_High Channel 23255**



**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Peak Margin (dB)	Limit (dBµV/m)
1000.000000	46.1	1000.0	1000.000	120.7	H	4.0	-11.2	38.3	84.4
1564.600000	50.2	1000.0	1000.000	208.4	H	152.0	-8.4	34.2	84.4
1937.400000	50.1	1000.0	1000.000	227.4	V	270.0	-4.6	34.3	84.4
2499.800000	48.9	1000.0	1000.000	143.6	V	340.0	-5.0	35.5	84.4
3911.766667	47.4	1000.0	1000.000	405.1	V	-7.0	1.2	37.0	84.4
6258.866667	52.3	1000.0	1000.000	196.5	H	20.0	4.8	32.1	84.4
7041.066667	54.8	1000.0	1000.000	192.5	H	-19.0	6.4	29.6	84.4
17885.900000	56.5	1000.0	1000.000	202.4	V	19.0	24.0	27.9	84.4

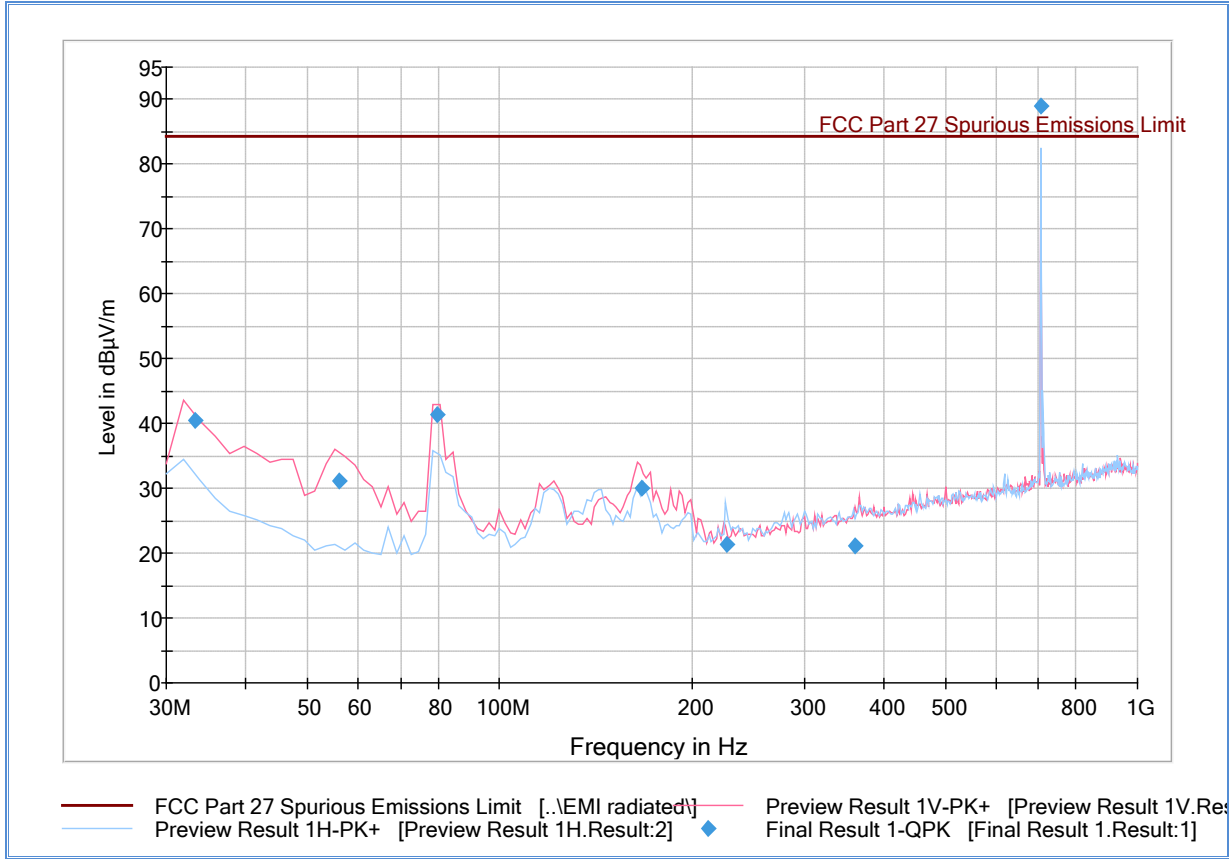
**Substitution Data**

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:** Only worst case modulation/bandwidth/channel presented for spurious emissions above 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



**2.8.17 Radiated Emission Test Results Below 1GHz – Worst Case Band 17\_QPSK\_10MHz BW\_Low Channel 23780**



**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)
33.280000	40.4	1000.0	120.000	100.0	V	263.0	-7.6	44.0	84.4
56.110541	31.2	1000.0	120.000	100.0	V	-11.0	-15.6	53.2	84.4
79.981082	41.5	1000.0	120.000	109.0	V	238.0	-16.6	42.9	84.4
166.768257	29.9	1000.0	120.000	100.0	V	174.0	-13.0	54.5	84.4
226.852665	21.3	1000.0	120.000	100.0	H	37.0	-9.7	63.1	84.4
361.500922	21.2	1000.0	120.000	242.0	V	232.0	-5.0	63.2	84.4
704.569058	88.9	1000.0	120.000	109.0	H	319.0	3.0	* Fundamental Freq.	

**Substitution Data**

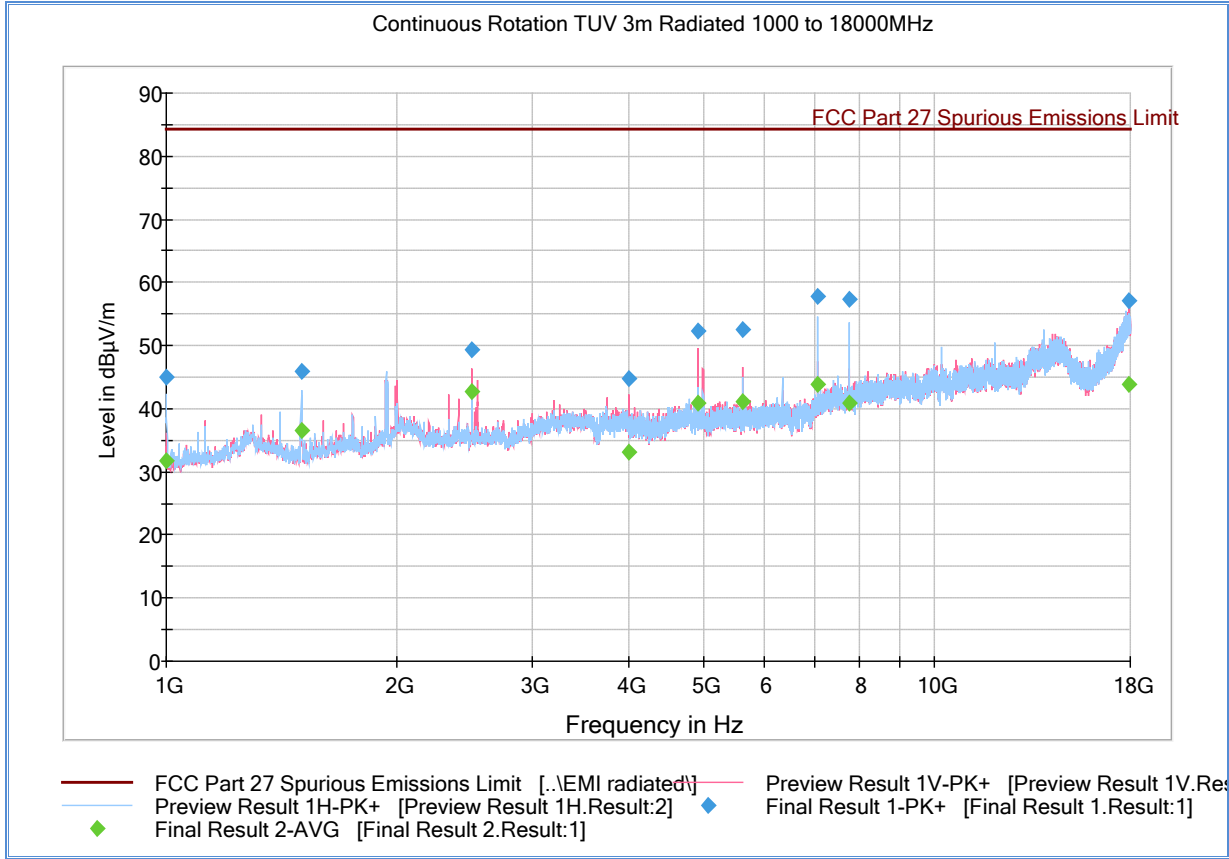
Frequency (MHz)	Field Strength @ 3 meters (dBµV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

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

**Test Notes:** Only worst case modulation/bandwidth presented for spurious emissions above 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



**2.8.18 Radiated Emission Test Results Above 1GHz – Worst Case Band 17\_QPSK\_10MHz BW\_Low Channel 23780**



**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Peak Margin (dB)	Limit (dBµV/m)
1000.400000	44.9	1000.0	1000.000	103.7	H	238.0	-11.2	39.5	84.4
1500.000000	46.0	1000.0	1000.000	99.7	H	280.0	-9.1	38.4	84.4
2499.766667	49.4	1000.0	1000.000	143.7	V	347.0	-5.0	35.0	84.4
3999.733333	44.8	1000.0	1000.000	126.7	V	11.0	1.4	39.6	84.4
4932.300000	52.3	1000.0	1000.000	268.3	V	348.0	2.4	32.1	84.4
5636.666667	52.6	1000.0	1000.000	113.7	V	-13.0	3.4	31.8	84.4
7045.733333	57.9	1000.0	1000.000	203.5	H	-20.0	6.4	26.6	84.4
7749.933333	57.3	1000.0	1000.000	161.6	H	29.0	8.2	27.1	84.4
17897.100000	57.2	1000.0	1000.000	402.7	V	137.0	24.0	27.2	84.4

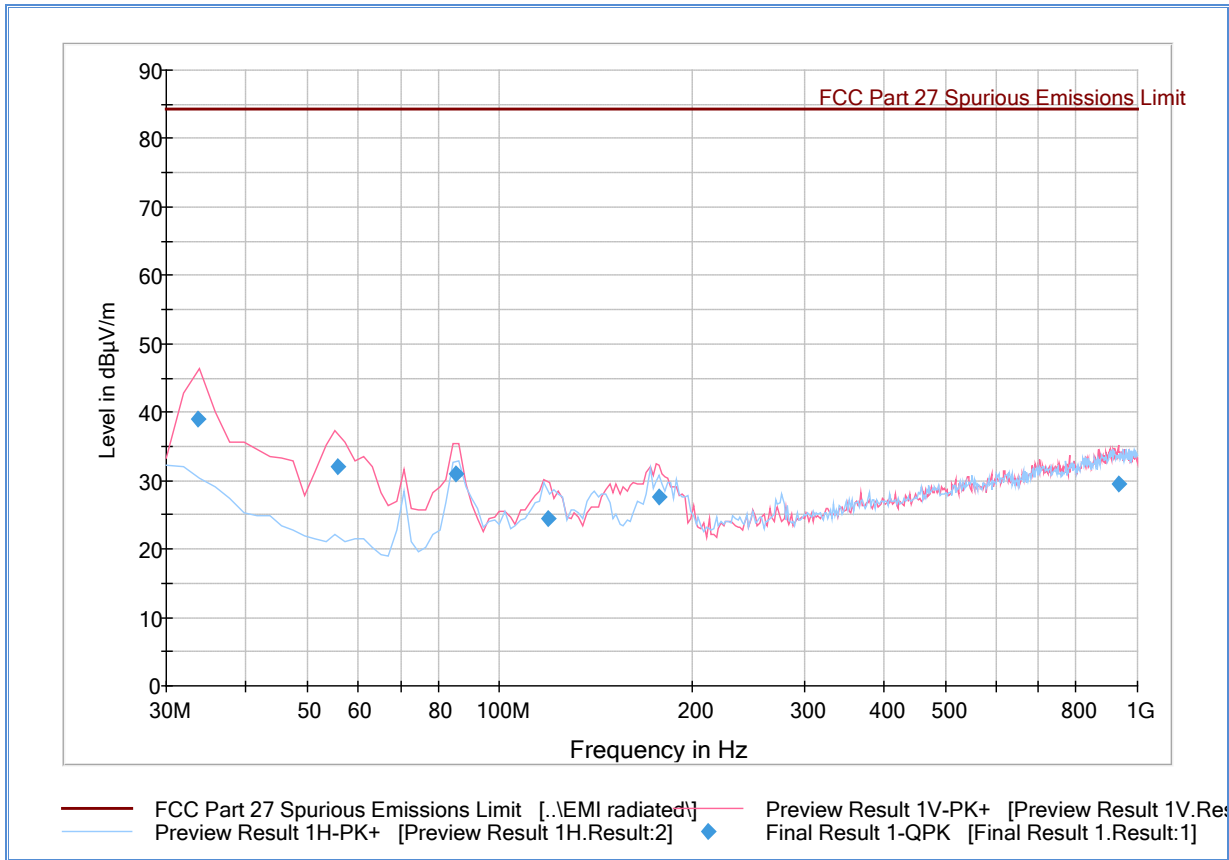
**Substitution Data**

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:** Only worst case modulation/bandwidth/channel presented for spurious emissions above 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



**2.8.19 Radiated Emission Test Results Below 1GHz – Worst Case Band 66\_QPSK\_15MHz BW\_Mid Channel 132322**



**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)
33.607776	39.1	1000.0	120.000	100.0	V	32.0	-7.8	45.3	84.4
55.750541	32.0	1000.0	120.000	100.0	V	324.0	-15.5	52.4	84.4
85.572745	31.0	1000.0	120.000	100.0	V	272.0	-16.0	53.4	84.4
119.258838	24.4	1000.0	120.000	132.0	V	91.0	-15.2	60.0	84.4
177.591583	27.7	1000.0	120.000	100.0	V	191.0	-12.6	56.7	84.4
935.067816	29.4	1000.0	120.000	202.0	V	328.0	6.3	55.0	84.4

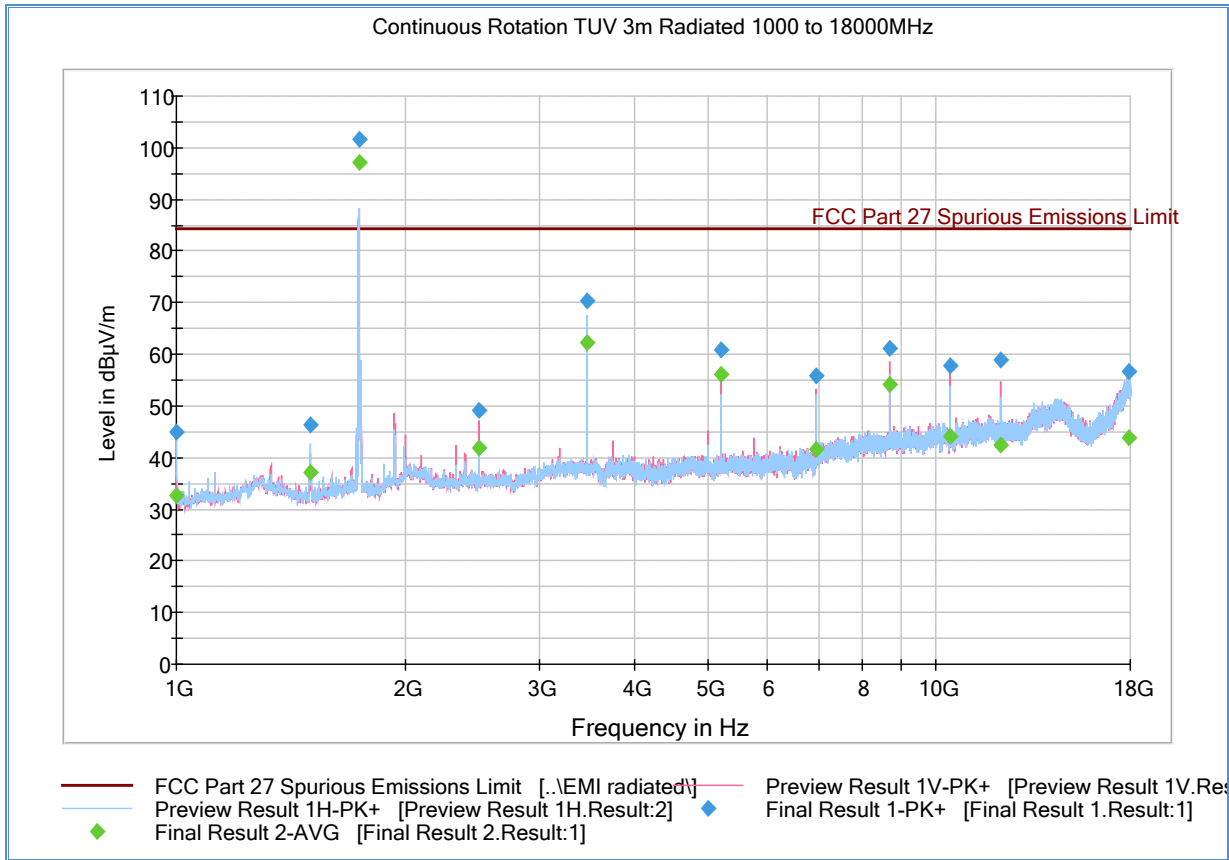
**Substitution Data**

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:** Only worst case modulation/bandwidth presented for spurious emissions above 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).



**2.8.20 Radiated Emission Test Results Above 1GHz – Worst Case Band 66\_QPSK\_15MHz BW\_Mid Channel 132322**



**Peak Data**

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Peak Margin (dB)	Limit (dBµV/m)
1000.000000	45.0	1000.0	1000.000	147.6	H	55.0	-11.2	39.4	84.4
1500.000000	46.2	1000.0	1000.000	103.7	H	284.0	-9.1	38.2	84.4
1738.166667	101.6	1000.0	1000.000	192.5	H	145.0	-6.8	* Fundamental Freq.	
2500.166667	49.2	1000.0	1000.000	116.7	V	17.0	-4.9	35.2	84.4
3476.533333	70.4	1000.0	1000.000	187.5	H	145.0	-1.3	14.0	84.4
5215.066667	60.9	1000.0	1000.000	263.3	V	178.0	2.8	23.5	84.4
6953.200000	55.9	1000.0	1000.000	154.6	H	124.0	6.1	28.5	84.4
8691.566667	61.2	1000.0	1000.000	201.5	V	191.0	9.9	23.2	84.4
10430.100000	57.9	1000.0	1000.000	395.0	V	222.0	12.1	26.5	84.4
12168.633333	58.8	1000.0	1000.000	192.5	V	214.0	13.9	25.6	84.4
17895.933333	56.8	1000.0	1000.000	267.3	V	319.0	24.0	27.6	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

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

**Test Notes:** Only worst case modulation/bandwidth/channel presented for spurious emissions above 1GHz.



## **2.9 FREQUENCY STABILITY**

### **2.9.1 Specification Reference**

27.54, Part 2.1055 (a)(1) and (d)(1)  
RSS-130 (4.3), RSS-139 (6.4) and RSS-199 (4.3)

### **2.9.2 Standard Applicable**

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

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  $43 + 10 \log_{10} p$  (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.

### **2.9.3 Equipment Under Test and Modification State**

Serial No: SZ17061900013 / Test Configuration A

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

July 22 to 26, 2016 / AC

### **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 Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.1°C
Relative Humidity	44.5%
ATM Pressure	98.7 kPa

### **2.9.7 Additional Observations**

- This is a conducted test. The EUT was operated at 3.7 VDC nominal voltage and was placed in the temperature chamber for this evaluation. The EUT was controlled by a CMW500 and utilizing a spectrum analyser for measurement.
- The Temperature was reduced to -30°C and allowed to sit for 1 hour to allow the equipment and chamber temperature to stabilize. The temperature was set increased by 10°C steps and allowed to settle before taking the next set of measurements.



- Voltage variation was also performed at voltage 3.3VDC and higher 4.3VDC of the nominal voltage at 20°C
- The maximum frequency deviation was verified against the frequency band edges using the EBW data. Sample calculation:

**2.9.8 Test Results**

LTE Band 4 – QPSK 1.4MHz BW-Low Channel 19957 @ 1710.7 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	1710.1443	1711.2557	1710.7	1710.09	1.22	Y
	-20	1710.1472	1711.2557	1710.7015	1710.0915		Y
	-10	1710.1472	1711.2528	1710.7	1710.09		Y
	0	1710.1472	1711.2557	1710.7015	1710.0915		Y
	+10	1710.1472	1711.2528	1710.7	1710.09		Y
	+20	1710.1443	1711.2557	1710.7	1710.09		Y
	+30	1710.1501	1711.2499	1710.7	1710.09		Y
	+40	1710.1443	1711.2586	1710.7015	1710.0915		Y
+50	1710.1443	1711.2586	1710.7015	1710.0945	Y		

LTE Band 4 – QPSK 1.4MHz BW-Low Channel 19957 @ 1710.7 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	1710.1443	1711.2557	1710.7	1710.09	1.22	Y
4.3		1710.1443	1711.2586	1710.7015	1710.0915		Y

LTE Band 4 – QPSK 1.4MHz BW-High Channel 20393 @ 1754.3 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	1753.7472	1754.8528	1754.3	1754.915	1.23	Y
	-20	1753.7472	1754.8557	1754.3015	1754.9165		Y
	-10	1753.7472	1754.8586	1754.3029	1754.9179		Y
	0	1753.7472	1754.8528	1754.3	1754.915		Y
	+10	1753.7501	1754.8525	1754.3013	1754.9163		Y
	+20	1753.7472	1754.8528	1754.3	1754.915		Y
	+30	1753.7472	1754.8557	1754.3015	1754.9165		Y
	+40	1753.7472	1754.8528	1754.3	1754.915		Y
+50	1753.7472	1754.8528	1754.3	1754.915	Y		

LTE Band 4 – QPSK 1.4MHz BW-High Channel 20393 @ 1754.3 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	1753.7472	1754.8528	1754.3	1754.915	1.23	Y
4.3		1753.7501	1754.8528	1754.3015	1754.9165		Y





LTE Band 7 – QPSK 5MHz BW-Low Channel 20775 @ 2502.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	2500.1975	2504.8125	2502.5050	2500.0050	5.0	Y
	-20	2500.1475	2504.8775	2502.5125	2500.0125		Y
	-10	2500.1475	2504.8775	2502.5125	2500.0125		Y
	0	2500.0975	2504.9075	2502.5025	2500.0025		Y
	+10	2498.815	2506.245	2502.530	2500.030		Y
	+20	2498.815	2506.215	2502.515	2500.015		Y
	+30	2499.9525	2505.0525	2502.5025	2500.0025		Y
	+40	2500.1475	2504.8575	2502.5025	2500.0025		Y
	+50	2499.577	2505.438	2502.5075	2500.0075		Y

LTE Band 7 – QPSK 5MHz BW-Low Channel 20775 @ 2502.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	2498.805	2506.245	2502.525	2500.025	5.0	Y
4.3		2498.805	2506.245	2502.525	2500.025		Y

LTE Band 7 – QPSK 5MHz BW-High Channel 21425 @ 2567.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	2565.1875	2569.8025	2567.4950	2569.9950	5.0	Y
	-20	2565.1925	2569.7875	2567.4900	2569.9900		Y
	-10	2565.1875	2569.7925	2567.4875	2569.9875		Y
	0	2565.1775	2569.8175	2567.4975	2569.9975		Y
	+10	2565.0725	2569.8925	2567.4825	2569.9825		Y
	+20	2565.0675	2569.8975	2567.4825	2569.9825		Y
	+30	2565.0725	2569.8875	2567.4800	2569.9800		Y
	+40	2565.0875	2569.8925	2567.4900	2569.9900		Y
	+50	2565.0975	2569.8825	2567.4900	2569.9900		Y

LTE Band 7 – QPSK 5MHz BW-High Channel 21425 @ 2567.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	2565.0825	2569.9075	2567.495	2569.995	5.0	Y
4.3		2565.0625	2569.9275	2567.495	2569.995		Y



LTE Band 12 – QPSK 1.4MHz BW-Low Channel 23017 @ 699.7 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	699.1009	700.2962	699.6986	699.0936	1.21	Y
	-20	699.1009	700.302	699.7015	699.0965		Y
	-10	699.0864	700.2962	699.6913	699.0863		Y
	0	699.0806	700.2933	699.6870	699.0820		Y
	+10	699.1009	700.2904	699.6957	699.0907		Y
	+20	699.1588	700.2412	699.7	699.095		Y
	+30	699.1588	700.2412	699.7	699.095		Y
	+40	699.0951	700.2904	699.6928	699.0878		Y
	+50	699.1038	700.2933	699.6986	699.0936		Y

LTE Band 12 – QPSK 1.4MHz BW-Low Channel 23017 @ 699.7 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	699.1588	700.2412	699.7	699.095	1.21	Y
4.3		699.1588	700.2412	699.7	699.095		Y

LTE Band 12 – QPSK 1.4MHz BW-High Channel 23173 @ 715.3 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	714.7067	715.8933	715.3	715.915	1.23	Y
	-20	714.7067	715.8933	715.3	715.915		Y
	-10	714.6835	715.8933	715.2884	715.9034		Y
	0	714.6893	715.8991	715.2942	715.9092		Y
	+10	714.7096	715.8962	715.3029	715.9179		Y
	+20	714.7559	715.8412	715.2986	715.9136		Y
	+30	714.7588	715.8441	715.3015	715.9165		Y
	+40	714.7588	715.8412	715.3	715.915		Y
	+50	714.7067	715.8991	715.3029	715.9179		Y

LTE Band 12 – QPSK 1.4MHz BW-High Channel 23173 @ 715.3 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	714.7559	715.8412	715.2986	715.9136	1.23	Y
4.3		714.7443	715.8586	715.3015	715.9165		Y



LTE Band 13 – QPSK 5MHz BW-Low Channel 23205 @ 779.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	777.199	781.815	779.507	777.002	5.01	Y
	-20	777.199	781.815	779.507	777.002		Y
	-10	777.228	781.787	779.5075	777.0025		Y
	0	777.228	781.787	779.5075	777.0025		Y
	+10	777.2062	781.8155	779.5109	777.0059		Y
	+20	777.1483	781.8661	779.5072	777.0022		Y
	+30	777.0977	781.9385	779.5181	777.0131		Y
	+40	777.0904	781.9385	779.5145	777.0095		Y
+50	776.6525	782.3925	779.5225	777.0175	Y		

LTE Band 13 – QPSK 5MHz BW-Low Channel 23205 @ 779.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	777.1411	781.8806	779.5109	777.0059	5.01	Y
4.3		777.17	781.8517	779.5109	777.0059		Y

LTE Band 13 – QPSK 5MHz BW-High Channel 23255 @ 784.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	782.170	786.787	784.4785	786.9835	5.01	Y
	-20	782.185	786.801	784.493	786.998		Y
	-10	782.170	786.801	784.4855	786.9905		Y
	0	782.185	786.787	784.486	786.991		Y
	+10	782.1845	786.7938	784.4892	786.9942		Y
	+20	782.1918	786.7865	784.4892	786.9942		Y
	+30	782.17	786.7938	784.4819	786.9869		Y
	+40	782.1845	786.801	784.4928	786.9978		Y
+50	782.17	786.801	784.4855	786.9905	Y		

LTE Band 13 – QPSK 5MHz BW-High Channel 23255 @ 782.0 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	782.1845	786.801	784.4928	786.9978	5.01	Y
4.3		782.1845	786.7938	784.4892	786.9942		Y



LTE Band 17 – QPSK 5MHz BW-Low Channel 23755 @ 706.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	704.242	708.758	706.5	704.09	4.82	Y
	-20	704.242	708.772	706.507	704.097		Y
	-10	704.242	708.758	706.5	704.09		Y
	0	704.242	708.758	706.5	704.09		Y
	+10	704.199	708.8155	706.5073	704.0973		Y
	+20	704.199	708.83	706.5145	704.1045		Y
	+30	704.199	708.8082	706.5036	704.0936		Y
	+40	704.199	708.7938	706.4964	704.0864		Y
+50	704.199	708.8155	706.5073	704.0973	Y		

LTE Band 17 – QPSK 5MHz BW-Low Channel 23755 @ 706.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	704.1918	708.83	706.5109	704.1009	4.82	Y
4.3		704.1918	708.83	706.5109	704.1009		Y

LTE Band 17 – QPSK 5MHz BW-High Channel 23825 @ 713.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	711.185	715.787	713.486	715.981	4.99	Y
	-20	711.199	715.787	713.493	715.988		Y
	-10	711.185	715.787	713.486	715.981		Y
	0	711.17	715.815	713.4925	715.9875		Y
	+10	711.1918	715.7938	713.4928	715.9878		Y
	+20	711.1918	715.7938	713.4928	715.9878		Y
	+30	711.1773	715.7938	713.4856	715.9806		Y
	+40	711.1845	715.8082	713.4964	715.9914		Y
+50	711.1773	715.8082	713.4928	715.9878	Y		

LTE Band 17 – QPSK 5MHz BW-High Channel 23825 @ 713.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	711.1845	715.801	713.4928	715.9878	4.99	Y
4.3		711.1845	715.801	713.4928	715.9878		Y



LTE Band 66 – QPSK 5MHz BW-Low Channel 131997 @ 1712.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	1710.0725	1714.9375	1712.5050	1710.0050	5.00	Y
	-20	1709.9675	1715.0475	1712.5075	1710.0075		Y
	-10	1709.6325	1715.3875	1712.510	1710.010		Y
	0	1709.6025	1715.4025	1712.5025	1710.0025		Y
	+10	1709.6425	1715.3975	1712.5025	1710.0025		Y
	+20	1710.1925	1714.8225	1712.5075	1710.0075		Y
	+30	1710.1975	1714.8075	1712.5025	1710.0025		Y
	+40	1709.6125	1715.4125	1712.5125	1710.0125		Y
	+50	1709.6175	1715.3975	1712.5075	1710.0075		Y

LTE Band 66 – QPSK 5MHz BW-Low Channel 131997 @ 1712.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	1710.1825	1714.8225	1712.5025	1710.0025	5.00	Y
4.3		1710.1875	1714.8175	1712.5025	1710.0025		Y

LTE Band 66 – QPSK 5MHz BW-High Channel 132647 @ 1777.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.7	-30	1773.7675	1781.1975	1777.4825	1779.9875	5.01	Y
	-20	1774.9575	1780.0175	1777.4875	1779.9925		Y
	-10	1773.8275	1781.1575	1777.4925	1779.9975		Y
	0	1773.7625	1781.2175	1777.490	1779.995		Y
	+10	1773.7825	1781.1975	1777.490	1779.995		Y
	+20	1774.953	1780.033	1777.493	1779.998		Y
	+30	1774.585	1780.395	1777.490	1779.995		Y
	+40	1774.5825	1780.3925	1777.4875	1779.9925		Y
	+50	1774.5775	1780.4025	1777.490	1779.995		Y

LTE Band 66 – QPSK 5MHz BW-High Channel 132647 @ 1777.5 MHz							
Voltage (VDC)	Temperature (°C)	f1 (MHz)	f2 (MHz)	Center Freq. (f1+f2)/2	Edge of fund. Emission (MHz)	Occupied BW(26dB) (MHz)	Complies (Y or N)
3.3	20	1774.967	1780.004	1777.486	1779.991	5.01	Y
4.3		1774.595	1780.385	1777.490	1779.995		Y



### 2.9.9 Sample Calculation and plot

Variables (from test plot):  
M1 = (Peak value of the power envelope)  
T1 = (-10 dBc point)  
T2 = (+10 dBc point)

Center Frequency Formula:  
 $= (T1+T2) / 2$   
 $= (699.1588+700.2412) / 2$   
 $= 699.7 \text{ MHz}$

#### **Low Channel Sample Calculation:**

Worst case 26dB BW of LTE Band 12 at 1.4MHz BW                      1.21 MHz  
Edge of fundamental emission (699.7-(1.21/2)):                      699.095 MHz  
EUT complies. 699.095 MHz > 698 MHz (edge of authorized band)

#### **High Channel Sample Calculation:**

Worst case 26dB BW of LTE Band 12 at 1.4MHz BW                      1.23 MHz  
Edge of fundamental emission (715.3015+(1.23/2)):                      715.9165 MHz  
EUT complies. 715.9165 MHz < 716 MHz (edge of authorized band)



## **2.10 RECEIVER SPURIOUS EMISSIONS**

### **2.10.1 Specification Reference**

RSS-GEN (7.0)

### **2.10.2 Standard Applicable**

Receiver spurious emissions shall comply with the limits specified in RSS-Gen.

### **2.10.3 Equipment Under Test and Modification State**

Serial No: SZ17061900013 / Test Configuration B

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

August 04, 2016 / AC

### **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	22.3 °C
Relative Humidity	47.0 %
ATM Pressure	99.8 kPa

### **2.10.7 Additional Observations**

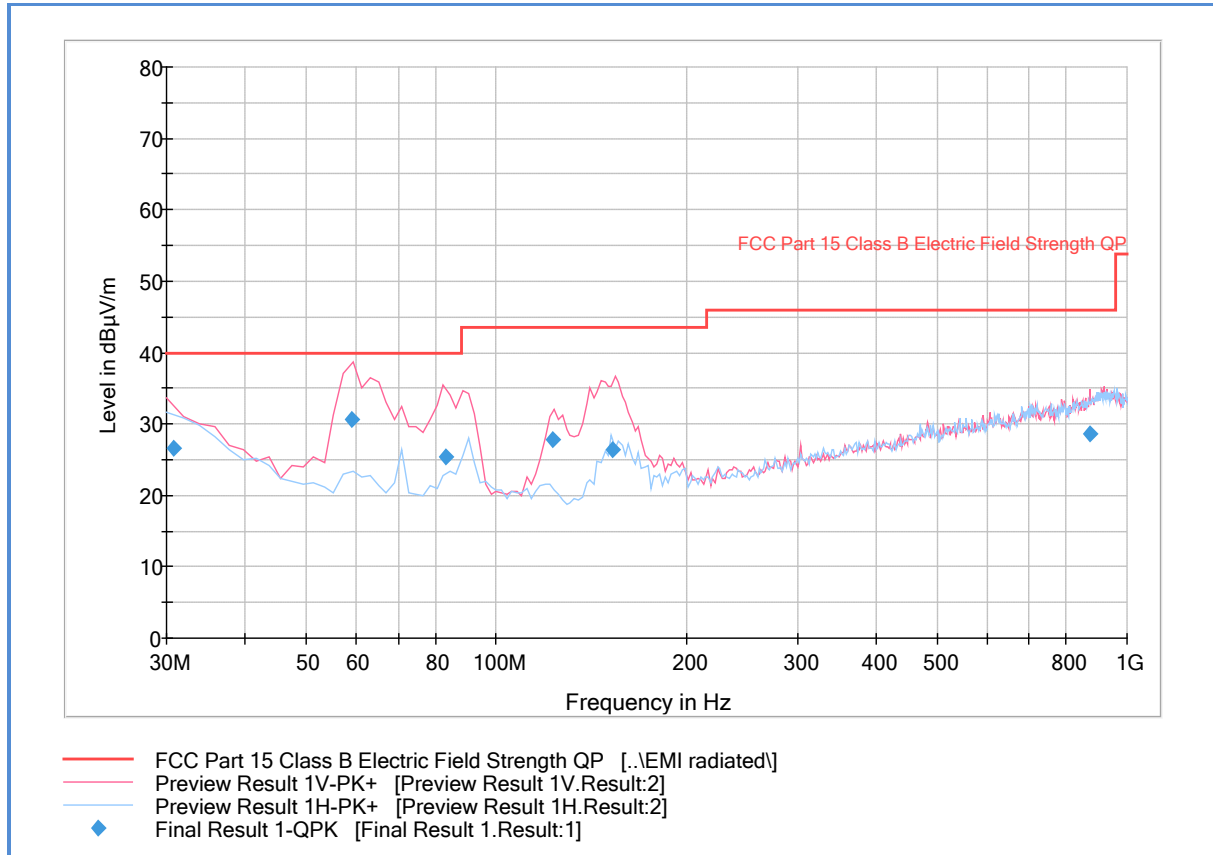
- This is a radiated test. The spectrum was searched from 30MHz to the 18GHz (6GHz as per requirement).
- Limit used is from FCC §15.209 which is identical to RSS-Gen limits.
- There are no separate receive mode configurable during verification, the EUT was verified in stand-by mode.
- Measurement was 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.

### **2.10.8 Test Results**

See attached plots.



**2.10.9 Test Results Below 1GHz (Receive Mode)**



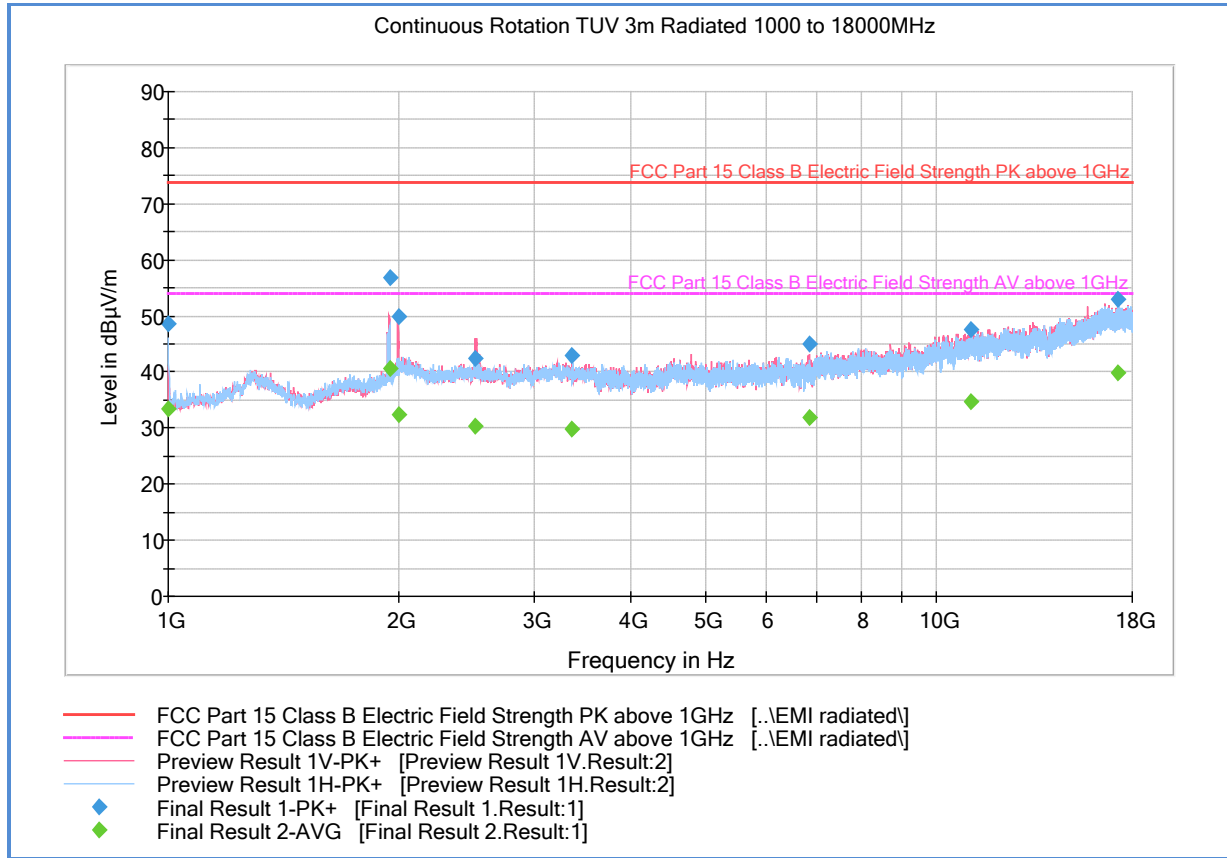
**Quasi Peak Data**

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.727776	26.7	1000.0	120.000	100.0	V	86.0	-6.2	13.4	40.0
59.038317	30.7	1000.0	120.000	115.0	V	138.0	-16.0	9.3	40.0
83.044970	25.4	1000.0	120.000	106.0	V	135.0	-16.2	14.6	40.0
123.146613	27.9	1000.0	120.000	108.0	V	246.0	-15.4	15.6	43.5
152.888818	26.3	1000.0	120.000	100.0	V	175.0	-13.1	17.2	43.5
873.927295	28.6	1000.0	120.000	264.0	V	289.0	5.1	17.4	46.0





**2.10.10 Test Results Above 1GHz (Receive Mode)**



**Peak Data**

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.800000	48.6	1000.0	1000.000	146.7	H	50.0	-7.7	25.3	73.9
1941.066667	56.8	1000.0	1000.000	387.0	V	142.0	-0.6	17.1	73.9
1992.100000	49.9	1000.0	1000.000	151.6	V	111.0	-0.2	24.0	73.9
2514.000000	42.4	1000.0	1000.000	306.2	V	106.0	-0.7	31.5	73.9
3347.500000	43.0	1000.0	1000.000	103.7	V	5.0	0.8	30.9	73.9
6828.533333	45.1	1000.0	1000.000	256.4	V	16.0	5.9	28.8	73.9
11106.066666	47.6	1000.0	1000.000	403.8	V	199.0	12.9	26.3	73.9
17225.566666	52.9	1000.0	1000.000	403.8	V	44.0	19.7	21.0	73.9

**Average Data**

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.800000	33.4	1000.0	1000.000	146.7	H	50.0	-7.7	20.5	53.9
1941.066667	40.7	1000.0	1000.000	387.0	V	142.0	-0.6	13.2	53.9
1992.100000	32.5	1000.0	1000.000	151.6	V	111.0	-0.2	21.4	53.9
2514.000000	30.4	1000.0	1000.000	306.2	V	106.0	-0.7	23.5	53.9
3347.500000	29.9	1000.0	1000.000	103.7	V	5.0	0.8	24.0	53.9
6828.533333	31.8	1000.0	1000.000	256.4	V	16.0	5.9	22.1	53.9
11106.066666	34.7	1000.0	1000.000	403.8	V	199.0	12.9	19.2	53.9
17225.566666	39.8	1000.0	1000.000	403.8	V	44.0	19.7	14.1	53.9

**Test Notes:** No significant emissions observed above 18GHz.



### **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
<b>Conducted Port Setup</b>						
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	02/01/16	02/01/17
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 7611 and 7608	
7578	Wideband Radio Communication Tester	CMW 500	1201.0002K50 -116735-rQ	Rhode & Schwarz	Used for connectivity only, calibration not required	
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	07/29/15	07/29/16
<b>Radiated Test Setup</b>						
1033	Bilog Antenna	3142C	00044556	EMCO	09/25/14	09/25/16
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	09/29/15	09/29/16
1016	Pre-amplifier	PAM-0202	187	PAM	12/15/15	12/15/16
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	05/12/16	05/12/17
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
1054	Horn antenna (18-40 GHz)	3116	9407-2233	EMCO	12/22/15	12/22/17
n/a	Pre-amplifier (18-40 GHz)	SLKka-30-6	15G27	Spacek Labs	Verified by 1003 and 7611	
7578	Wideband Radio Communication Tester	CMW 500	1201.0002K50 -116735-rQ	Rhode & Schwarz	Used for connectivity only, calibration not required	
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/16/16	05/16/17
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	02/01/16	02/01/17
<b>Miscellaneous</b>						
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	
1123	DC Power Supply	E3631A	N/A	Hewlett Packard	Verified by 6452	
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/14/15	08/14/16
7579	Temperature Chamber	115	151617	TestQuity	08/14/15	08/14/16
7560	Barometer/Temperature/Humidity Transmitter	iBTHX-W	1240476	Omega	10/19/15	10/19/16



### 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	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

#### 3.2.2 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	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty ( $u_c$ ):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.56

#### 3.2.3 Conducted Antenna Port Measurement

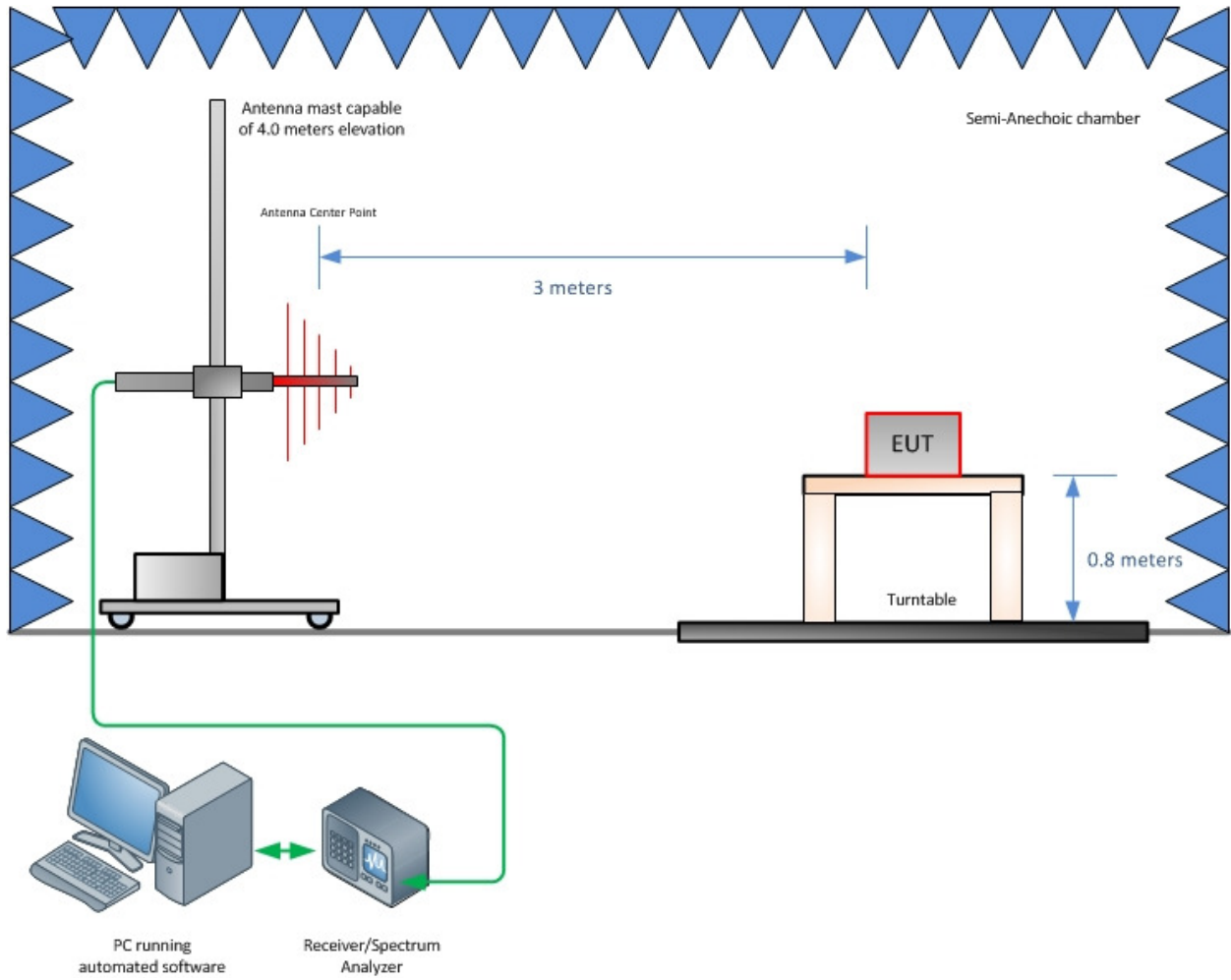
Contribution		Probability Distribution Type	Probability Distribution $x_i$	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.34	0.20	0.04
2	Cables	Rectangular	0.30	0.17	0.03
3	EUT Setup	Rectangular	0.50	0.29	0.08
Combined Uncertainty ( $u_c$ ):					0.39
Coverage Factor (k):					1.96
Expanded Uncertainty:					0.76



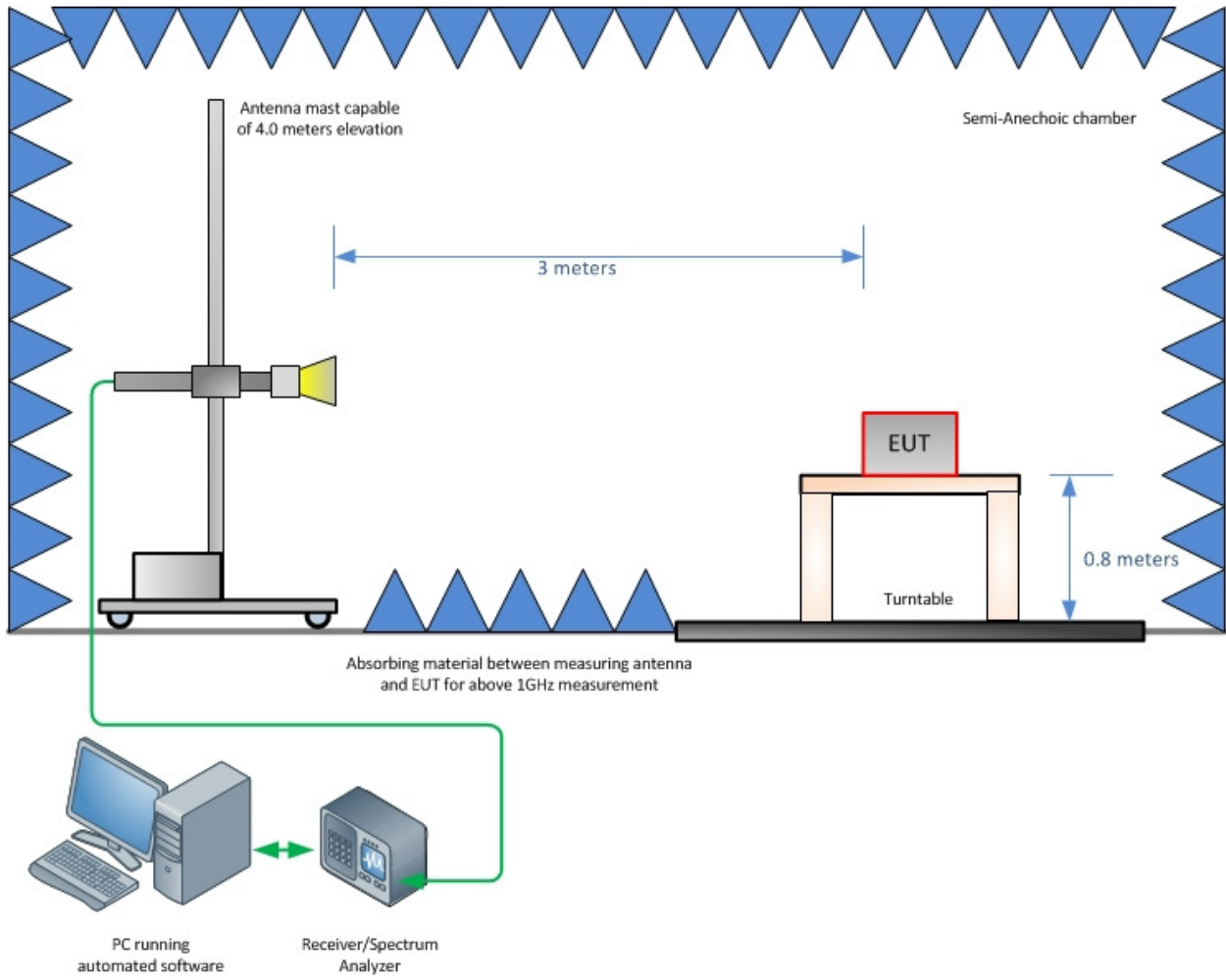
## **SECTION 4**

### **DIAGRAM OF TEST SETUP**

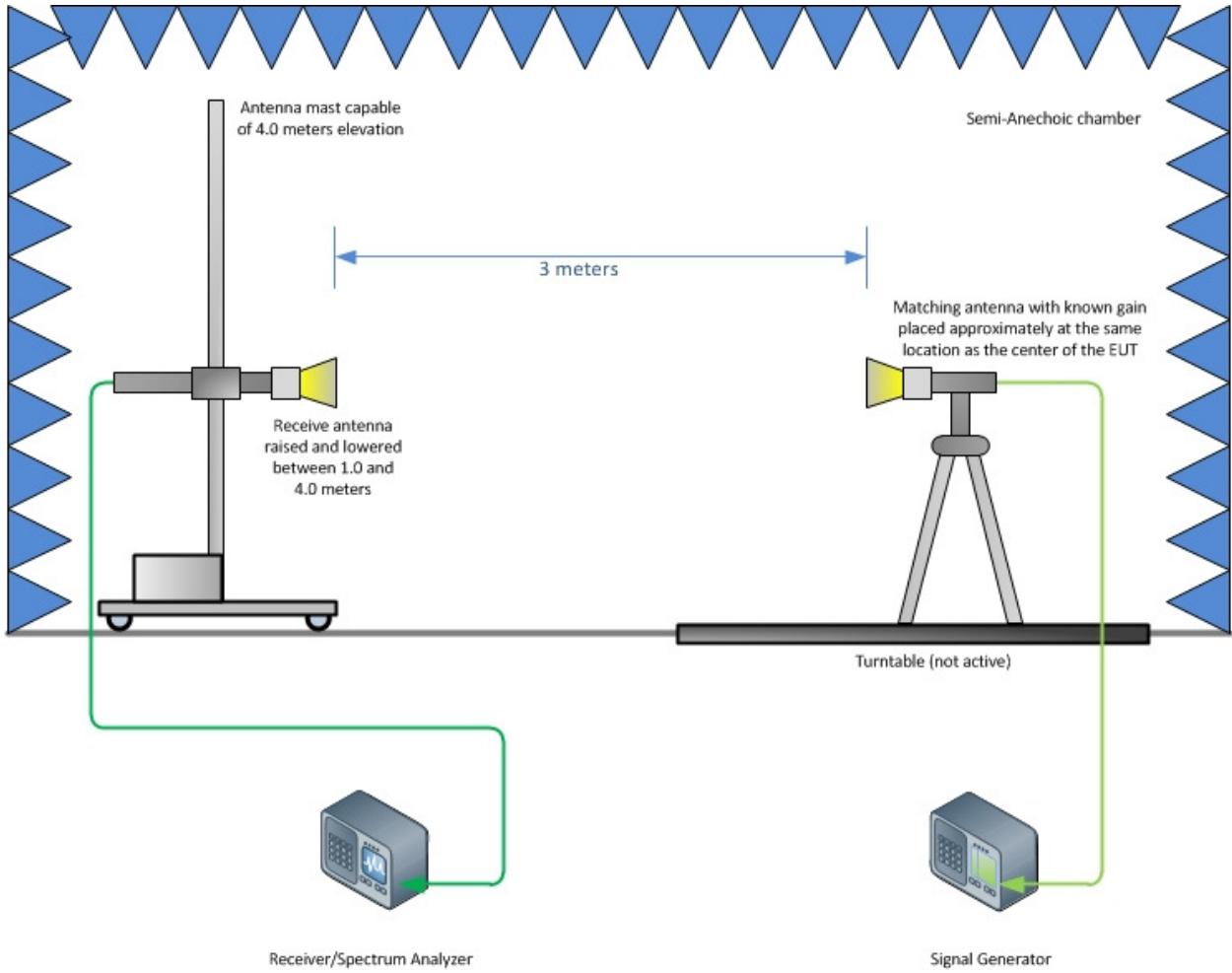
#### 4.1 TEST SETUP DIAGRAM



**Radiated Emission Test Setup (Below 1GHz)**

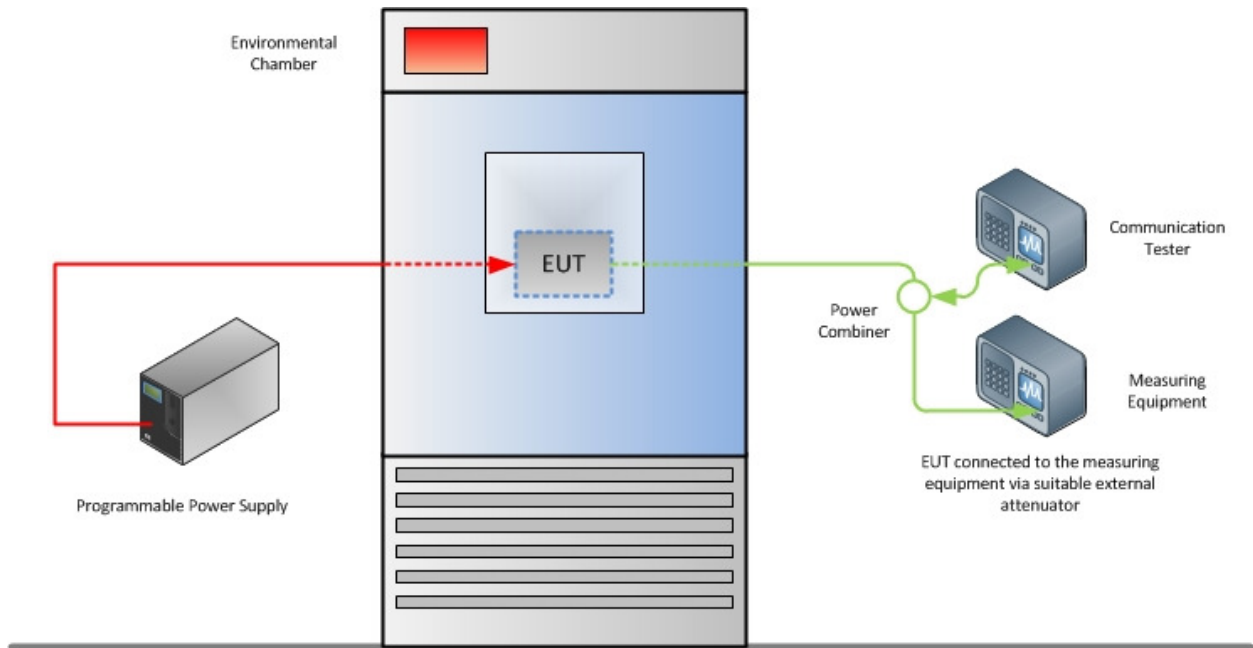


**Radiated Emission Test Setup (Above 1GHz)**



**Substitution Test Method (Above 1GHz)**





**Frequency Stability Test Configuration**



## **SECTION 5**

### **ACCREDITATION, DISCLAIMERS AND COPYRIGHT**



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