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Report On

Radio Testing of the
Globalstar, Inc.
SatFi2 Multi-Media Broadband Data WiFi Terminal

FCC Part 25 Subpart C
RSS-170 Issue 3 (July, 2015)

Report No. SD72134149-1217A **February 2018**

REPORT ON	Radio Testing of the Globalstar, Inc. Multi-Media Broadband Data WiFi Terminal
TEST REPORT NUMBER	SD72134149-1217A
PREPARED FOR	Globalstar, Inc. 300 Holiday Square Blvd Covington,LA 70433 USA
CONTACT PERSON	Tom Maher Director of Quality and Manufacturing (985) 335-1518 Tom.Maher@globalstar.com
PREPARED BY	Joel Rivera **Name** Title: EMC/Wireless Test Engineer
APPROVED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: Senior Test Engineer EMC/ Wireless Team Lead
DATED	March 28, 2018

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

Revision History

SD72134149-1217A Globalstar, Inc. Multi-Media Broadband Data WiFi Terminal SatFi2					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
03/28/2018	Initial Release				Ferdinand Custodio

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Globalstar, Inc.
Multi-Media Broadband Data WiFi Terminal

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1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Globalstar, Inc. Multi-Media Broadband Data WiFi Terminal to the requirements of FCC Part 25 Subpart C (October 1, 2017) and RSS-170 Issue 3 (July, 2015).

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	Globalstar, Inc.
Model Number(s)	SatFi2
Serial Number(s)	N/A
Number of Samples Tested	1
Test Specification/Issue/Date	FCC Part 25 Subpart C (October 1, 2017) and RSS-170 Issue 3 (July, 2015)
Start of Test	February 02, 2018
Finish of Test	February 12, 2018
Name of Engineer(s)	Joel Rivera
Related Document(s)	Supporting documents for EUT certification are separate exhibits.

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1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 25 Subpart C (October 1, 2017) and RSS-170 Issue 3 (July, 2015) is shown below.

Part 2	Part 25	RSS-170	Test Description	Result	Comments/Base Standard
§2.1046	§25.204(a)	Sec. 5.3.2	RF Power Output	Compliant	
§2.1049			Occupied Bandwidth	Compliant	
§2.1051	§25.202(f)	Sec. 5.4.3.1	Spurious Emissions at Antenna Terminals	Compliant	
§2.1053	§25.202(f)	Sec. 5.4.3.1	Field Strength of Radiated Spurious Emissions	Compliant	
§2.1055	§25.202(d)	Sec. 5.2	Frequency Stability	Compliant	
	§25.216(g) and (i)	Sec. 5.4.3.2.1, Sec. 5.4.4	Protection of Aeronautical Radio Navigation Satellite Service	Compliant	

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1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Globalstar, Inc**.** Model SatFi2 Multi-Media Broadband Data WiFi Terminal. The EUT provides location-based messaging and emergency notification technology, voice and data that allows a user to communicate from remote locations through a commercial satellite network. The SatFi2 incorporates a Satellite radio and a GPS receiver. The satellite radio functions of the EUT were verified in this test report.

1.3.2 EUT General Description

EUT Description	Multi-Media Broadband Data WiFi Terminal
Model Name	SatFi2
Serial Number	N/A
Input Voltage	10.0 VDC - 48 VDC
Output RF Power	1.17dBW EIRP
Frequency Range (TX)	1610.73 – 1625.49 MHz in the 1610.0-1626.5 MHz L-Band Mobile Satellite Service
Emission Designator	1M33G1W
Antenna Type	External antenna non detachable
Antenna Model	Satfi TPE Plastic Tube
Antenna gain	3.3 dBi
Modulation	HPSK for transmit and QPSK for receive
EUT Sample Type	Pre-production
Dimensions	(D) 1117.3mm x (W) 74.6mm x (H) 35.5mm

Transmit Channel Table

Channel	ARFCN (decimal)	ARFCN (hex)	Frequency (MHz)
1	***4***	***4***	***1610.73***
2	45	2d	1611.96
3	86	56	1613.19
4	127	7f	1614.42

Rest of the table next page

5	168	a8	1615.65
6	209	d1	1616.88
7	***250***	***fa***	***1618.11***
8	291	123	1619.34
9	332	14c	1620.57
10	373	175	1621.8
11	414	19e	1623.03
12	455	1c7	1624.26
13	***496***	***1f0***	***1625.49***

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1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Conducted port configuration: SMA Pigtail directly attached to antenna for conducted measurement.
B	Radiated emissions configuration: Stand alone with AC/DC power supply for radiated cabinet emissions measurement.

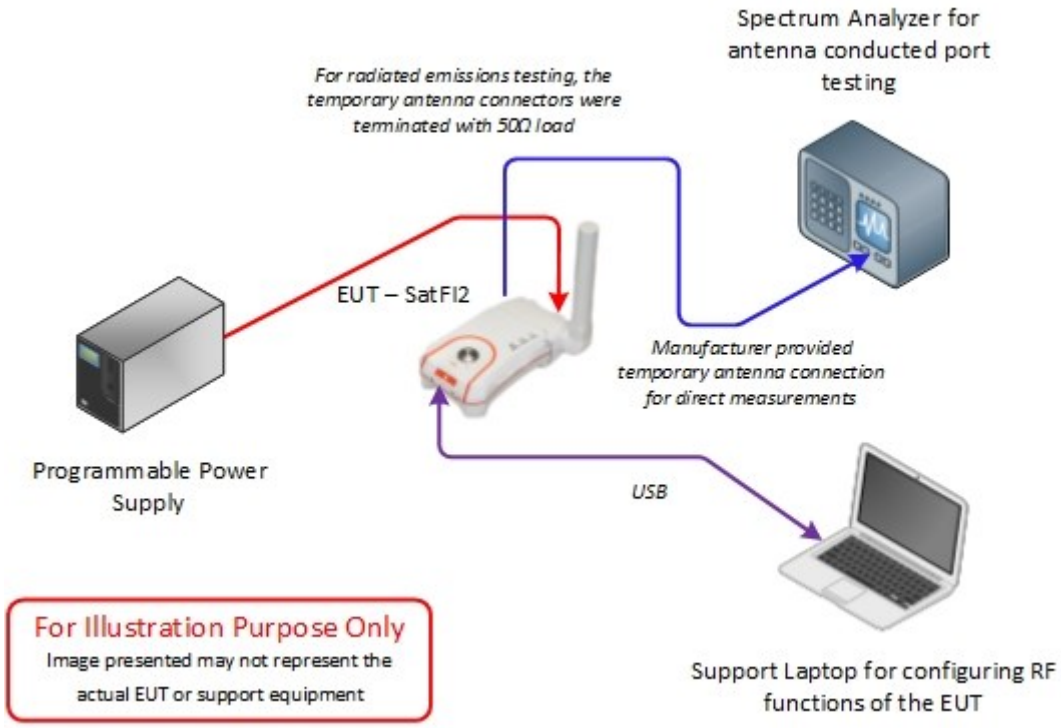
1.4.2 EUT Exercise Software

EUT is configured via USB port. Once connected to the support Laptop, putty.exe and RTDM.exe application was used to send radio configuration commands to set the EUT in continuous modulated transmission mode at Low, Mid and High channels.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
DELL	Laptop latitude E6430s	S/N CBMRMX1
N/A	Micro USB EUT to Laptop cable	1 meters, micro USB cable
Protek	DC Power Supply	SDGE09075
MCL	2X 50Ω SMA Termination	ANNE-50L+ DC-12GHz
MCL	2X 50Ω SMA Load	VAT-6W2+2W 6dB DC-6GHz 1502

1.4.4 Simplified Test Configuration Diagram



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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 N/A		
N/A		

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

1.7 TEST METHODOLOGY

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

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

1.8 TEST FACILITY REGISTRATION

1.8.1 FCC – Registration No.: US1146

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

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

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

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

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1.8.3 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.

1.8.4 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.

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

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

1.8.6 RRA – Identification No. US0102

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

1.8.7 OFCA – U.S. Identification No. US0102

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

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SECTION 2

TEST DETAILS

Radio Testing of the
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SatFi2 Multi-Media Broadband Data WiFi Terminal

2.1 RF POWER OUTPUT

2.1.1 Specification Reference

Part 25 Subpart C §25.204(a), RSS-170 Issue 3 Sec. 5.3.2

2.1.2 Standard Applicable

(a) In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station, other than an ESV, operating in frequency bands between 1 and 15 GHz, shall not exceed the following limits except as provided for in paragraph (c) of this section:
+40 dBW in any 4 kHz band for Θ ≤ 0°
+40 + 3Θ dBW in any 4 kHz band for 0° < Θ ≤ 5°
where Θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it..

2.1.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration A

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

March 14, 2017/ JR

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	24.5 °C
Relative Humidity	25.7 %
ATM Pressure	99.8 kPa

2.1.7 Additional Observations

- This is a conducted test utilizing a spectrum analyzer.
- The attenuation for the external attenuator, adapter and cable is measured and entered as an offset.
- RBW of 4 kHz is not available in the instrument used. RBW is set to 5 kHz, which is worst case.
- Power integration function of the spectrum analyzer used. Power integration bandwidth is based from the occupied bandwidth data (see Section 2.2 of this test report).

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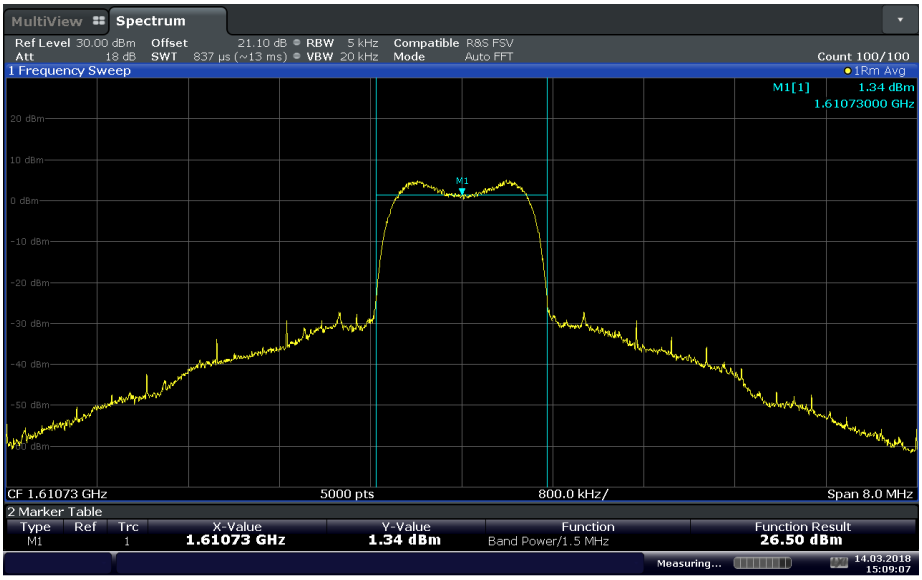
2.1.8 Worst Case Data Rate Verification

Frequency (MHz)	Data Rate (kb/s)	Output Power (dBm)
1610.73	***9.6***	***26.11***
	19.2	25.87
	36	25.69
	72	25.63
	144	25.22
	256	25.05



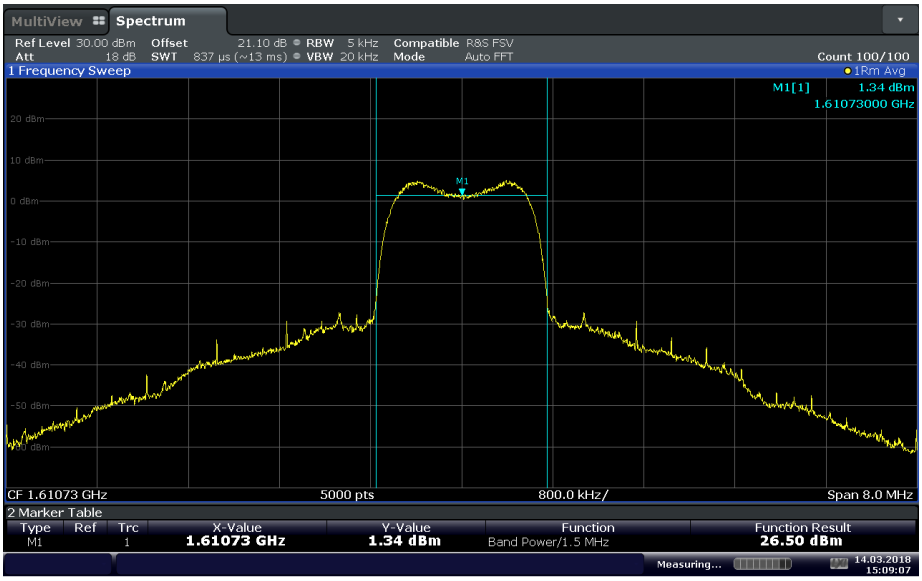
15:09:08 14.03.2018

Sample data rate verification (9.6kb/s (worst case))

2.1.9 Test Results

Frequency (MHz)	Output Power (dBm)	Antenna Gain (dBi)	E.I.R.P. (dBm)	E.I.R.P. (dBW)
1610.73	26.50	3.3	29.80	0.95
1618.11	27.41	3.3	30.71	1.17
1625.49	26.32	3.3	29.62	0.95

2.1.10 Test Plots



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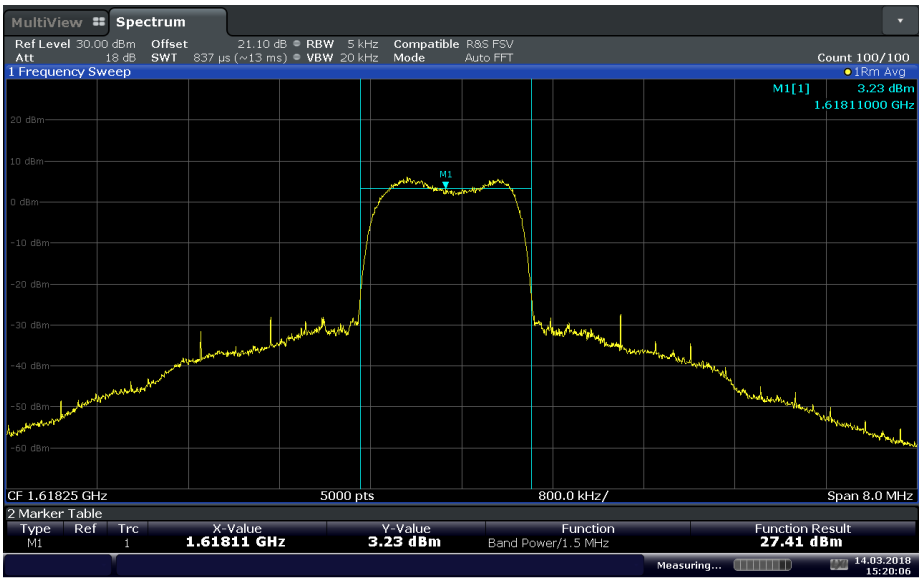
Low Channel



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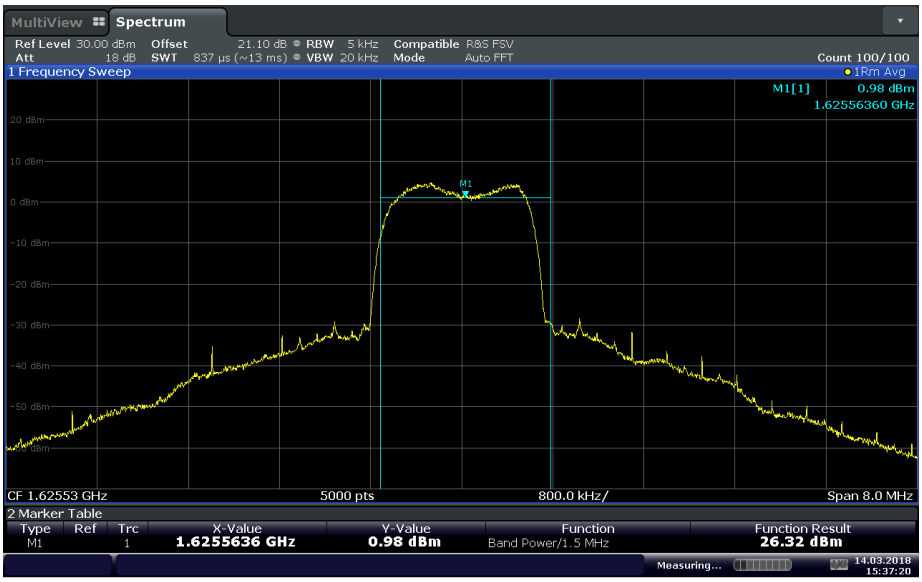
Mid Channel



15:37:21 14.03.2018

High Channel

2.2 OCCUPIED BANDWIDTH

2.2.1 Specification Reference

Part 2 Subpart J §2.1049

2.2.2 Standard Applicable

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

2.2.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration A

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

Febuary 2, 2018 / JR

2.2.5 Test Equipment Used

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

2.2.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.0 °C
Relative Humidity	24.1 %
ATM Pressure	99.2 kPa

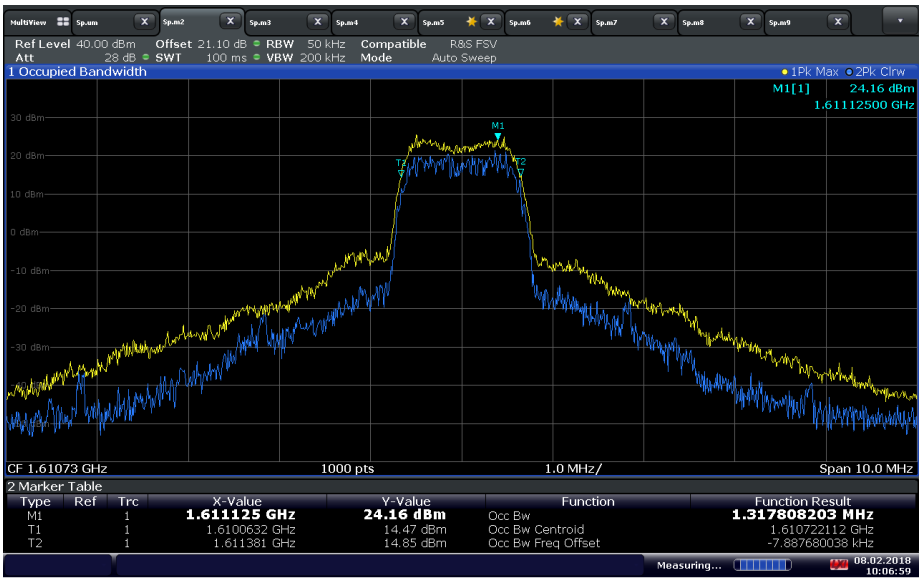
2.2.7 Additional Observations

- This is a conducted test utilizing a spectrum analyzer.
- The attenuation for the external attenuator, adapter and cable is measured and entered as an offset.
- Occupied bandwidth measurement function of the spectrum analyzer was utilized for this test.
- Span is wide enough to capture the channel transmission.
- RBW is 1% to 5% of the Occupied bandwidth.
- VBW is >3 X RBW.
- Sweep is auto.
- Detector is peak.
- Trace is max hold.

2.2.8 Test Results

Channel	Frequency	Occupied Bandwidth
Low	1610.73	1.31
Mid	1618.11	1.33
High	1625.49	1.31

2.2.9 Test Plots



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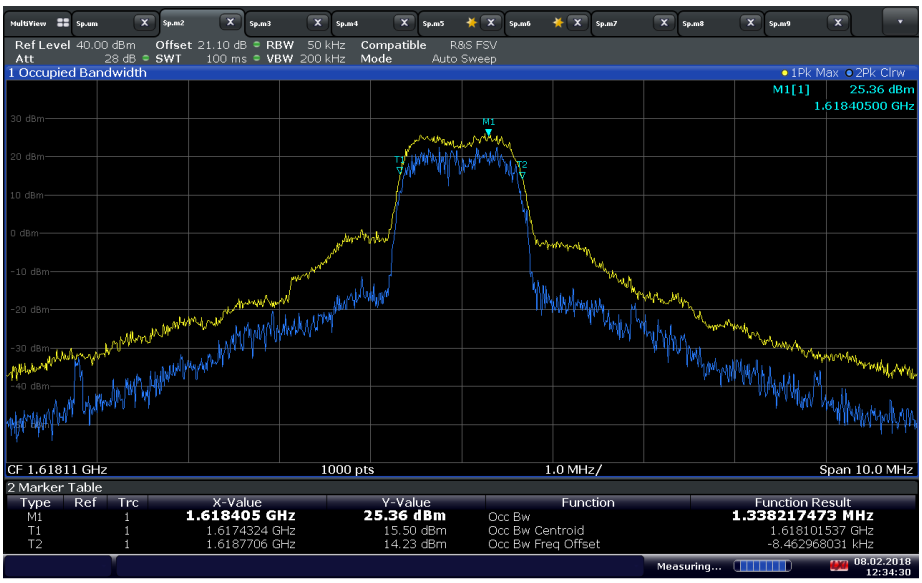
Low Channel



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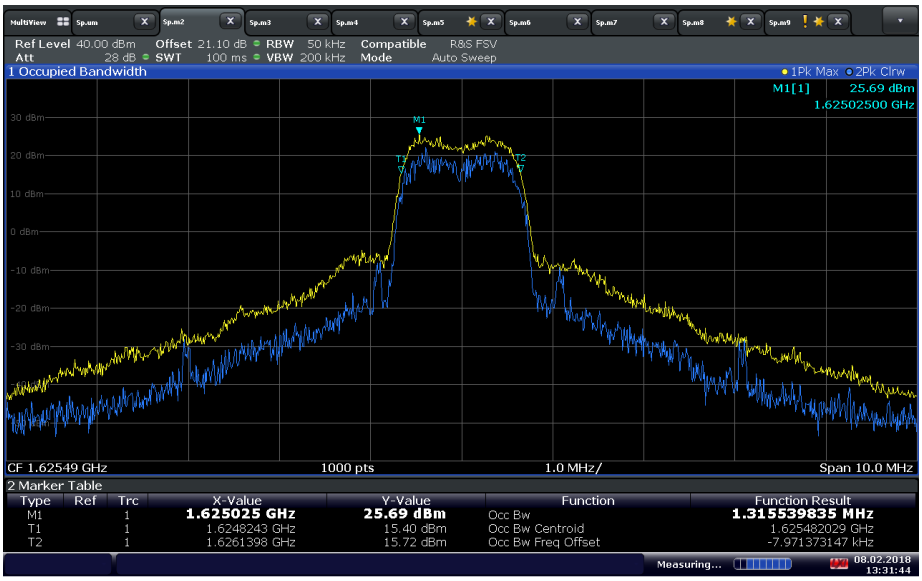
Mid Channel



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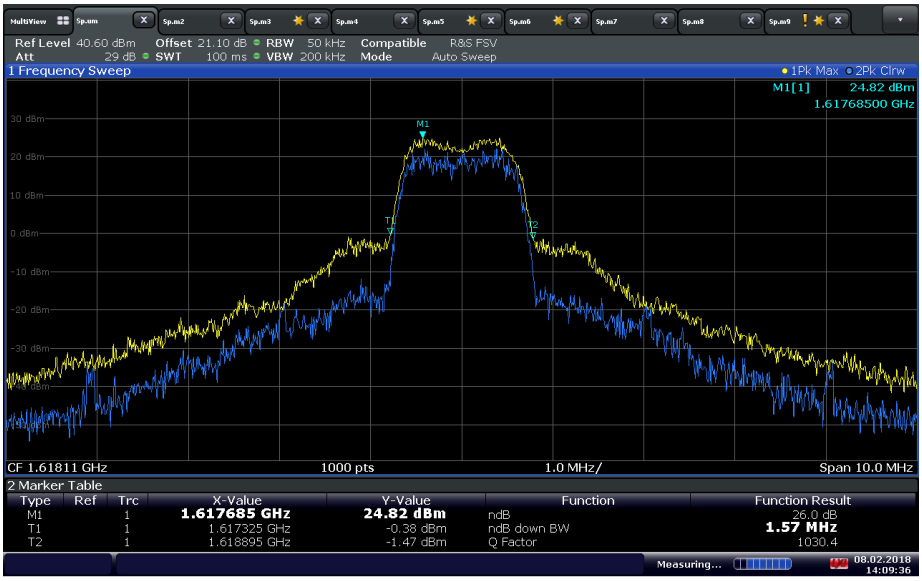
High Channel



14:09:36 08.02.2018

Middle Channel 26dB Bandwidth (BW used for band power measurement of Section 2.1.7)

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2.3 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

2.3.1 Specification Reference

Part 25 Subpart C §25.202(f), RSS-170 Issue 3 Sec. 5.4.3.1

2.3.2 Standard Applicable

(f) Emission limitations. Except for SDARS terrestrial repeaters, the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The out-of-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.
(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;
(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;
(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;
(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

2.3.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration A

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

Febuary 2, 2018 / JR

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

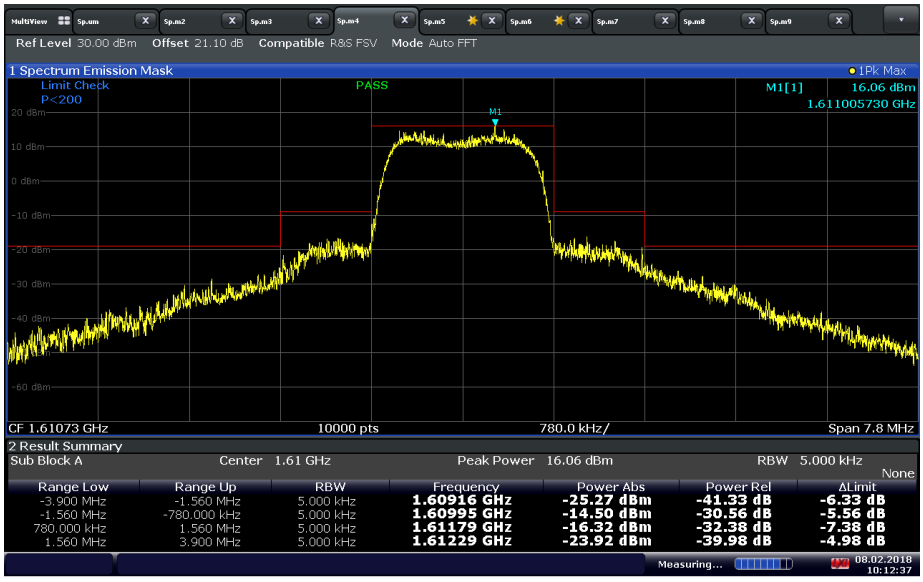
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.0 °C
Relative Humidity	24.1 %
ATM Pressure	99.2 kPa

2.3.7 Additional Observations

- This is a conducted test utilizing a spectrum analyzer.
- The attenuation for the external attenuator, adapter and cable is measured and entered as an offset.
- RBW of 4 kHz is not available in the instrument used. RBW is set to 5 kHz, which is worst case.
- The emission mask as per §25.202(f)(1) to (3) was drawn for each channel and modulation scheme investigated.
- Separate plots outside ±250% from the center frequency were also provided.
- The emission mask was calculated each time based from the mean output power and authorized bandwidth of each channel/modulation investigated.

2.3.8 Test plots



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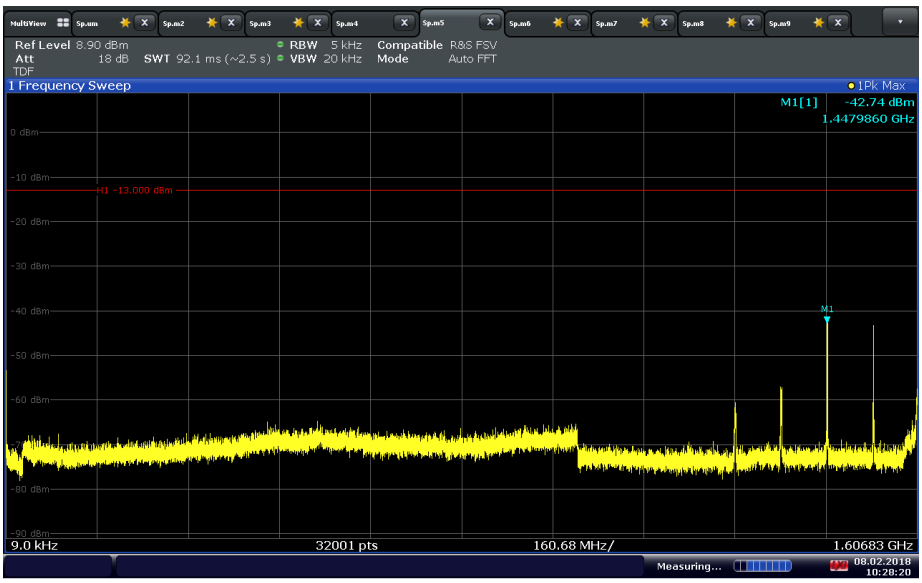
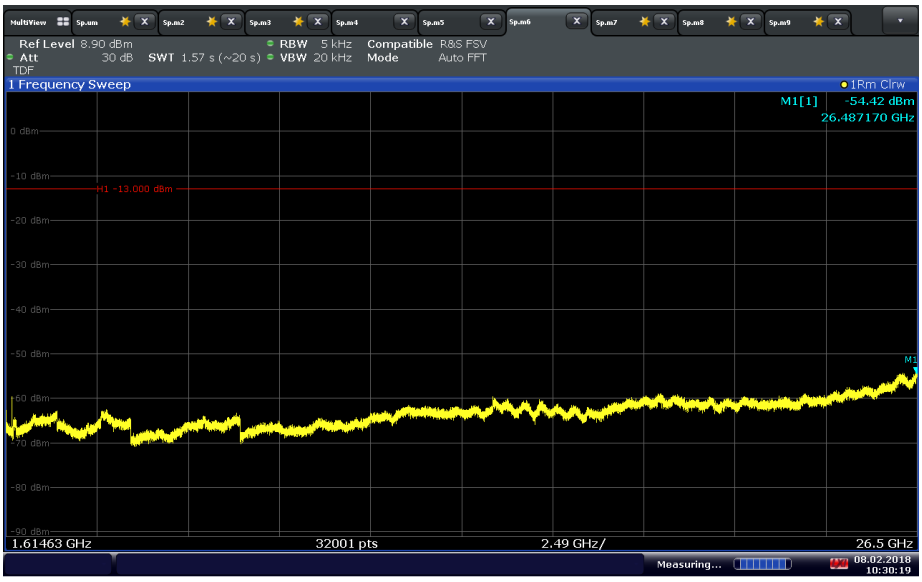
Low Channel (centred at the transmit frequency)



10:28:20 08.02.2018

Low Channel (30 MHz to lower edge sweep)



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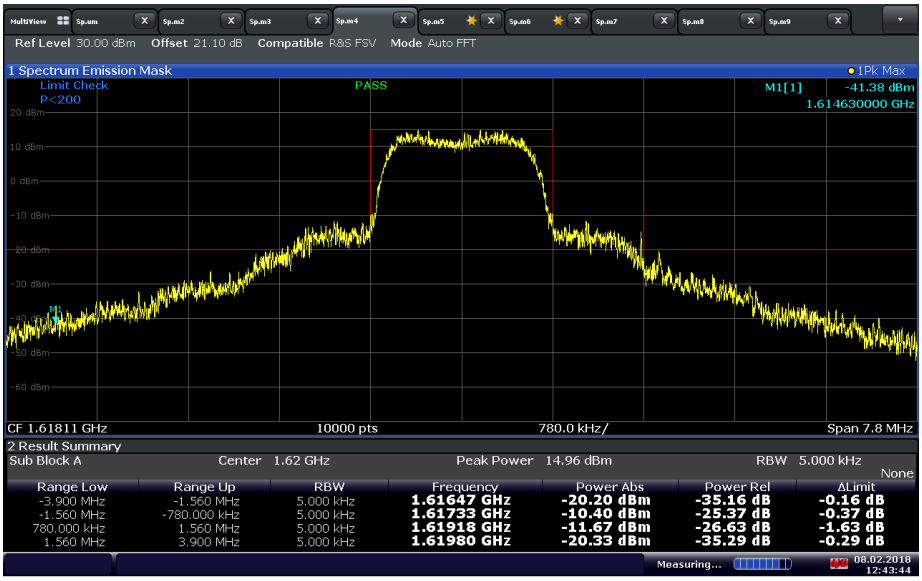
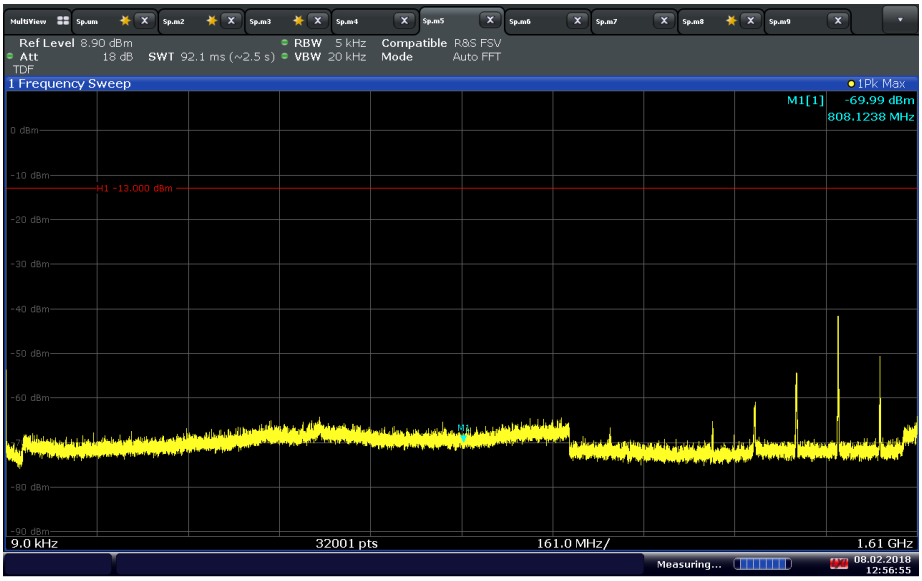
Low Channel (upper edge to 2.0 GHz sweep)



12:43:45 08.02.2018

Mid Channel (centred at the transmit frequency)



12:56:55 08.02.2018

Mid Channel (30 MHz to lower edge sweep)

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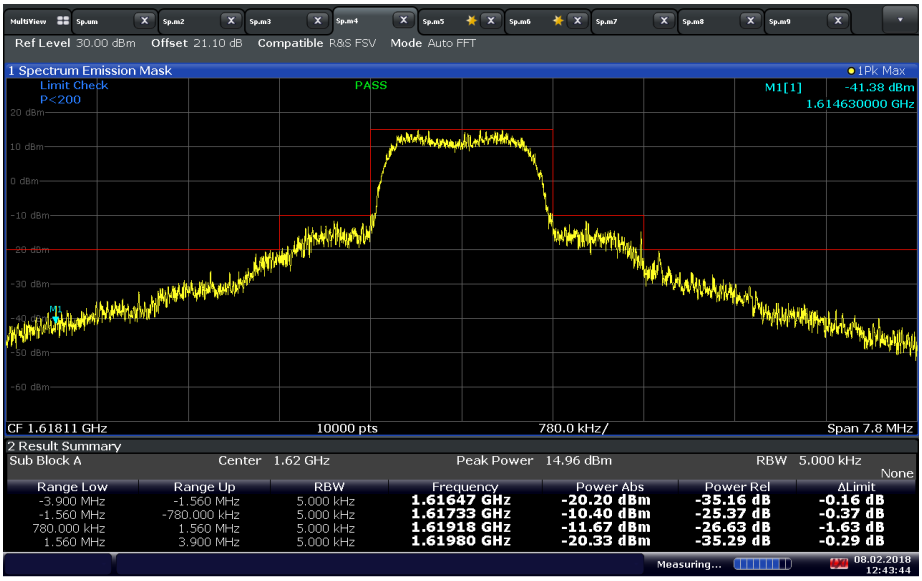

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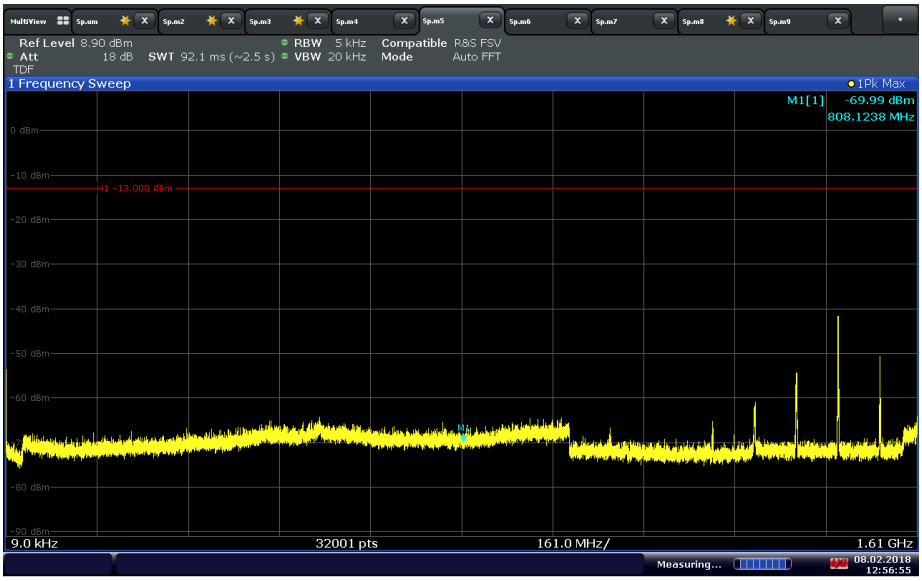
High Channel (centred at the transmit frequency)



12:56:55 08.02.2018

Mid Channel (30 MHz to lower edge sweep)

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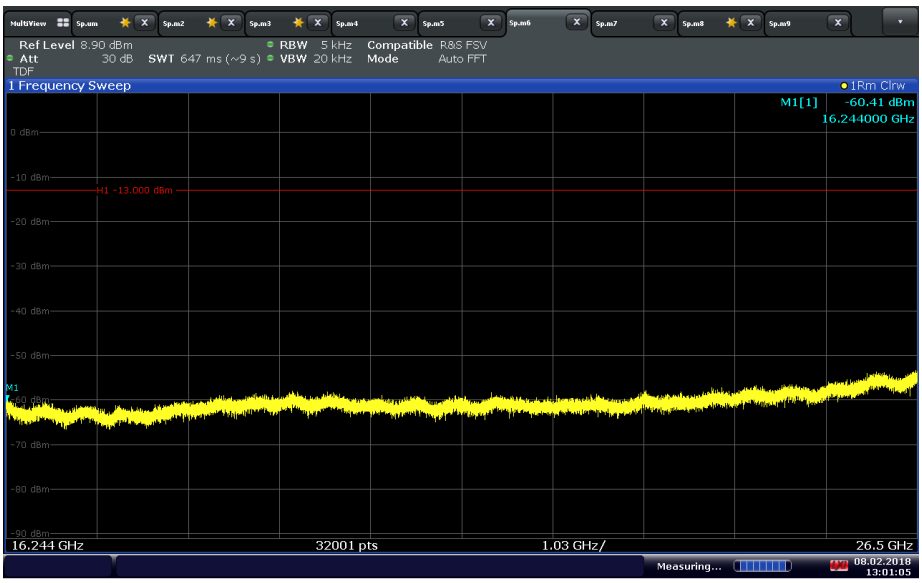

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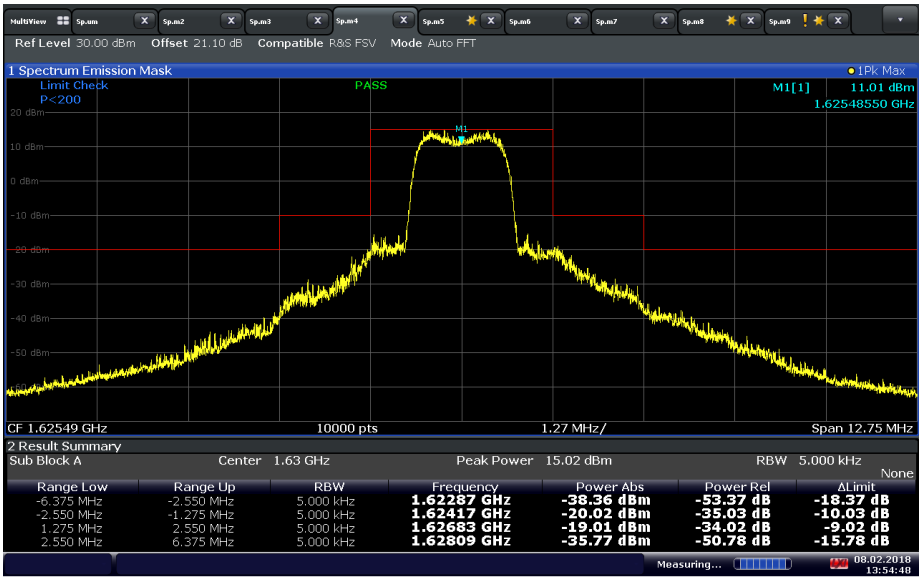
Mid Channel (upper edge to 26.5GHz sweep)



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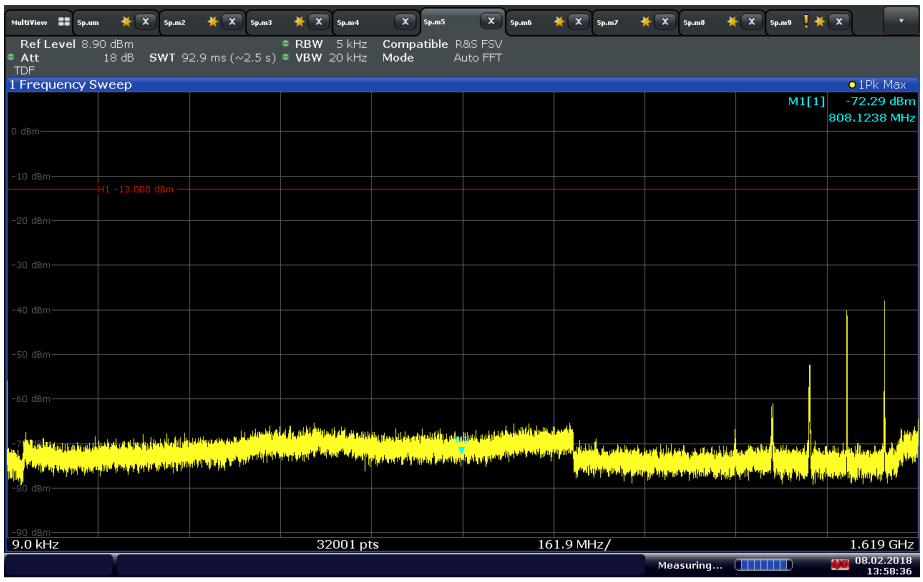
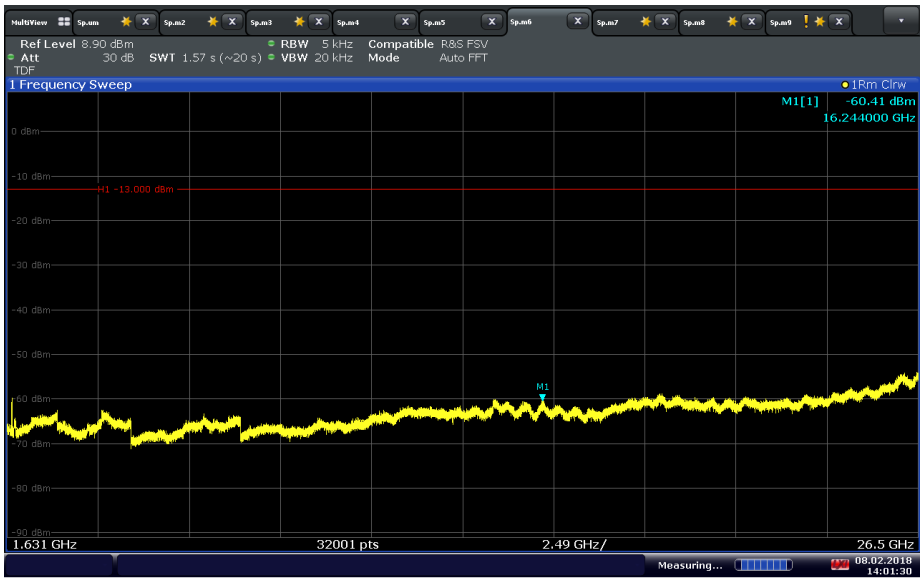
High Channel (centred at the transmit frequency)



13:58:37 08.02.2018

High Channel (30 MHz to lower edge sweep)



14:01:31 08.02.2018

High Channel (upper edge to 26.5GHz sweep)

2.4 FIELD STRENGTH OF RADIATED SPURIOUS EMISSIONS

2.4.1 Specification Reference

Part 25 Subpart C §25.202(f) as required by Part 2 Subpart J §2.1053, RSS-170 Issue 3 Sec. 5.4.3.1

2.4.2 Standard Applicable

Identical to Section 2.3.2 of this test report.

2.4.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration B

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

Febuary 12, 2018

2.4.5 Test Equipment Used

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

2.4.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2 °C
Relative Humidity	24.5 %
ATM Pressure	99.9 kPa

2.4.7 Additional Observations

- This is a radiated test.
- The spectrum was searched from 30MHz to 10X the transmit frequency (up to 18GHz).
- Test procedure is per ANSI C63.10-2013 (120kHz RBW below 1GHz and 1MHz RBW above 1GHz). Any emission which is within 6dB of §25.202(f) limit will be proven by substitution method.
- Limit for this test is 82.23dBµV/m @ 3 meters (-13dBm) E.I.R.P.
- 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 2.4.8 for sample computation.

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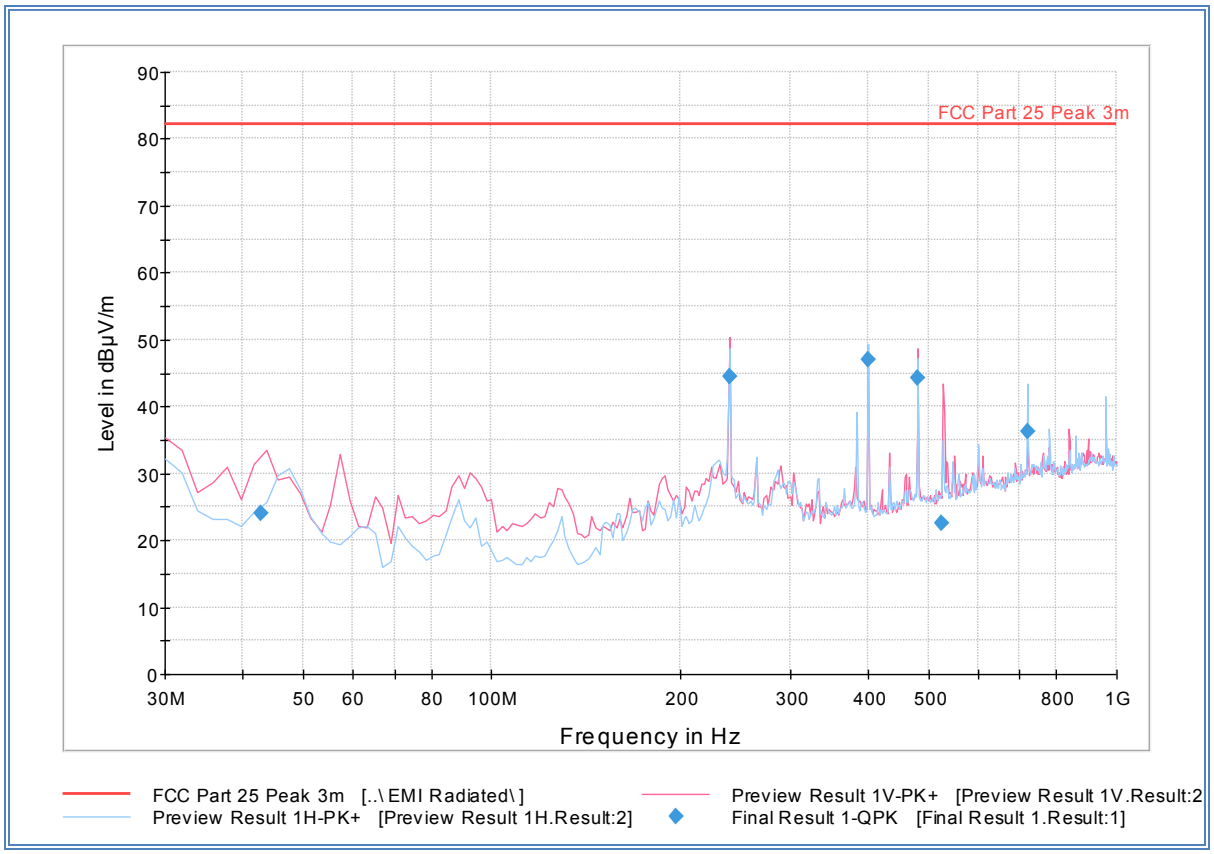
2.4.8 Sample Computation (Radiated Emission)

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# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.4.9 Test Results

See attached plots.

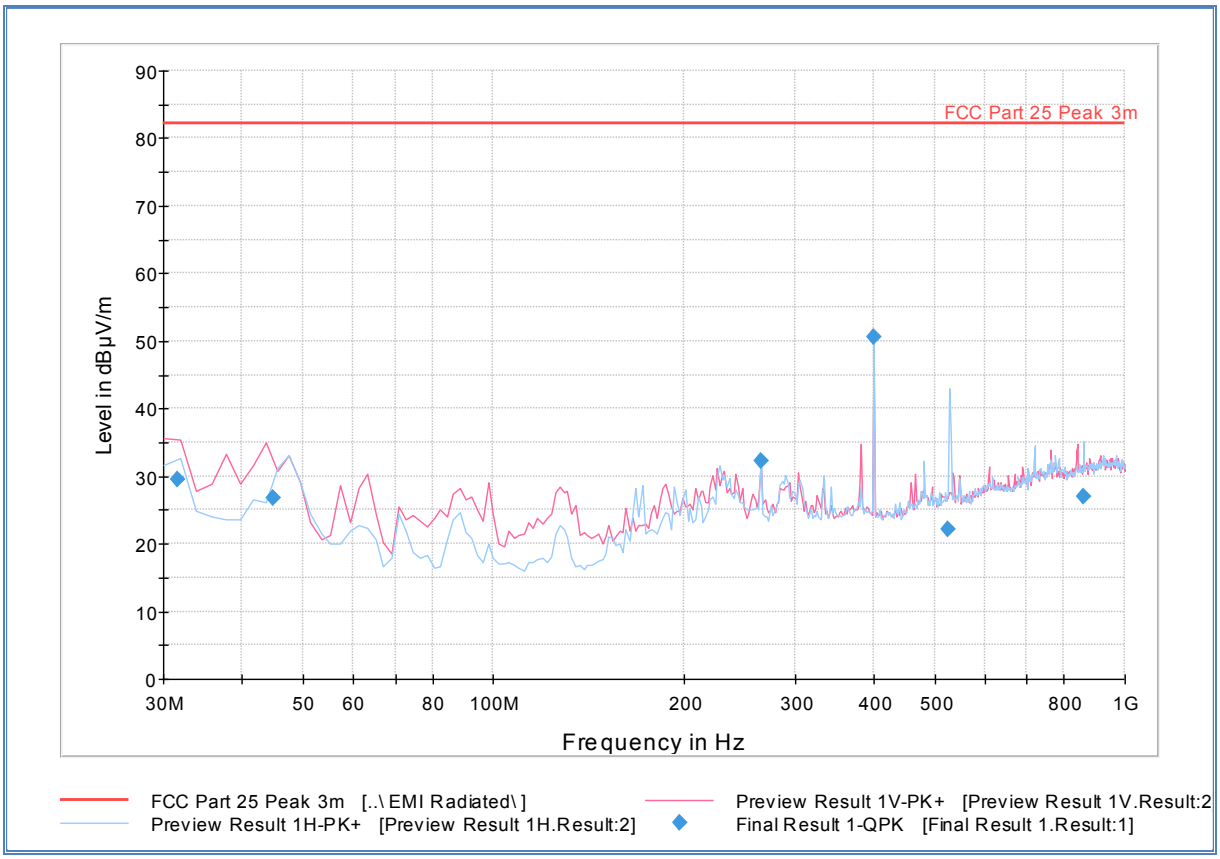
2.4.9.1 Below 1GHz Radiated Emission Test (Transmit Mode, Worst Case Channel)



Quasi-Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.727214	24.1	1000.0	120.000	155.0	V	257.0	-12.5	58.1	82.2
239.979880	44.5	1000.0	120.000	100.0	V	-12.0	-8.7	37.8	82.2
400.018677	47.1	1000.0	120.000	138.0	V	341.0	-3.5	35.2	82.2
479.701964	44.2	1000.0	120.000	150.0	V	323.0	-1.1	38.0	82.2
525.555271	22.5	1000.0	120.000	100.0	V	185.0	0.0	59.8	82.2
719.600160	36.2	1000.0	120.000	139.0	H	282.0	3.9	46.0	82.2
42.727214	24.1	1000.0	120.000	155.0	V	257.0	-12.5	58.1	82.2

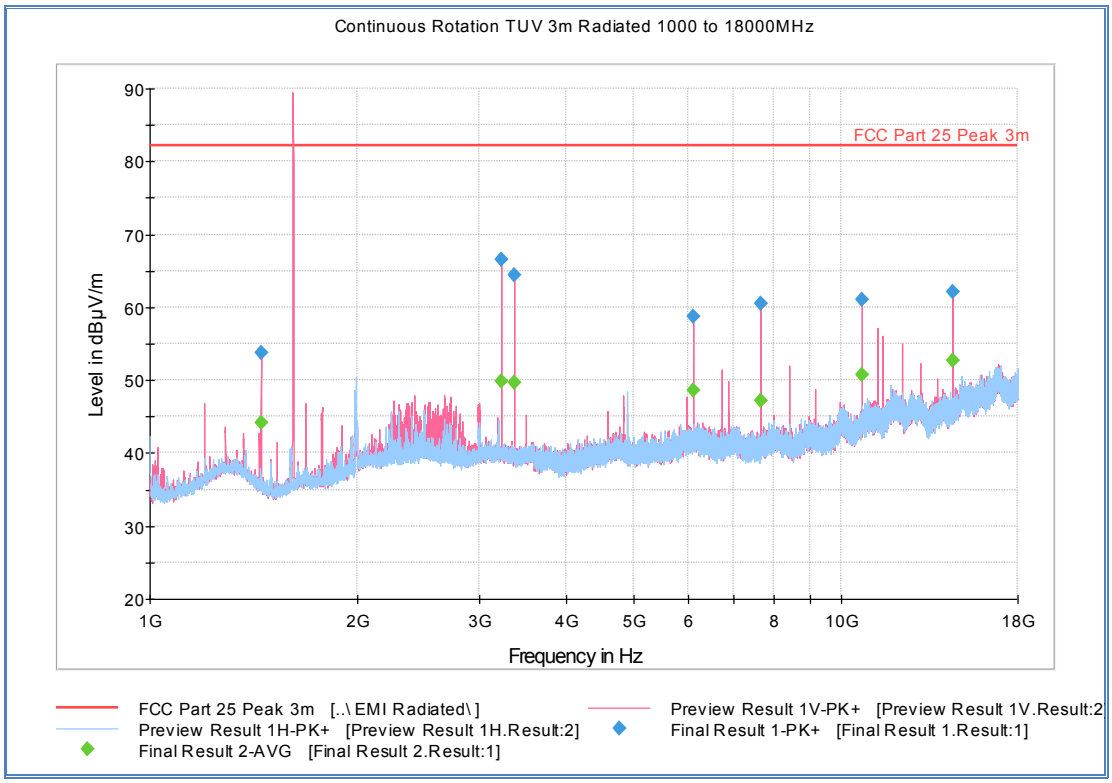
2.4.9.2 Below 1GHz Radiated Emission Test (Receive Mode)



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)
31.640000	29.4	1000.0	120.000	100.0	V	-12.0	-6.4	52.8	82.2
44.727214	26.8	1000.0	120.000	100.0	V	259.0	-12.9	55.4	82.2
265.570421	32.2	1000.0	120.000	100.0	H	280.0	-7.9	50.0	82.2
399.898677	50.5	1000.0	120.000	100.0	H	167.0	-3.5	31.7	82.2
525.715271	22.2	1000.0	120.000	250.0	H	71.0	0.0	60.0	82.2
857.840080	27.1	1000.0	120.000	150.0	H	314.0	5.9	55.1	82.2

2.4.9.3 From 1GHz to 18GHz Radiated Emission Test (Transmit Mode, Low Channel)



Peak Data

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1448.266667	53.7	1000.0	1000.000	123.0	V	309.0	-5.6	28.5	82.2
3222.700000	66.5	1000.0	1000.000	141.9	V	40.0	1.1	15.7	82.2
3367.200000	64.4	1000.0	1000.000	126.9	V	10.0	1.0	17.8	82.2
6117.966667	58.8	1000.0	1000.000	144.9	V	336.0	6.6	23.5	82.2
7647.600000	60.4	1000.0	1000.000	126.0	V	320.0	7.2	21.8	82.2
10705.66666	61.1	1000.0	1000.000	111.0	V	232.0	12.0	21.1	82.2

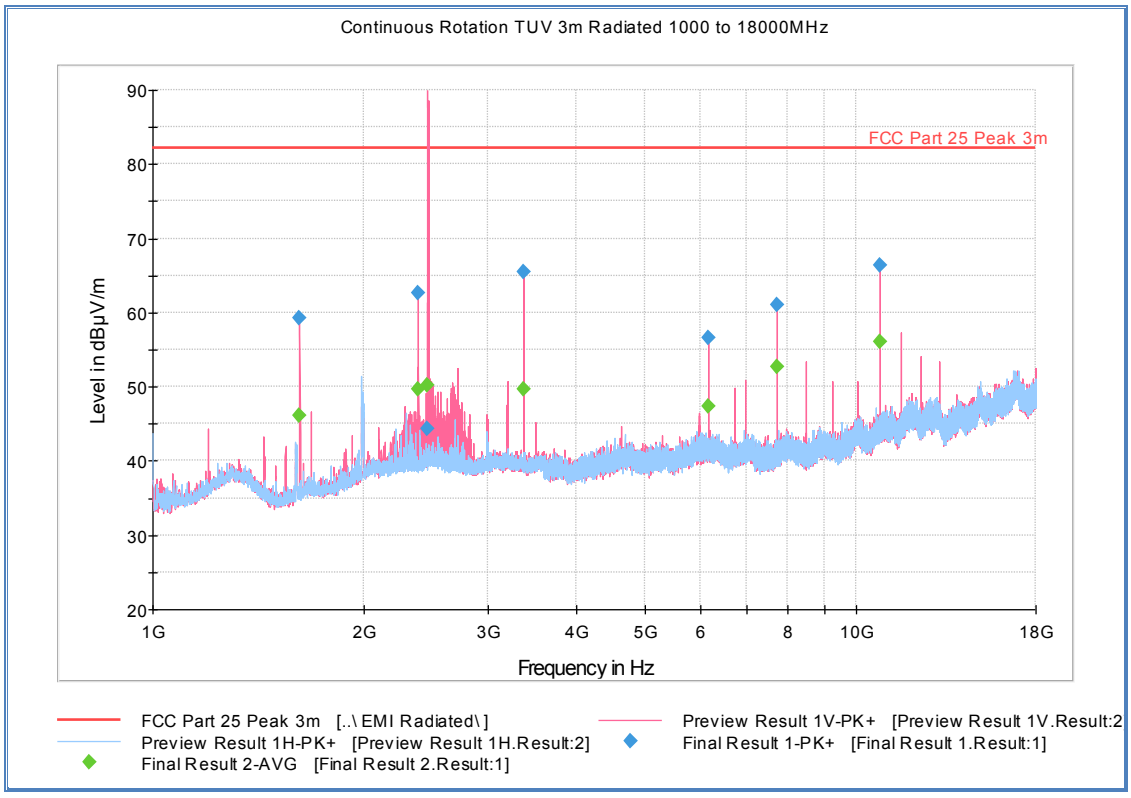
Test Note: *Fundamental emission ignored for this test.*

Substitution Data

Frequency (MHz)	Max Peak (dBµV/m)	Substitution signal generator level (dBm)	Substitution cable loss (dB)	Substitution antenna gain (dBi)	Substitution level (dBm)	Limit (dBm)	Margin (dB)

Test Note: *No emissions within 6 dB of the limit, substitution method not required.*

2.4.9.4 From 1GHz to 18GHz radiated Emission Test (Transmit Mode, Mid Channel)



Peak Data

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1618.466667	59.3	1000.0	1000.000	113.0	V	16.0	-5.4	22.9	82.2
2386.433333	62.7	1000.0	1000.000	250.4	V	307.0	-0.9	19.6	82.2
2460.700000	44.4	1000.0	1000.000	167.7	V	120.0	-0.4	37.8	82.2
3366.200000	65.6	1000.0	1000.000	103.0	V	74.0	1.0	16.7	82.2
6176.300000	56.6	1000.0	1000.000	151.0	V	241.0	6.6	25.6	82.2
7721.233333	61.0	1000.0	1000.000	114.0	V	-13.0	7.2	21.2	82.2
10808.96666	66.4	1000.0	1000.000	111.0	V	252.0	12.1	15.8	82.2

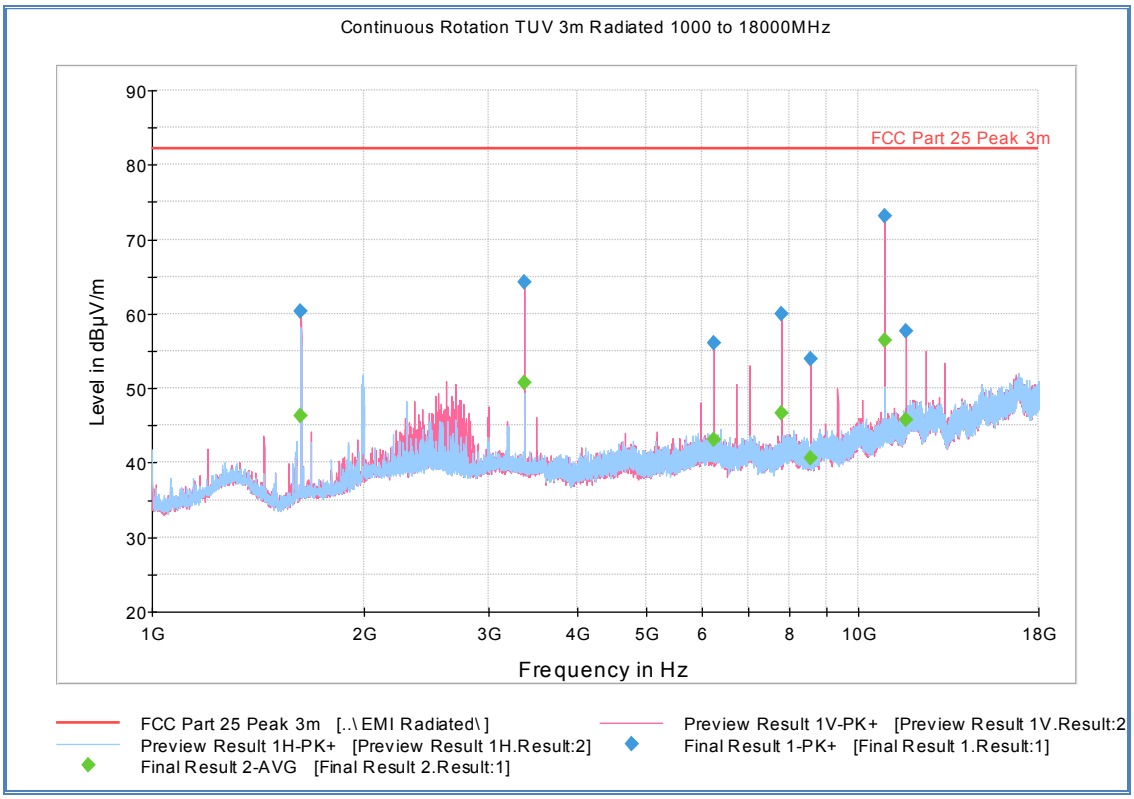
Test Note: *Fundamental emission ignored for this test.*

Substitution Data

Frequency (MHz)	Max Peak (dBµV/m)	Substitution signal generator level (dBm)	Substitution cable loss (dB)	Substitution antenna gain (dBi)	Substitution level (dBm)	Limit (dBm)	Margin (dB)

Test Note: *No emissions within 6 dB of the limit, substitution method not required.*

2.4.9.5 Above 1GHz to 18GHz Radiated Emission Test (Transmit Mode, High Channel)



Peak Data

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1625.600000	60.4	1000.0	1000.000	151.0	V	179.0	-5.3	21.8	82.2
3366.800000	64.2	1000.0	1000.000	103.0	V	48.0	1.0	18.0	82.2
6236.600000	56.0	1000.0	1000.000	138.9	V	55.0	6.5	26.2	82.2
7794.700000	60.0	1000.0	1000.000	122.0	V	27.0	7.3	22.2	82.2
8573.866667	53.9	1000.0	1000.000	103.0	V	105.0	7.6	28.4	82.2
10913.10000	73.1	1000.0	1000.000	145.9	V	285.0	12.1	9.1	82.2
11692.23333	57.6	1000.0	1000.000	104.0	V	115.0	14.3	24.6	82.2

Substitution Data

Frequency (MHz)	Max Peak (dBµV/m)	Substitution signal generator level (dBm)	Substitution cable loss (dB)	Substitution antenna gain (dBi)	Substitution level (dBm)	Limit (dBm)	Margin (dB)

Test Note: *No emissions within 6 dB of the limit, substitution method not required.*

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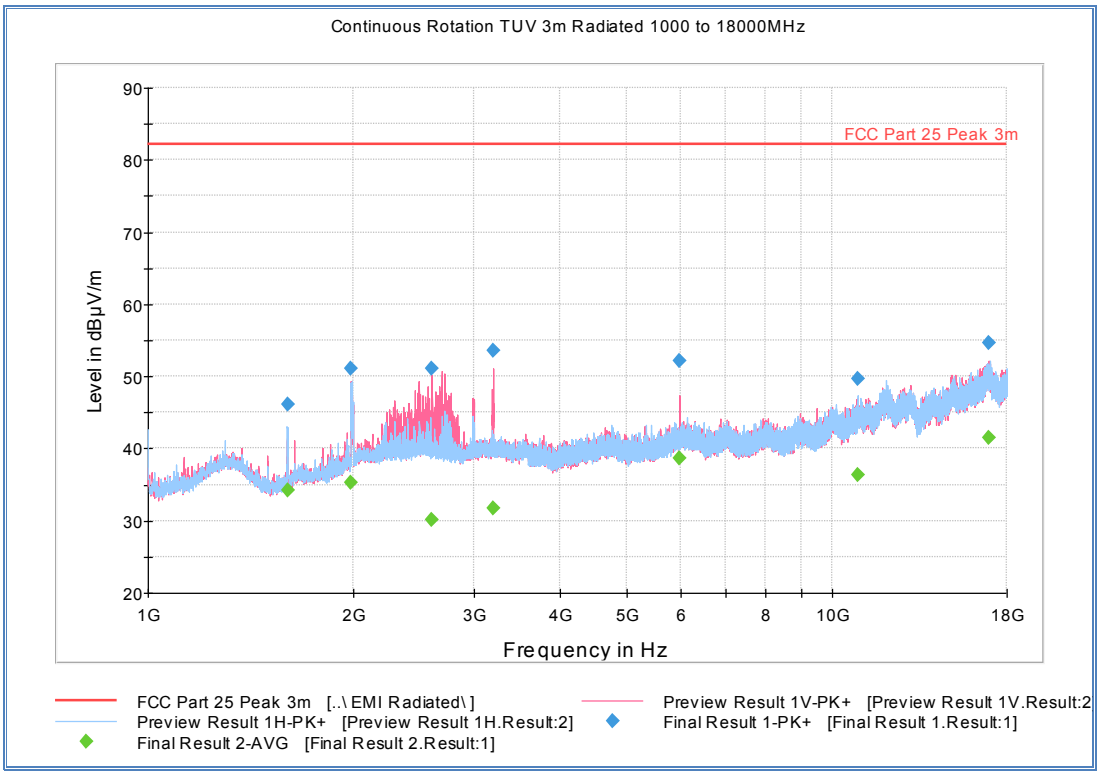
2.4.9.6 1GHz to 18GHz Radiated Emission Test (Receive Mode, Low Channel)



Peak Data

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1598.233333	46.1	1000.0	1000.000	118.0	H	241.0	-5.6	36.1	82.2
1981.133333	51.1	1000.0	1000.000	400.0	V	150.0	-2.1	31.1	82.2
2595.933333	51.0	1000.0	1000.000	118.0	V	168.0	-0.1	31.2	82.2
3190.533333	53.6	1000.0	1000.000	112.0	V	-7.0	1.1	28.6	82.2
5978.166667	52.2	1000.0	1000.000	120.9	V	278.0	6.2	30.1	82.2
10910.26666	49.6	1000.0	1000.000	251.4	H	134.0	12.1	32.6	82.2
16952.66666	54.7	1000.0	1000.000	319.2	V	237.0	19.0	27.6	82.2
1598.233333	46.1	1000.0	1000.000	118.0	H	241.0	-5.6	36.1	82.2

Substitution Data

Frequency (MHz)	Max Peak (dBµV/m)	Substitution signal generator level (dBm)	Substitution cable loss (dB)	Substitution antenna gain (dBi)	Substitution level (dBm)	Limit (dBm)	Margin (dB)

Test Note: *No emissions within 6 dB of the limit, substitution method not required.*

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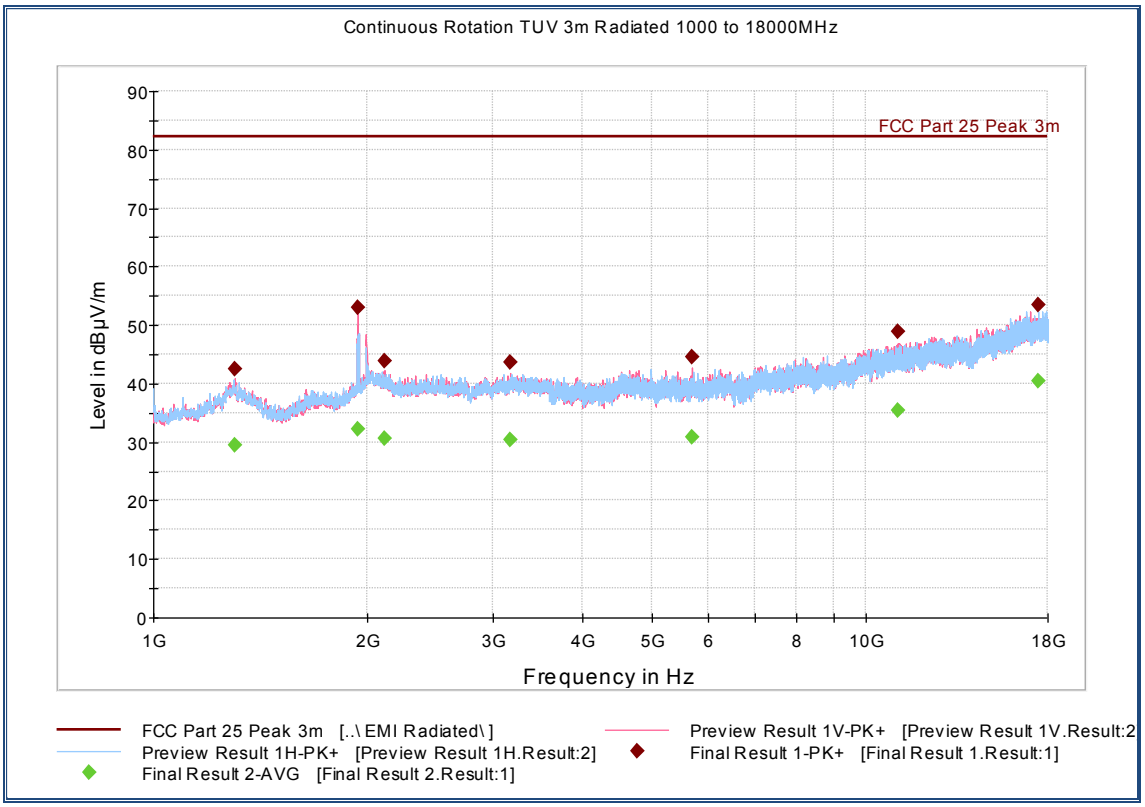
2.4.9.7 1GHz to 18GHz Radiated Emission Test (Receive Mode)



Peak Data

Frequency (MHz)	Max Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1598.233333	46.1	1000.0	1000.000	118.0	H	241.0	-5.6	36.1	82.2
1981.133333	51.1	1000.0	1000.000	400.0	V	150.0	-2.1	31.1	82.2
2595.933333	51.0	1000.0	1000.000	118.0	V	168.0	-0.1	31.2	82.2
3190.533333	53.6	1000.0	1000.000	112.0	V	-7.0	1.1	28.6	82.2
5978.166667	52.2	1000.0	1000.000	120.9	V	278.0	6.2	30.1	82.2
10910.26666	49.6	1000.0	1000.000	251.4	H	134.0	12.1	32.6	82.2
16952.66666	54.7	1000.0	1000.000	319.2	V	237.0	19.0	27.6	82.2

Substitution Data

Frequency (MHz)	Max Peak (dBµV/m)	Substitution signal generator level (dBm)	Substitution cable loss (dB)	Substitution antenna gain (dBi)	Substitution level (dBm)	Limit (dBm)	Margin (dB)

Test Note: *No emissions within 6 dB of the limit, substitution method not required.*

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2.5 FREQUENCY STABILITY

2.5.1 Specification Reference

FCC CFR Part 25, Section25.202(d) as required by Part 2, Section 2.1055

2.5.2 Standard Applicable

(d) Frequency tolerance, Earth stations. The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent of the reference frequency.

2.5.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration A

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

Febuary 10, 2018 / JR

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	22.8°C
Relative Humidity	29.8%
ATM Pressure	99.1 kPa

2.5.7 Additional Observations

- This is a conducted test.
- For the channel channel investigated, the reference is the frequency @ 20°C/nominal voltage.
- Limit is 0.001% (10ppm) of reference. Frequency differential higher than this level is considered a failure.
- The frequency stability of the EUT was observed with voltage ranging from 10VDC to 48 VDC as declared by the client.
- Temperature range is from -30°C up to 50°C.
- At each observed point, the EUT transmission frequency is compared to the reference.
- The EUT can operate from 10 to 48 VDC, verification was performed at 10VDC as nominal low end.

2.5.8 Test Results

Complies. See attached tables.

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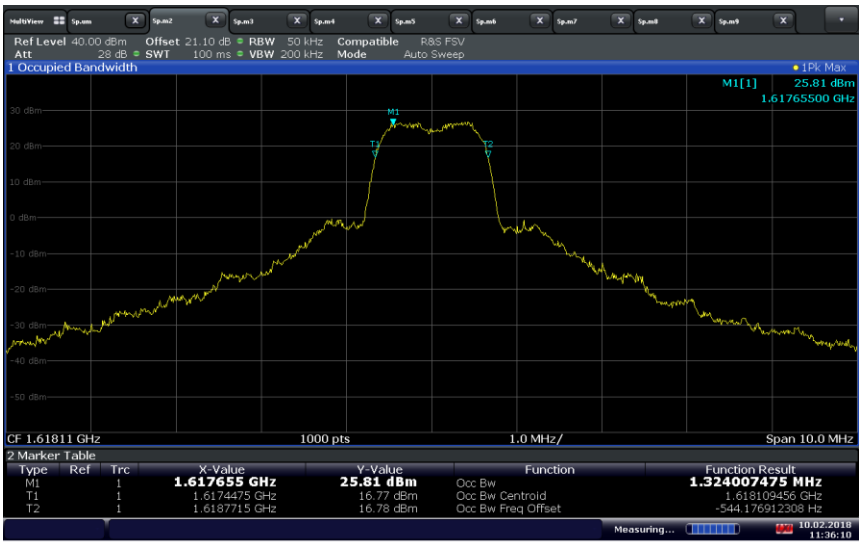
2.5.8.1 Frequency Stability (Temperature Variations) Results

Temperature Variations		
Voltage	***Temperature(°C)***	***Frequency Deviation (ppm)***
10.0	-30	-3.708031
	-20	-6.087351
	-10	0.278102
	0	0.061801
	+10	0.030900
	+20	0.000000
	+30	-0.123601
	+40	-1.236010
	+50	-6.087351

Voltage Variations		
Temperature(°C)	***Voltage***	***Frequency Deviation (kHz/ppm)***
20	8.5	-5.376645
	11.5	-3.738931

2.5.9 Sample Test Plots



11:36:10 10.02.2018

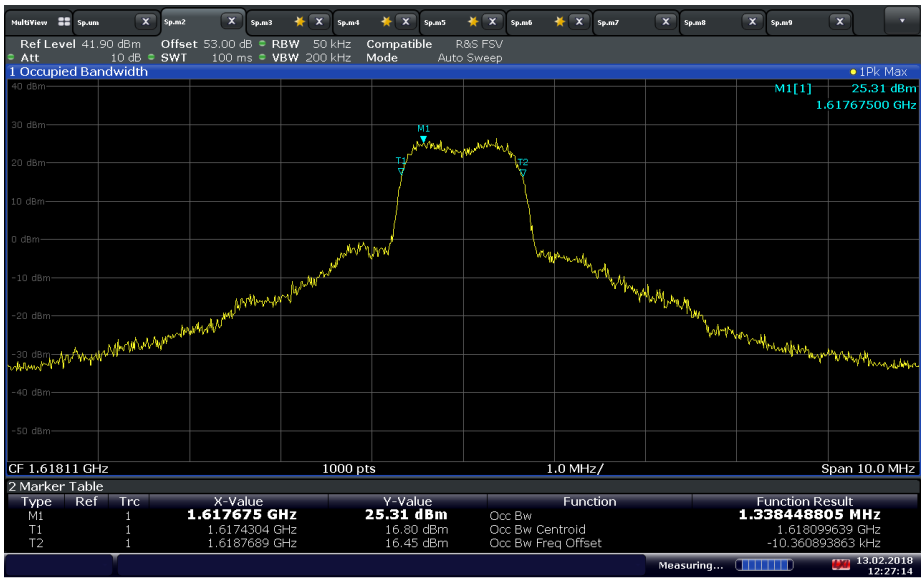
20°C, Sample Plot at Nominal Voltage

Reference Center Frequency @ 20°C: $= \frac{T1+T2}{2}$

T_2 and T_1 are Marker Points on the plot based on 99% OBW)

$$= \frac{16187715\ \text{MHz} + 1617.4475\text{MHz}}{2}$$

$$= 1618.10950\ \text{MHz}$$



12:27:15 13.02.2018

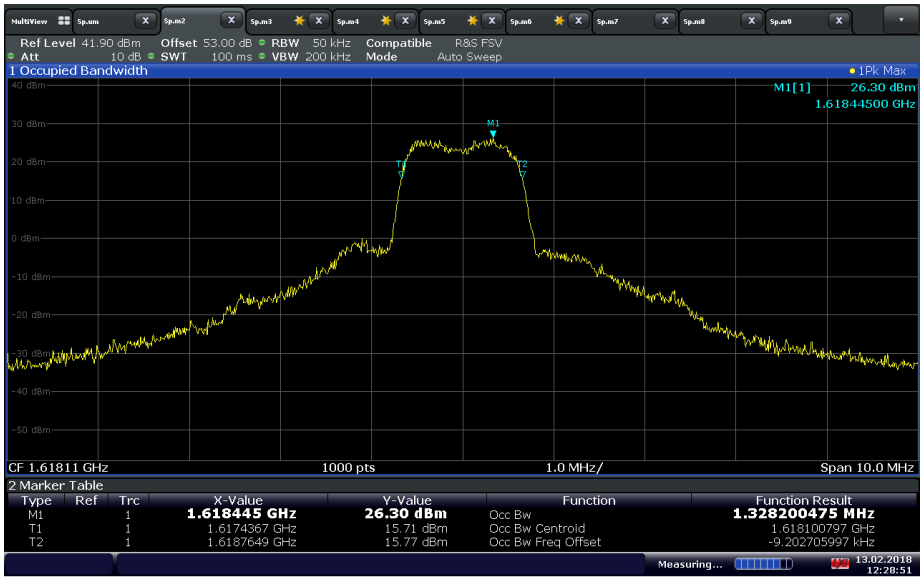
20°C, 10.0 VDC

Reference Center Frequency @ -20°C: $= \frac{1618.7689\ \text{MHz} + 1617.4304\ \text{MHz}}{2}$

$= 1618.09965\ \text{MHz}$

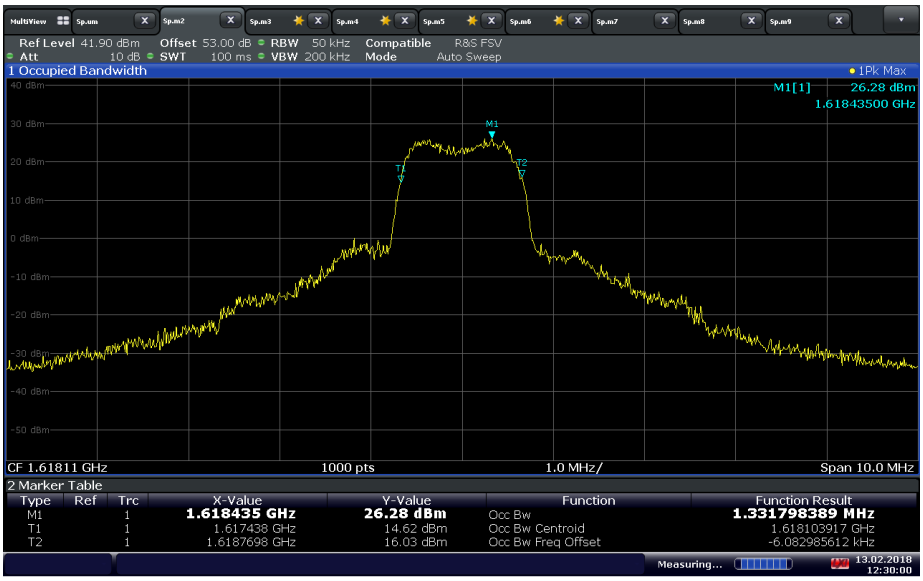
Therefore Frequency Deviation: $= 1618.09965\ \text{MHz} - 1618.10950\ \text{MHz}$

$= 0.00985\ \text{MHz}$



12:28:52 13.02.2018

20°C, 8.5 VDC



12:30:00 13.02.2018

20°C, 11.5 VDC

2.6 PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE

2.6.1 Specification Reference

Part 25 Subpart C §25.216(g),(i) and (j), RSS-170 Issue 3 Sec. 5.4.3.2.1 and Sec. 5.4.4

2.6.2 Standard Applicable

Part 25 Subpart C §25.216, RSS-170

(g) Mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03-283 with assigned uplink frequencies in the 1610-1626.5 MHz band shall suppress the power density of emissions in the 1605-1610 MHz band-segment to an extent determined by linear interpolation from -70 dBW/MHz at 1605 MHz to -10 dBW/MHz at 1610 MHz averaged over any 2 millisecond active transmission interval. The e.i.r.p of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from -80 dBW at 1605 MHz to -20 dBW at 1610 MHz, averaged over any 2 millisecond active transmission interval.

(i) The e.i.r.p density of carrier-off state emissions from mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03–283 with assigned uplink frequencies between 1 and 3 GHz shall not exceed -80 dBW/MHz in the 1559–1610 MHz band averaged over any two millisecond interval.

(j) A Root-Mean-Square detector shall be used for all power density measurements.

RSS-170 Issue 3

5.4.3.2.1 Band 1610-1626.5 MHz

Mobile earth stations with transmitting frequencies between 1610 MHz and 1626.5 MHz shall have the e.i.r.p. density of unwanted emissions in the band 1605-1610 MHz, averaged over any 2-ms active transmission interval, not exceed the following limits:

(1) −70 dBW/MHz at 1605 MHz, linearly interpolated to −10 dBW/MHz at 1610 MHz for broadband emissions; and

(2) −80 dBW/kHz at 1605 MHz, linearly interpolated to −20 dBW/kHz at 1610 MHz for discrete emissions.

5.4.4. Carrier-off State Emissions

Mobile equipment with transmitting frequencies between 1 GHz and 3 GHz shall have the e.i.r.p. density of carrier-off state emissions in the band 1559-1610 MHz not exceed -80 dBW/MHz.

2.6.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration A

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

Febuary 8, 2018 / JR

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

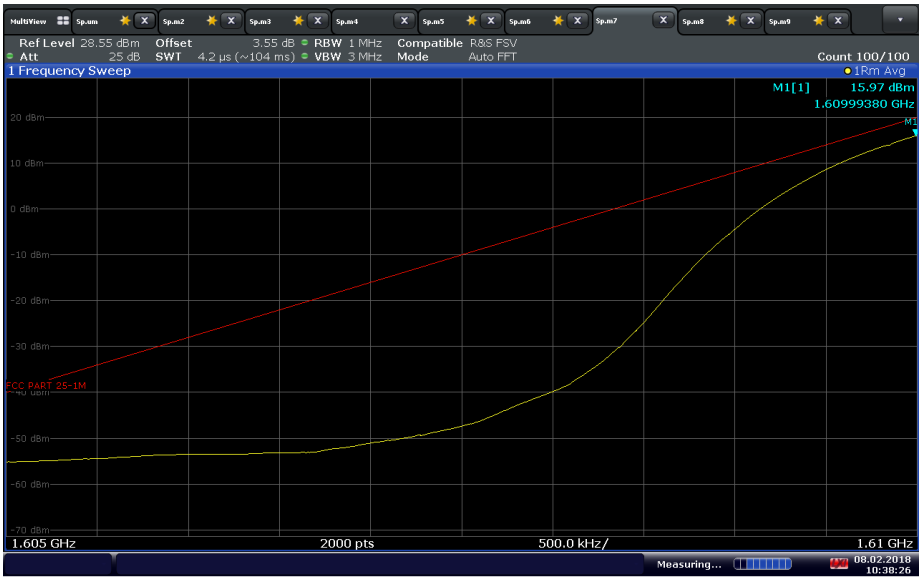
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	22.8°C
Relative Humidity	29.8%
ATM Pressure	99.1 kPa

2.6.7 Additional Observations

- This is a conducted test utilizing a spectrum analyzer.
- The verification was performed with 1 MHz and 1 kHz RBW settings.
- An offset of 18.45 dB was added to compensate for the external attenuator and cable used.
- The spectrum was investigated from 1605 MHz to 1610 MHz (carrier-on state) and from 1559 MHz to 1610 MHz (carrier-off state).

2.6.8 Test Results



10:38:27 08.02.2018

Low Channel (1 MHz RBW)

10:39:44 08.02.2018

Low Channel (1 kHz RBW)

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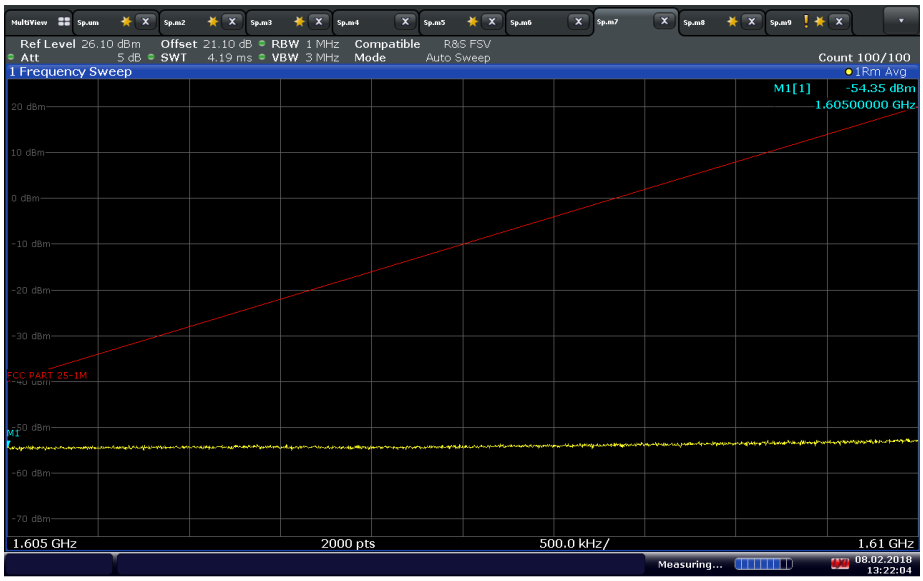
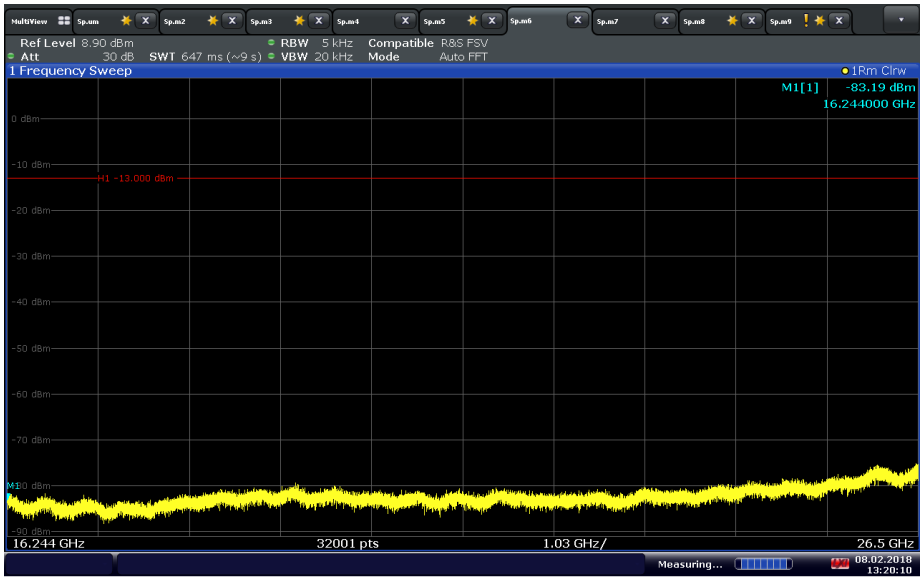


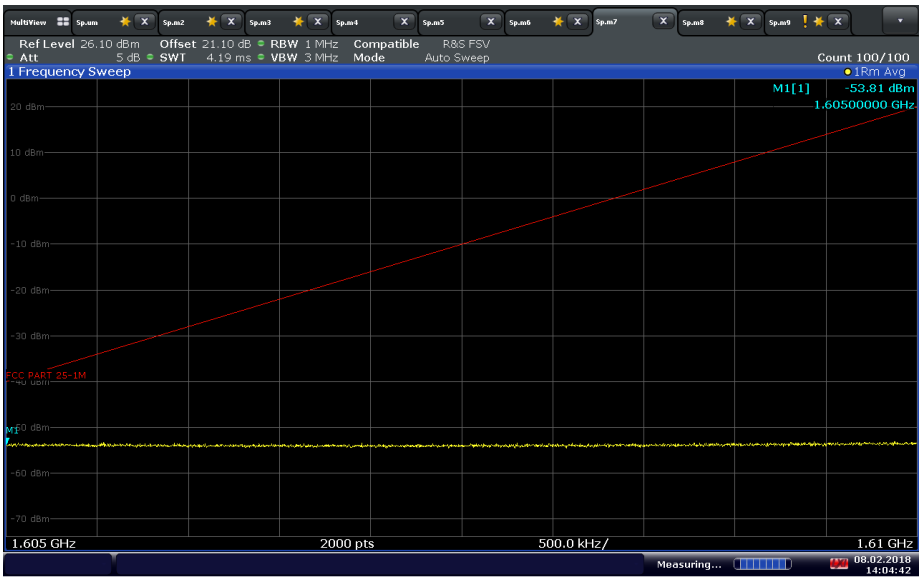
13:22:05 08.02.2018

Mid Channel (1 MHz RBW)



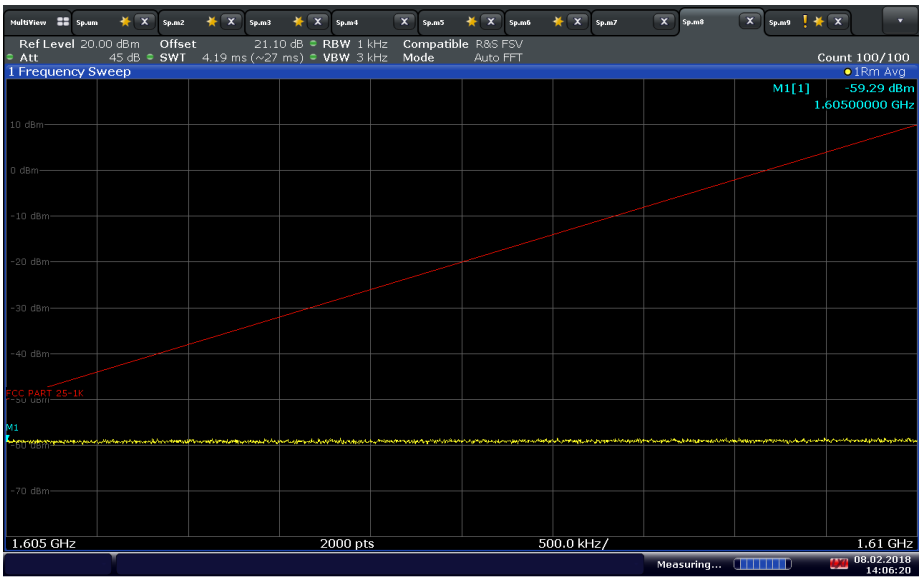
13:20:11 08.02.2018

Mid Channel (1 KHz RBW)



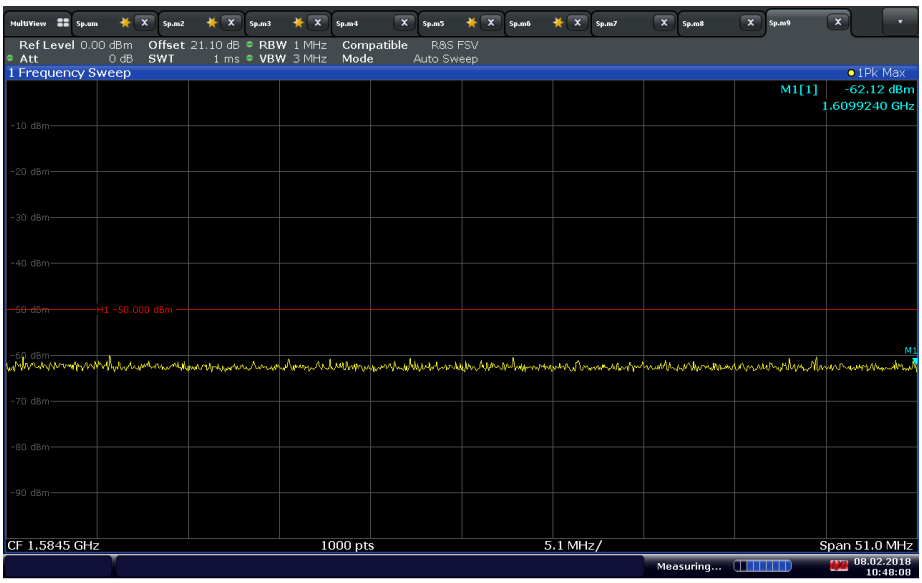
14:04:43 08.02.2018

High Channel (1 MHz RBW)



14:06:21 08.02.2018

High Channel (1 kHz RBW)



10:48:08 08.02.2018

Carrier-off state

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						
7606	USB RF Power Sensor	RadiPower RPR3006W	14I00048SNO 048	DARE!! Instruments	01/02/18	01/02/19
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	12/14/17	12/14/18
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/30/17	05/30/18
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 1003 and 7582	
8832	20dB Attenuator	34-20-34	BP4150	MCE/Weinschel	Verified by 1003 and 7582	
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/20/17	11/20/19
8891	Pre-Amplifier	PE15A3262	1012	TUV SUD America	06/15/17	06/15/18
7620	EMI Test Receiver	ESU40	100399	Rhode & Schwarz	10/17/17	10/17/18
7631	Double-ridged waveguide horn antenna	3117	00205418	ETS-Lindgren	08/03/17	08/03/18
8891	Pre-Amplifier	PE15A3262	1012	TUV SUD America	06/15/17	06/15/18
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/20/17	11/20/19
Miscellaneous						
6708	Multimeter	34401A	US36086974	Hewlett Packard	07/05/17	07/05/18
7560	Barometer/ Temperature/ Humidity Transmitter	iBTHX-W	1240476	Omega	01/17/17	01/17/18
	DC Power Supply	35010M	D102007S	Protek	Verified by 6708	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 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	0.75	0.44	0.19
4	Antenna	Rectangular	3.52	1.44	2.07
5	Site	Rectangular	1.00	0.58	0.33
6	EUT Setup	Rectangular	0.45	0.26	0.07
				Combined Uncertainty (u_c):	1.66
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.31

3.2.2 Radiated Emission Measurements (Above 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.00	1.22	1.50
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.49
				Coverage Factor (k):	2
				Expanded Uncertainty:	2.99

3.2.3 Conducted Antenna Port Measurements

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.08	0.05	0.00
2	Cables	Rectangular	0.30	0.17	0.03
3	EUT Setup	Rectangular	0.50	0.29	0.08
				Combined Uncertainty (u_c):	0.34
				Coverage Factor (k):	1.96
				Expanded Uncertainty:	0.67

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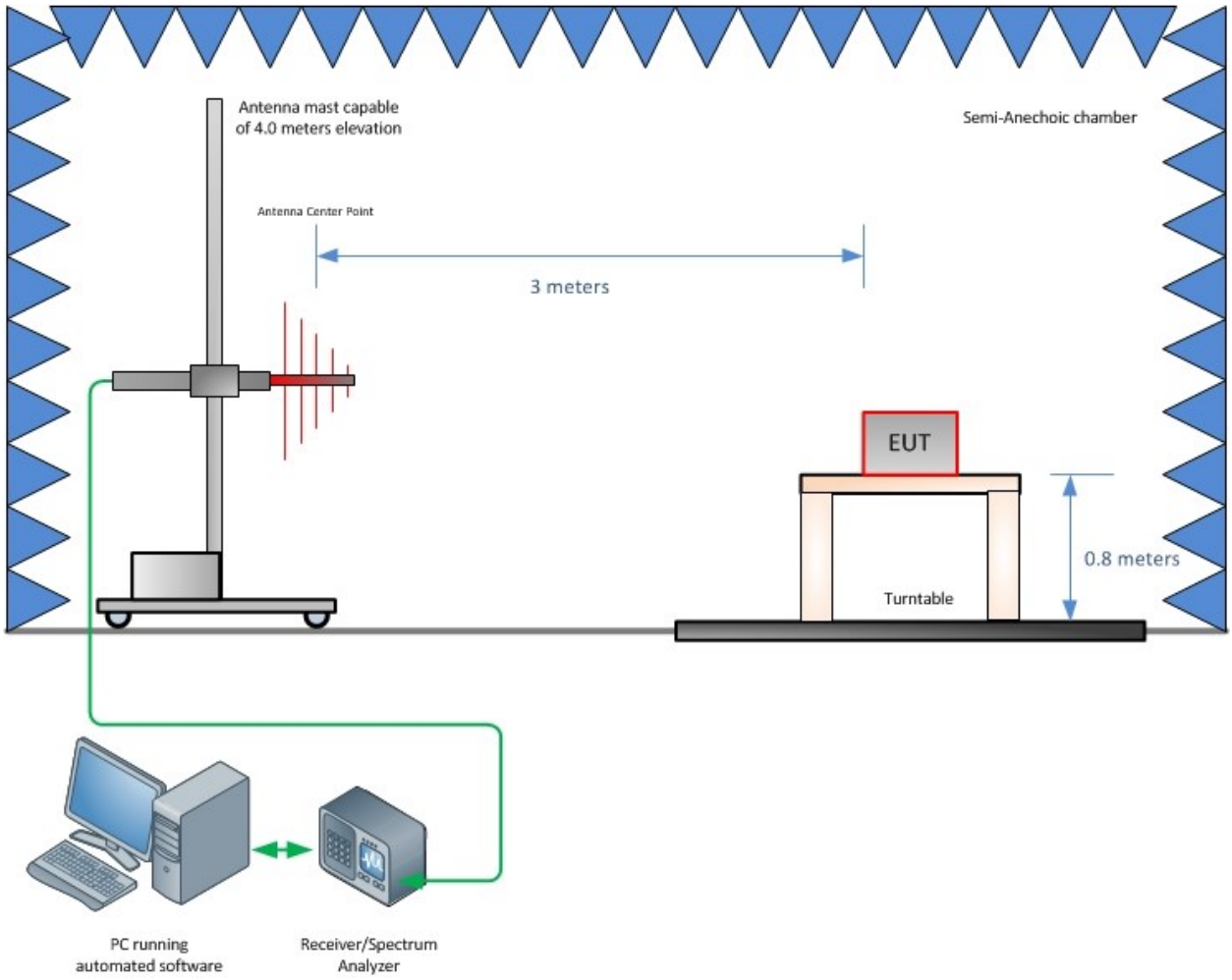
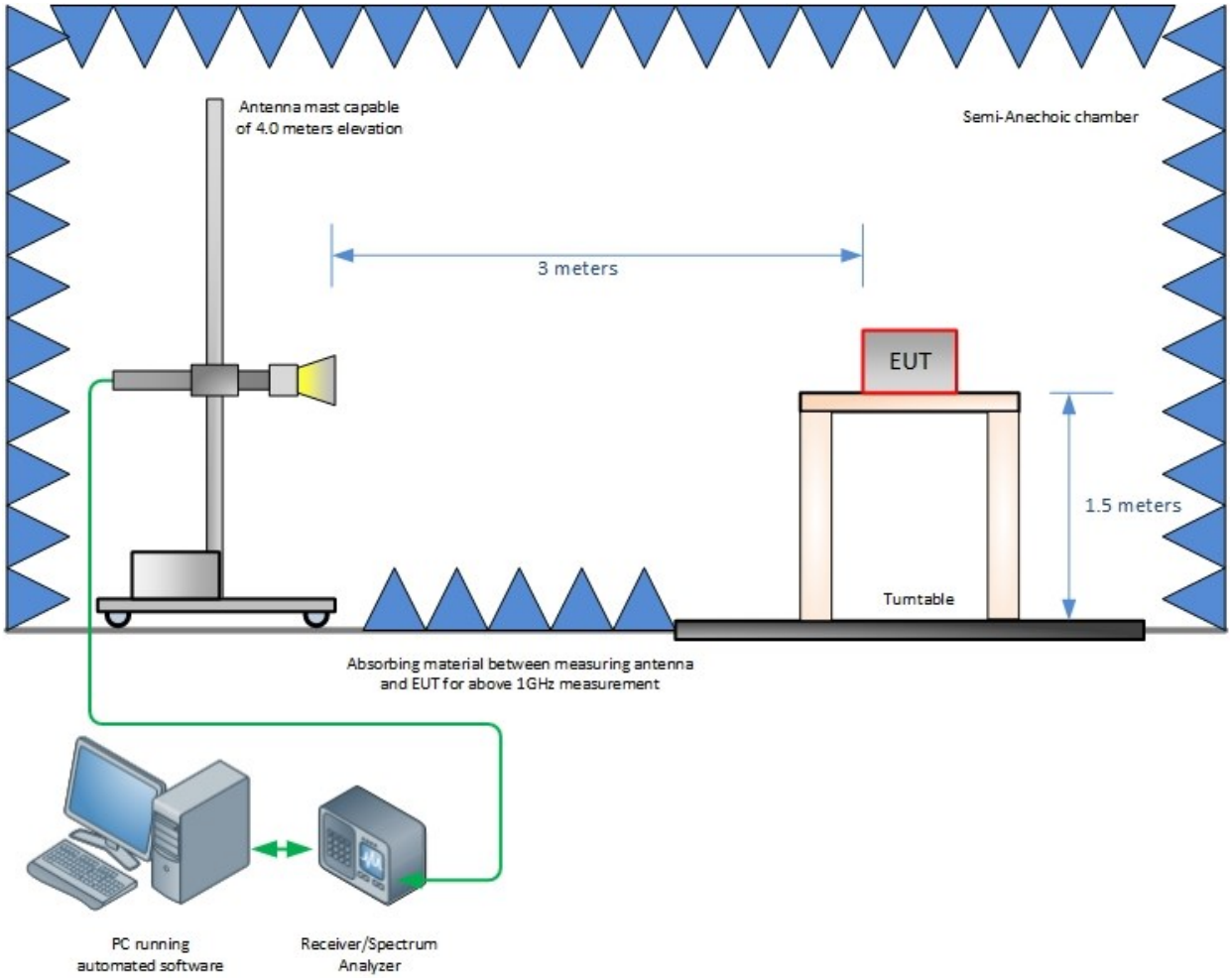
SECTION 4

DIAGRAM OF TEST SETUP

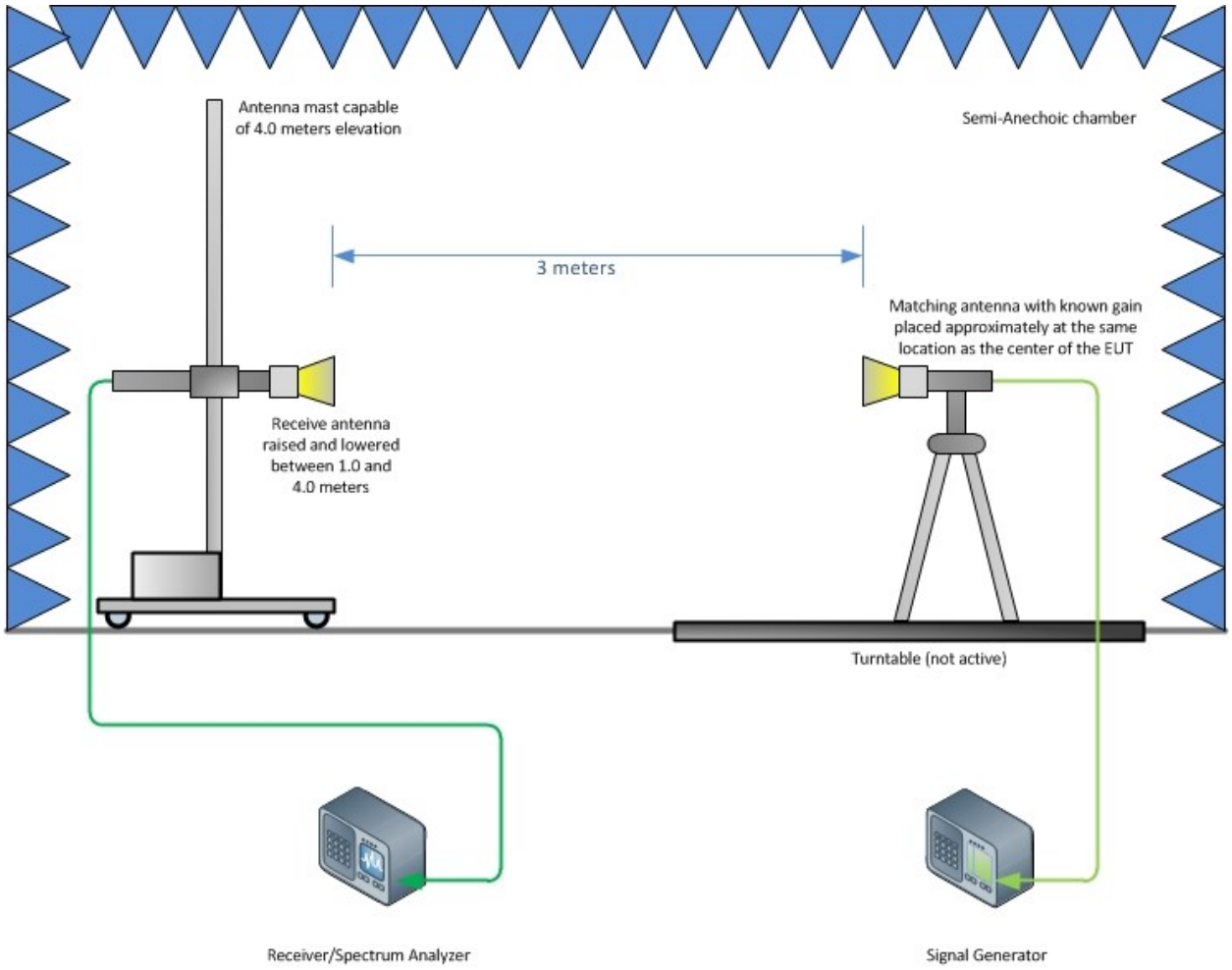
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



Substitution Test Method (Above 1GHz, if applicable)

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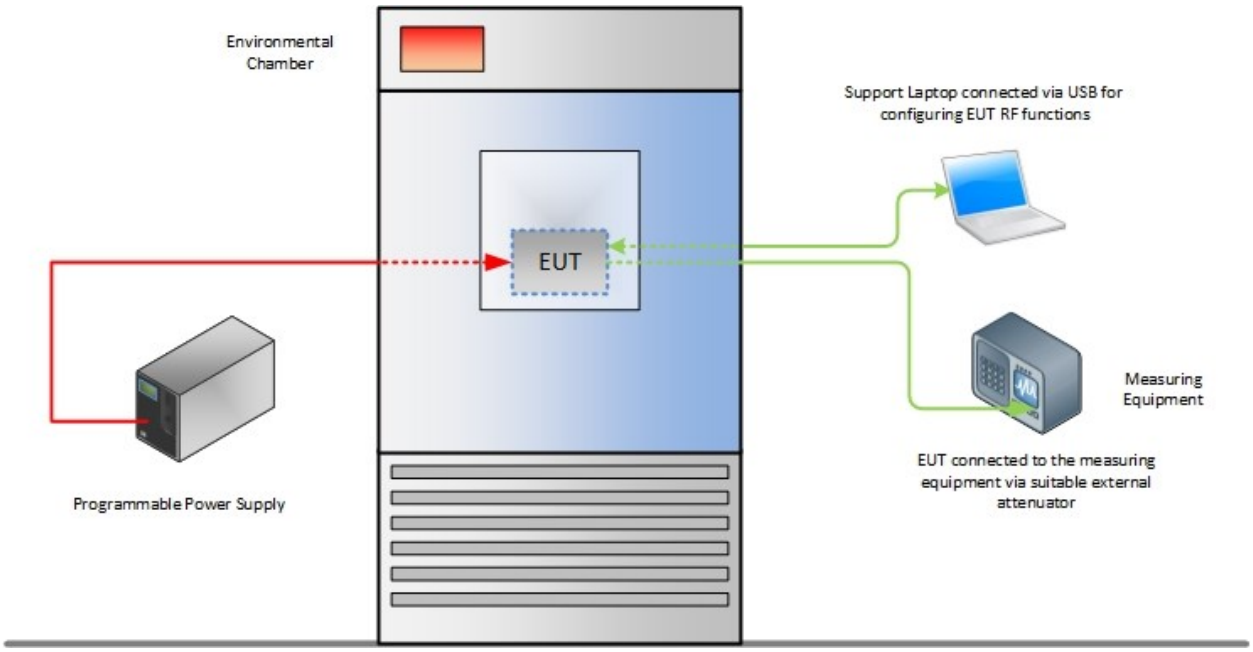

Frequency Stability Test Configuration

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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