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Report On

Radio Testing of the
Globalstar USA LLC
SPOTXB Satellite GPS Messenger

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

Report No. 72142941K (Supplement to Report SD72134058-1217C)

June 2019

REPORT ON

Radio Testing of the
Globalstar USA LLC
SPOTXB Satellite GPS Messenger

TEST REPORT NUMBER

72142941K

PREPARED FOR

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DATED

June 18, 2019

Revision History

72142941K Globalstar USA LLC SPOTXB Satellite GPS Messenger					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
06/18/2018	-	Initial Release			Ferdinand Custodio

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FCC ID: L2V-SPOTXB
IC: 3989A-SPOTXB
Report No. 72142941K



SECTION 1

REPORT SUMMARY

Radio Testing of the
Globalstar USA LLC
SPOTXB Satellite GPS Messenger

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Globalstar USA LLC Satellite GPS Messenger 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.
	This is a Supplement to Report SD72134058-1217C for Model SPOTX which is identical to SPOTXB with the exception of no BT LE support.
Manufacturer	Globalstar USA LLC
Model Name	SPOTXB
Model Number(s)	SPOTXB
Serial Number(s)	2904578, 2904544
Number of Samples Tested	2
Test Specification/Issue/Date	<ul style="list-style-type: none">• FCC Part 25 Subpart C (October 1, 2018)• RSS-170 issue 3 July 2015 - Mobile Earth Stations (MESs) and Ancillary Terrestrial Component (ATC) Equipment Operating in the Mobile-Satellite Service (MSS) Bands• RSS-GEN issue 5 Amendment 1, March 2019 – General Requirements for Compliance of Radio Apparatus
Start of Test	February 07, 2018
Finish of Test	March 08, 2018
Name of Engineer(s)	Xiaoying Zhang
Related Document(s)	<ul style="list-style-type: none">• Supporting documents for EUT certification are separate exhibits.• SD72134058-1217C Globalstar SpotX_FCC Part 25_Test Report

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 25 and RSS-170 issue 3 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		RSS-Gen Sec. 6.6	Occupied Bandwidth	Compliant	
§2.1051	§25.202(f)	Sec. 5.4.3	Spurious Emissions at Antenna Terminals	Compliant	
§2.1053	§25.202(f)	Sec. 5.4.2.2	Field Strength of Radiated Spurious Emissions	Compliant	
§2.1055	§25.202(d)	Sec. 5.2	Frequency Stability	Compliant	
	§25.216(h)(i)	Sec. 5.4.3.2.2, Sec. 5.4.4	Protection of Aeronautical Radio Navigation Satellite Service	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Globalstar USA LLC Model SPOTXB Satellite GPS Messenger. The EUT is designed to provide users with reliable 2-way messaging and tracking capabilities when beyond cellular services or when traditional means of communication are unavailable. The SPOTXB can be used to send and receive short text messages and emails, track trip routes, have 2-way communications with Search & Rescue personnel, and to navigate. It can also be linked to smart devices via Bluetooth Low Energy. The satellite radio functions of the EUT were verified in this test report.

All the testing were performed on Model SPOTX which is identical to this model with the exception of no BT LE support.

1.3.2 EUT General Description

EUT Description	Satellite GPS Messenger
Model Name	SPOTXB
Model Number(s)	SPOTXB
Serial Number	2904578, 2904544
Input Voltage	3.1 VDC – 4.2 VDC Battery input; 4.4 VDC – 5.25 VDC USB input
Battery Type	Lithium-Polymer 3400mAh
Mode Verified	Satellite Transmitter
Frequency Range (TX)	1610 – 1626.5 MHz Satellite Service
Capability	Satellite Service, BT LE and GPS
Antenna Type	Integral Antenna
Antenna gain	Max. -0.34 dBi
Dimensions	158.75mm x 76.2mm x 23.5mm (6.25" x 3" x 0.925")

1.3.3 Antenna Details

Please refer to the antenna file provided by the manufacturer.

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Antenna Conducted Port Single Channel Mode. EUT connect to a support Laptop via USB Cable and is set to transmit in fixed channel using Hex Dumper.
B	Case/Cabinet Radiated Emission Single Channel Mode. EUT connect to a support Laptop via USB Cable to setup the channel and is set to transmit in fixed channel using Hex Dumper, Antenna port is terminated by a 50 Ω Load.

1.4.2 Channel/Modulation Table List for Verification

Channel	Frequency (MHz)
Low	1611.25
Mid	1616.25
High	1618.75

1.4.3 EUT Exercise Software

Hex Dumper is used to set the transmitter to work in fixed channel. Once connected, corresponding programming commands were issued to set the EUT in continues transmission mode at particular channel.

1.4.4 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Acer	Laptop (ASPIREone)	S/N LUSAL0B137011532631601
Delta Electronics Inc.	Laptop AC Adapter (ADP-40TH)	S/N 592C60AYMSO26N
Borasen	AC/DC Adaptor*	M/N: BX-0502000 IP: 100-240 VAC,50/60 Hz 0.2A OP: 5 VDC 2.0A

* AC/DC Adaptor is not sold together with the device and thus are not part of the device. It was used as support equipment only.

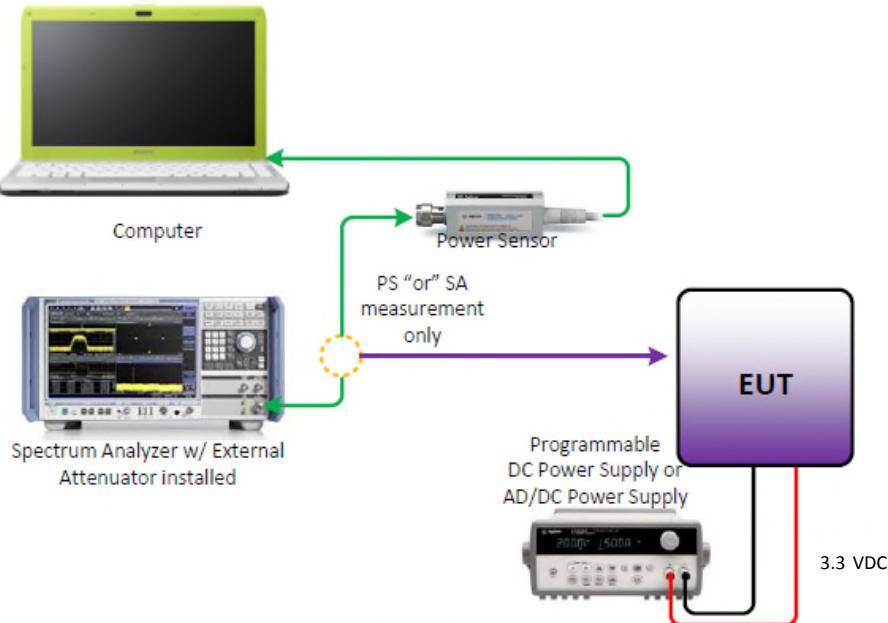
1.4.5 Simplified Test Configuration Diagram

Radiated Test Configuration



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

Conducted (Antenna Port) Test Configuration



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

1.5 DEVIATIONS FROM THE STANDARD

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

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number 2904578, 2904544		
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 LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

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

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Designation No.: US1146

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



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

The 10m Semi-anechoic chamber of TÜV 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 TÜV SUD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 22806-1.

1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.9.4 NCC (National Communications Commission - US0102)

TUV SUD America Inc. (San Diego) is listed as a Foreign Recognized Telecommunication Equipment Testing Laboratory and is accredited to ISO/IEC 17025 (A2LA Certificate No.2955.13) which under APEC TEL MRA Phase 1 was designated as a Conformity Assessment Body competent to perform testing of equipment subject to the Technical Regulations covered under its scope of accreditation including RTTE01, PLMN01 and PLMN08 for TTE type of testing and LP002 for Low-Power RF Device type of testing.

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

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

1.9.6 RRA – Identification No. US0102

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

1.9.7 OFCA – U.S. Identification No. US0102

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

FCC ID: L2V-SPOTXB
IC: 3989A-SPOTXB
Report No. 72142941K



SECTION 2

TEST DETAILS

Radio Testing of the
Globalstar USA LLC
SPOTXB Satellite GPS Messenger

2.1 RF POWER OUTPUT

2.1.1 Specification Reference

Part 25 Subpart C §25.204(a)

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:

$+40 \text{ dBW in any 4 kHz band for } \Theta \leq 0^\circ$

$+40 + 3\Theta \text{ dBW in any 4 kHz band for } 0^\circ < \Theta \leq 5^\circ$

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: 2904578 / Test Configuration A

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

January 31, 2018 / XYZ

2.1.5 Test Equipment Used

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

2.1.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.7°C
Relative Humidity	26.6 %
ATM Pressure	98.8kPa

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).

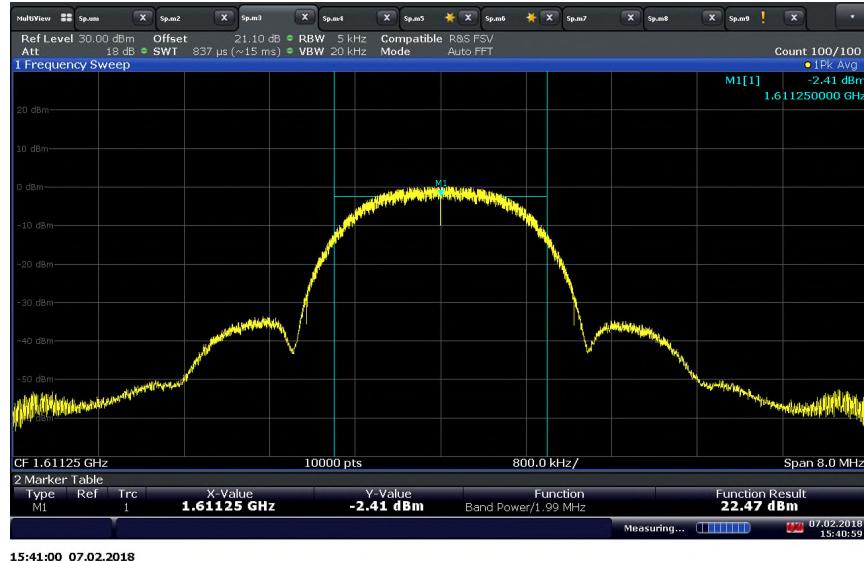


2.1.8 Test Results

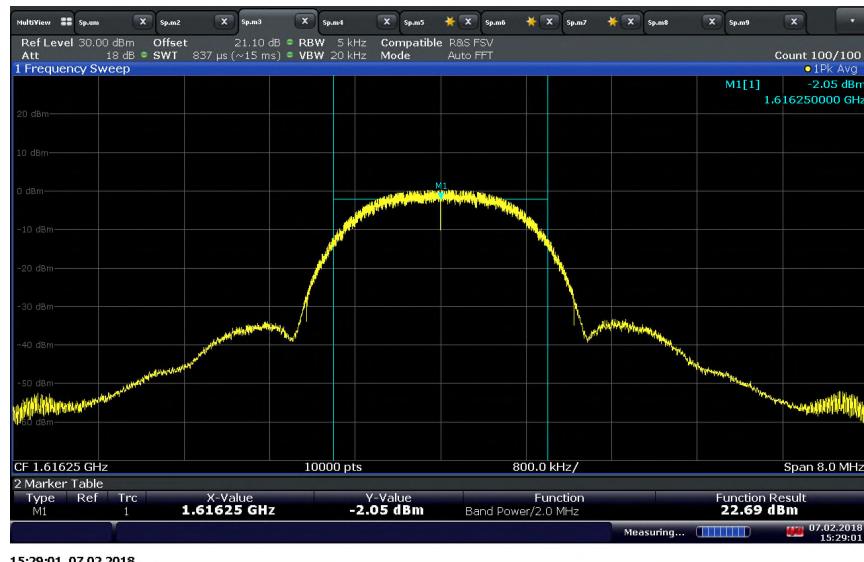
See table below.

Frequency (MHz)	Output Power (dBm)	Antenna Gain (dBi)	E.I.R.P. (dBm)	E.I.R.P. (W)
1610.25	22.47	-0.34	22.13	0.16
1616.25	22.69	-0.34	22.35	0.17
1618.75	22.67	-0.34	22.33	0.17

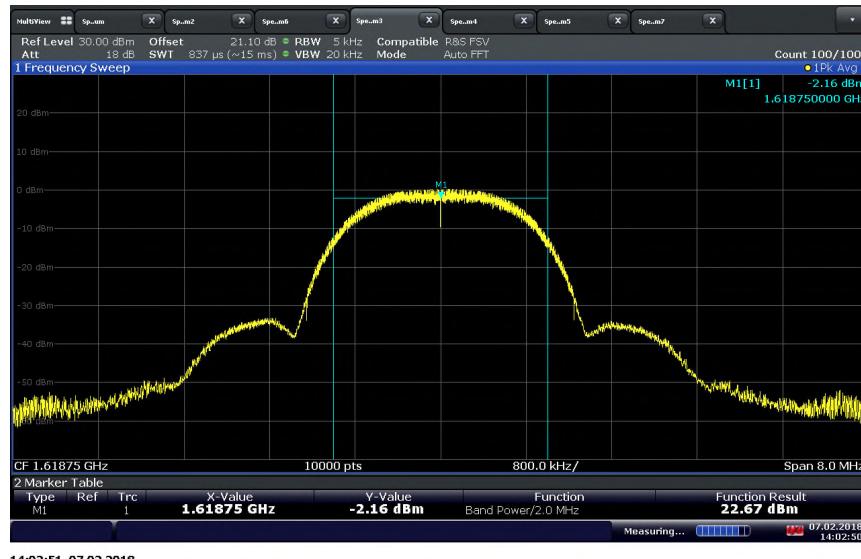
2.1.9 Test Plots



Low Channel



Mid Channel



High Channel

2.2 OCCUPIED BANDWIDTH

2.2.1 Specification Reference

FCC CFR Part 2, Section 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: 2904578 / Test Configuration A

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

February 07, 2018 / XYZ

2.2.5 Test Equipment Used

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

2.2.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	22.2 °C
Relative Humidity	42.4 %
ATM Pressure	99.7 kPa

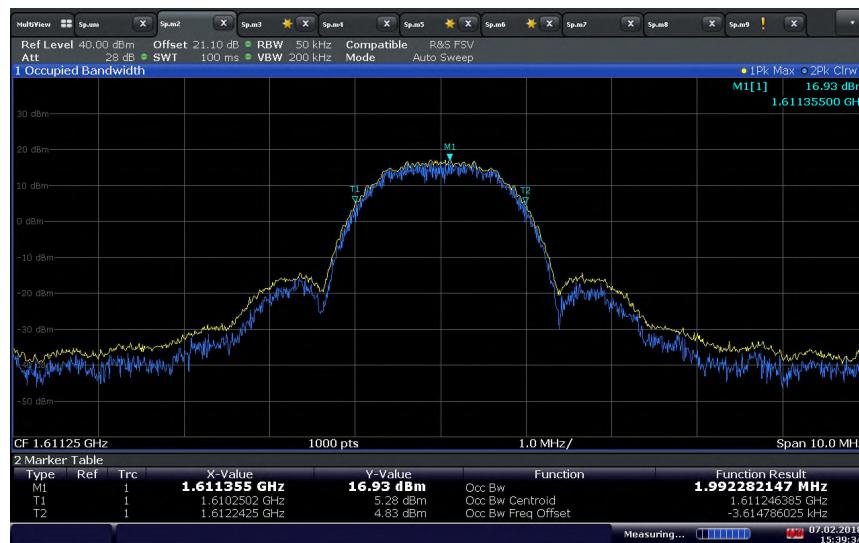
2.2.7 Additional Observations

- 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.

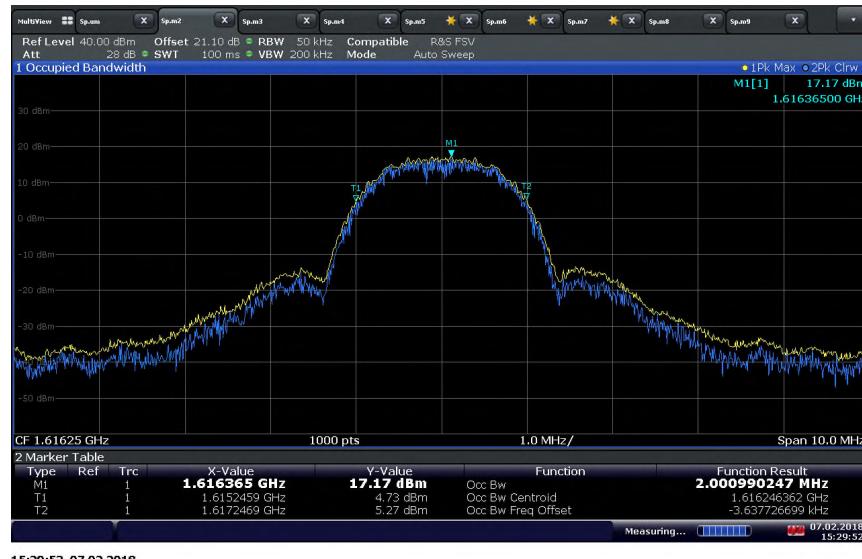
2.2.8 Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (kHz)
Low	1611.25	1.99
Mid	1616.25	2.00
High	1618.75	2.01

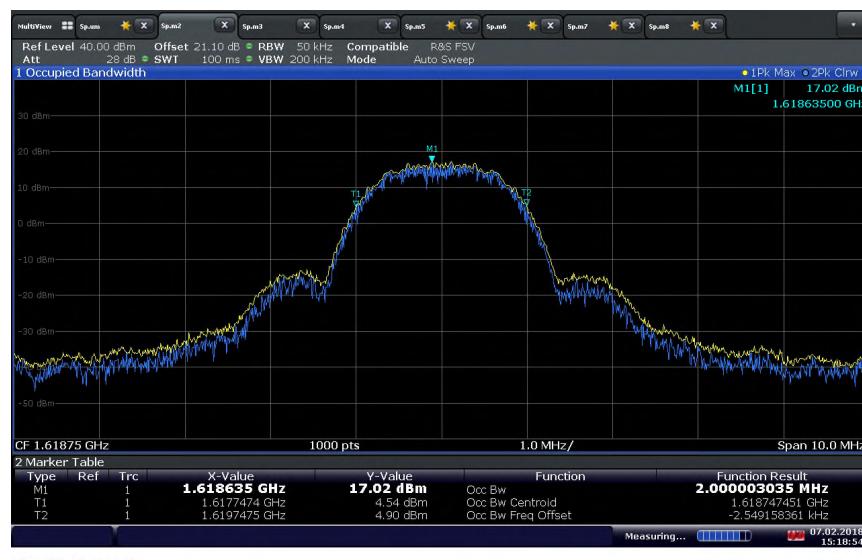
2.2.9 Test Plots



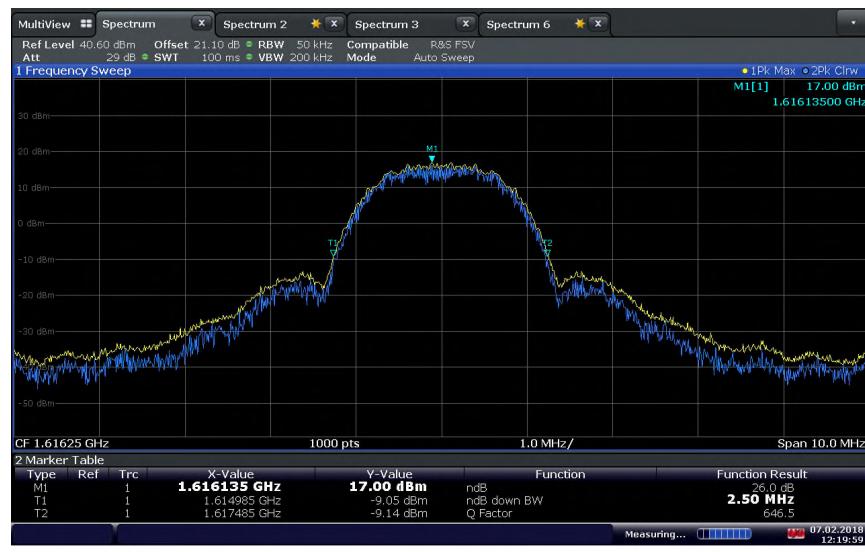
Low Channel



Mid Channel



High Channel



Middle Channel 26dB Bandwidth (for reference only)

2.3 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

2.3.1 Specification Reference

FCC CFR Part 25, Section 25.202(f)
RSS-170 issue 3, Section 5.4.3

2.3.2 Standard Applicable

FCC CFR Part 25, Section 25.202(f):

(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.*

RSS-170 issue 3, Section 5.4.3:

The average power of unwanted emissions shall be attenuated below the average output power, P (dBW), of the transmitter, as specified below:

(1) 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the occupied bandwidth or necessary bandwidth, whichever is greater;

(2) 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the occupied bandwidth or necessary bandwidth, whichever is greater; and

(3) $43 + 10 \log p$ (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the occupied bandwidth or necessary bandwidth, whichever is greater.

2.3.3 Equipment Under Test and Modification State

Serial No: 2904578 / Test Configuration A

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

February 07, 2018 / XYZ

2.3.5 Test Equipment Used

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

2.3.6 Environmental Conditions

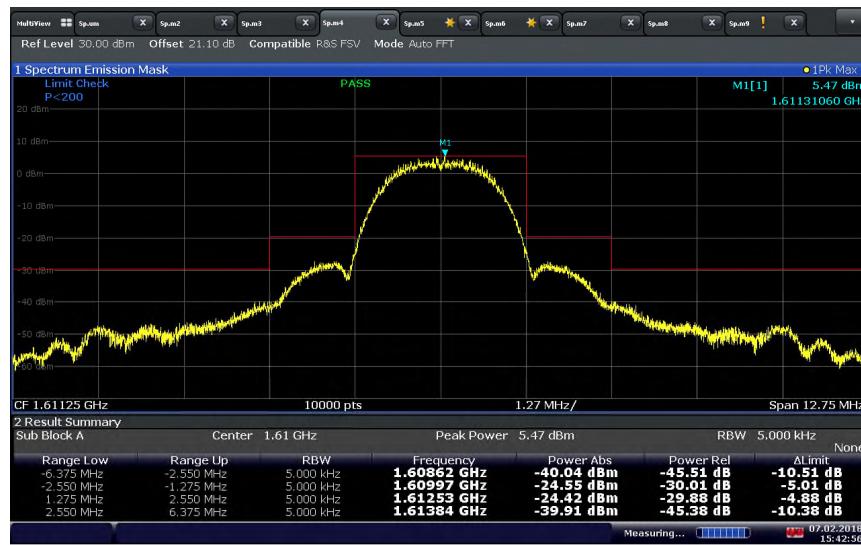
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 22.2°C
 Relative Humidity 42.4%
 ATM Pressure 99.7kPa

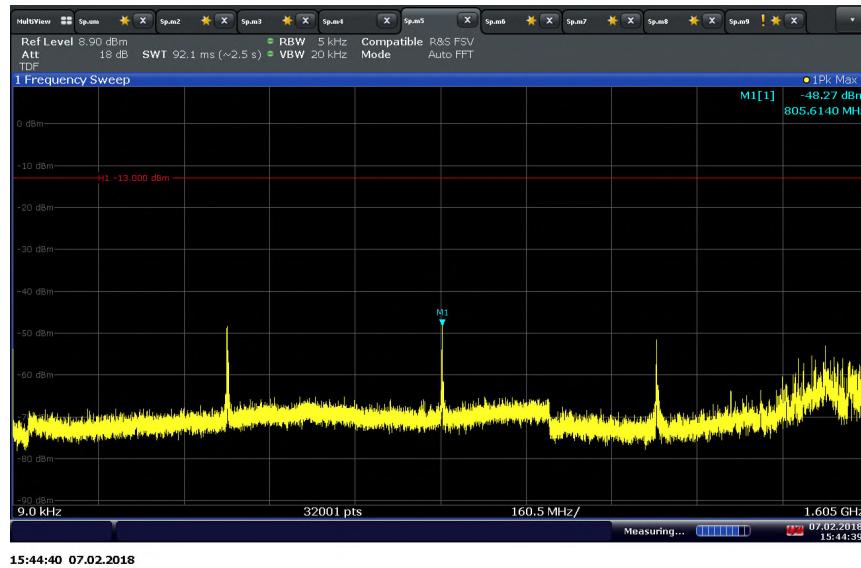
2.3.7 Additional Observations

- 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.
- 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



Low Channel (centred at the transmit frequency)



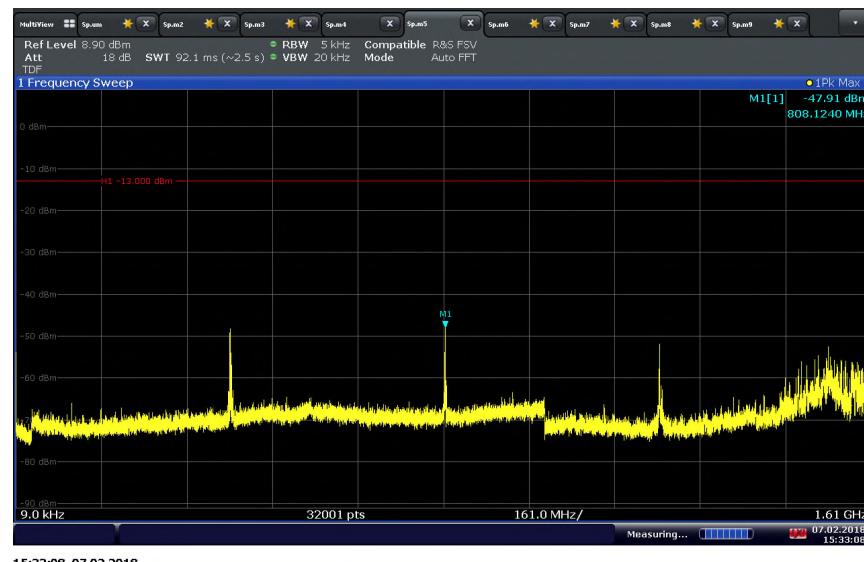
Low Channel (30 MHz to 1.605 GHz sweep)



Low Channel (1.6265 GHz to 18 GHz sweep)



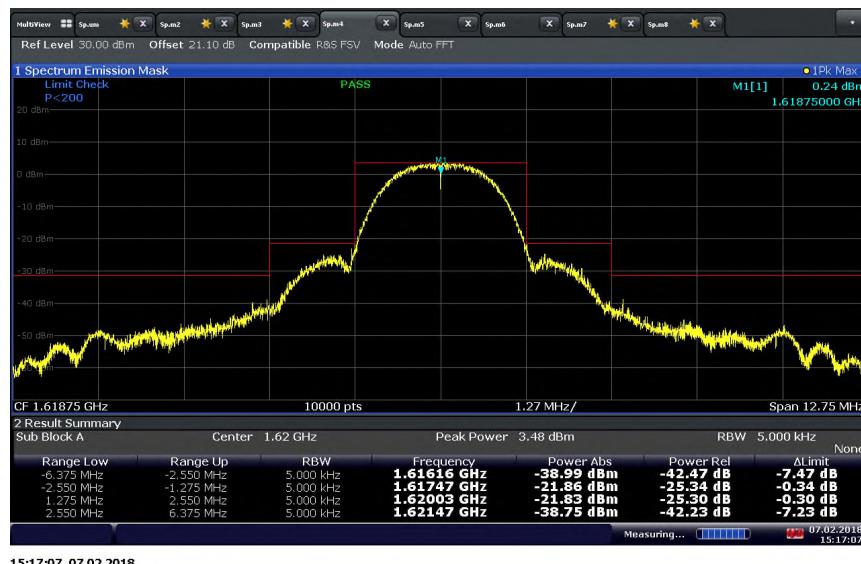
Mid Channel (centred at the transmit frequency)



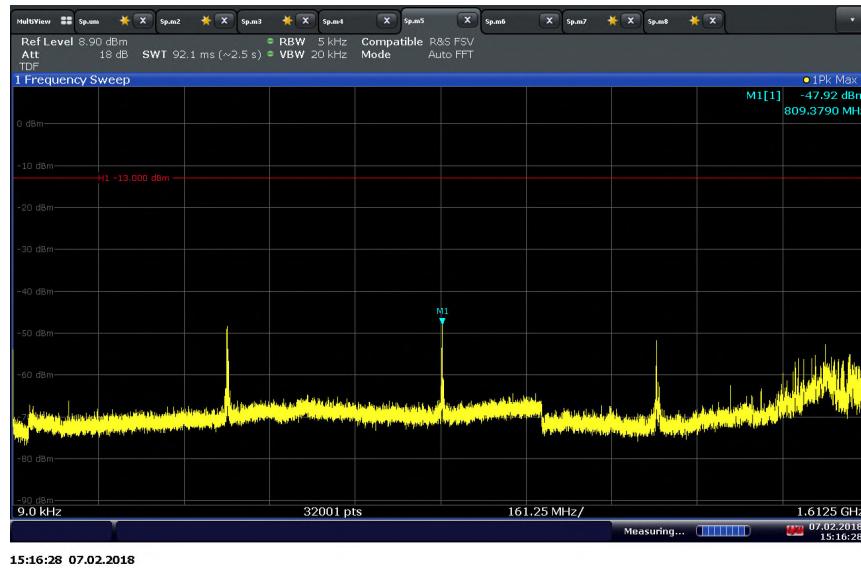
Mid Channel (30 MHz to 1.610 GHz sweep)



Mid Channel (1.6225 GHz to 26.5GHz sweep)



High Channel (centred at the transmit frequency)



15:16:28 07.02.2018

High Channel (30 MHz to 1.6125 GHz sweep)



15:15:40 07.02.2018

High Channel (1.6251 MHz to 26.5GHz sweep)

2.4 FIELD STRENGTH OF RADIATED SPURIOUS EMISSIONS

2.4.1 Specification Reference

FCC CFR Part 25, Section 25.202(f) as required by Part 2 Section 2.1053
RSS-170 issue 3, Section 5.4.3

2.4.2 Standard Applicable

FCC CFR Part 25, Section 25.202(f):

(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.*

RSS-170 issue 3, Section 5.4.3:

The average power of unwanted emissions shall be attenuated below the average output power, P (dBW), of the transmitter, as specified below:

(1) 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the occupied bandwidth or necessary bandwidth, whichever is greater;

(2) 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the occupied bandwidth or necessary bandwidth, whichever is greater; and

(3) $43 + 10 \log p$ (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the occupied bandwidth or necessary bandwidth, whichever is greater.

2.4.3 Equipment Under Test and Modification State

Serial No: 2904578 / Test Configuration B

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

February 19 and March 08, 2018 / XYZ

2.4.5 Test Equipment Used

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



2.4.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	20.7 - 21.2 °C
Relative Humidity	24.9 - 47.5%
ATM Pressure	99.1 - 99.2 kPa

2.4.7 Additional Observations

- This is a radiated test.
- The EUT antenna test port is connected to a load for this test.
- The spectrum was searched from 30MHz to 10X the transmit frequency (17GHz).
- Investigation was performed on the observed worst configuration base from power measurement.
- Test procedure is per ANSI C63.4-2014 (120kHz RBW below 1GHz and 1MHz RBW above 1GHz) as worst case. Any emission which is within 20dB of §25.202(f) limit will be proven by substitution method.
- Limit for this test is 82.23dB μ V/m @ 3 meters (-13dBm) E.I.R.P.
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.4.8 for sample computation.



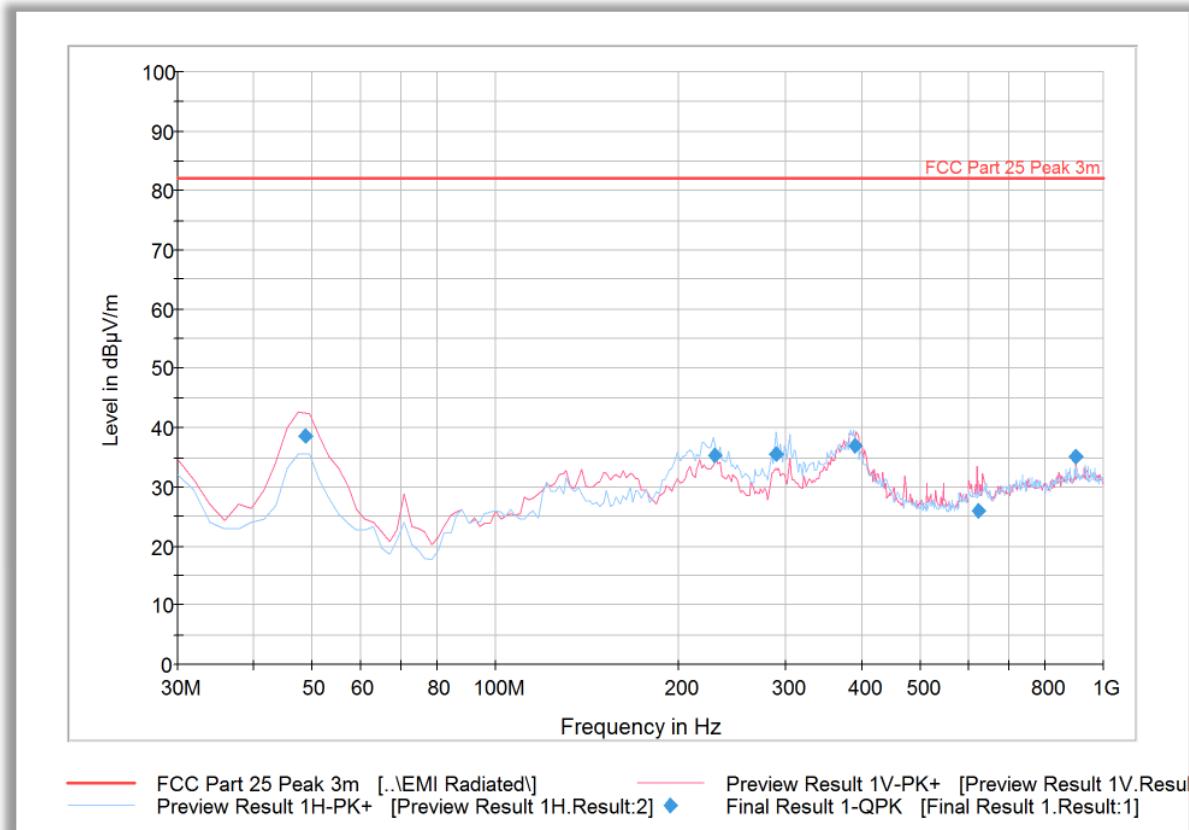
2.4.1 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (db μ V) @ 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 (db μ V/m) @ 30MHz		11.8

2.4.2 Test Results

See attached plots.

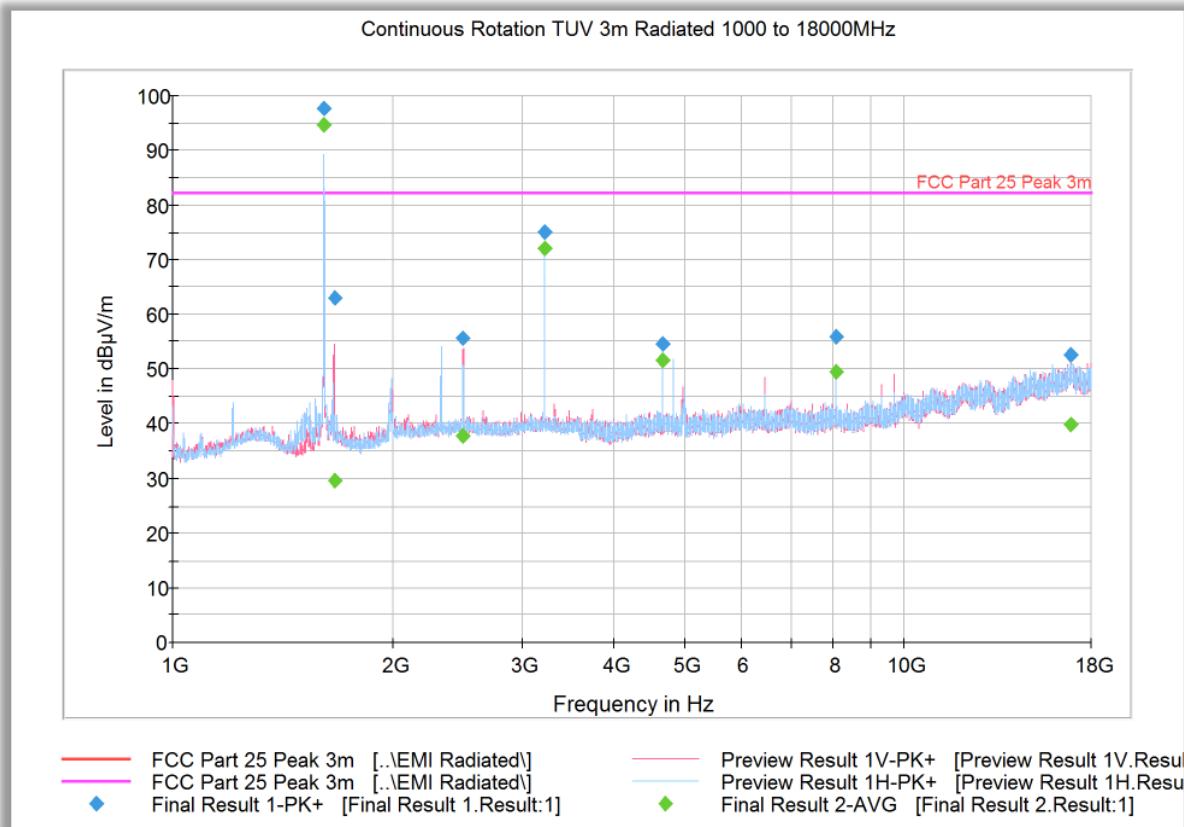
2.4.2.1 Below 1GHz Radiated Emission Test (worst case)



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)
48.694990	38.7	1000.0	120.000	140.0	V	25.0	-13.5	43.5	82.2
229.156553	35.4	1000.0	120.000	110.0	H	134.0	-9.4	46.8	82.2
288.697074	35.5	1000.0	120.000	100.0	H	71.0	-8.3	46.7	82.2
389.795351	37.0	1000.0	120.000	100.0	H	75.0	-3.4	45.3	82.2
621.661884	26.0	1000.0	120.000	100.0	V	267.0	2.1	56.2	82.2
899.981723	35.1	1000.0	120.000	100.0	V	305.0	6.5	47.1	82.2

2.4.2.2 Above 1GHz Radiated Emission Test (Transmit Mode, Low Channel)



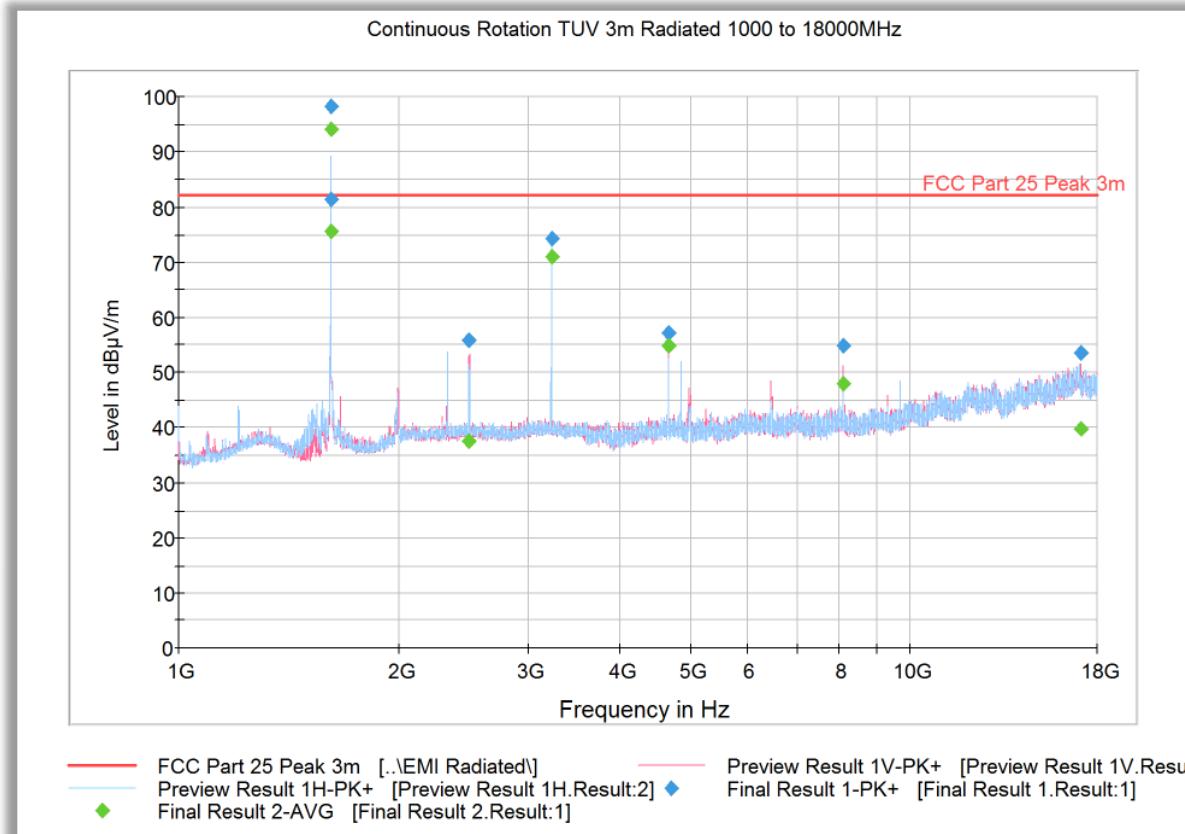
Peak Data

Frequency (MHz)	Max Peak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1611.066667	97.7	1000.0	1000.000	307.2	V	340.0	-5.7		Fundamental Carrier
1664.500000	63.0	1000.0	1000.000	291.2	V	11.0	-5.3	19.2	82.2
2489.733333	55.7	1000.0	1000.000	103.7	V	26.0	-0.5	26.5	82.2
3222.666667	75.2	1000.0	1000.000	103.7	H	333.0	1.0	7.0	82.2
4663.866667	54.6	1000.0	1000.000	134.7	H	81.0	3.4	27.7	82.2
8056.366667	55.8	1000.0	1000.000	196.5	H	88.0	6.7	26.4	82.2
16887.033333	52.7	1000.0	1000.000	317.2	V	103.0	17.9	29.6	82.2

Average Data

Frequency (MHz)	Average (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1611.066667	94.8	1000.0	1000.000	307.2	V	340.0	-5.7		Fundamental Carrier
1664.500000	29.6	1000.0	1000.000	291.2	V	11.0	-5.3	52.6	82.2
2489.733333	37.9	1000.0	1000.000	103.7	V	26.0	-0.5	44.3	82.2
3222.666667	72.2	1000.0	1000.000	103.7	H	333.0	1.0	10	82.2
4663.866667	51.5	1000.0	1000.000	134.7	H	81.0	3.4	30.7	82.2
8056.366667	49.5	1000.0	1000.000	196.5	H	88.0	6.7	32.7	82.2
16887.033333	39.9	1000.0	1000.000	317.2	V	103.0	17.9	42.3	82.2

2.4.2.3 Above 1GHz Radiated Emission Test (Transmit Mode, Mid Channel)



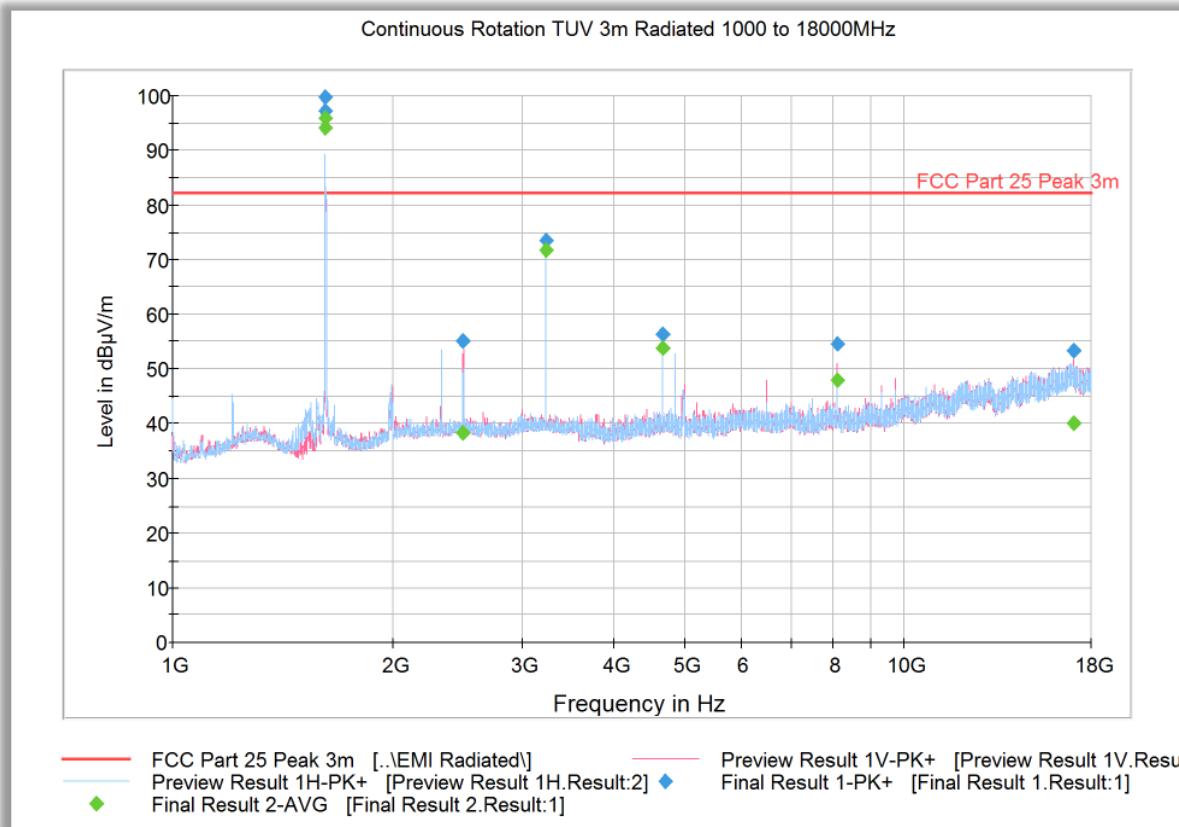
Peak Data

Frequency (MHz)	Max Peak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1616.166667	98.3	1000.0	1000.000	103.7	H	320.0	-5.6		Fundamental Carrier
1618.366667	81.5	1000.0	1000.000	102.7	H	34.0	-5.6		
2489.966667	55.9	1000.0	1000.000	103.7	V	26.0	-0.5	26.3	
3232.300000	74.4	1000.0	1000.000	108.7	H	326.0	1.0	7.9	
4664.100000	57.0	1000.0	1000.000	136.7	V	326.0	3.4	25.2	
8080.900000	54.9	1000.0	1000.000	352.7	V	4.0	6.6	27.3	
17094.03333	53.5	1000.0	1000.000	99.7	V	183.0	17.3	28.7	

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1616.166667	94.1	1000.0	1000.000	103.7	H	320.0	-5.6		Fundamental Carrier
1618.366667	75.7	1000.0	1000.000	102.7	H	34.0	-5.6		
2489.966667	37.6	1000.0	1000.000	103.7	V	26.0	-0.5	44.6	
3232.300000	71.1	1000.0	1000.000	108.7	H	326.0	1.0	11.1	
4664.100000	54.7	1000.0	1000.000	136.7	V	326.0	3.4	27.5	
8080.900000	47.9	1000.0	1000.000	352.7	V	4.0	6.6	34.3	
17094.03333	39.9	1000.0	1000.000	99.7	V	183.0	17.3	42.3	

2.4.2.4 Above 1GHz 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)
1618.633333	99.8	1000.0	1000.000	312.2	V	333.0	-5.6		
1618.766667	97.3	1000.0	1000.000	306.2	V	2.0	-5.6		Fundamental Carrier
2488.266667	55.1	1000.0	1000.000	103.7	V	26.0	-0.5	27.1	82.2
3237.400000	73.5	1000.0	1000.000	111.7	H	322.0	1.0	8.7	82.2
4663.900000	56.5	1000.0	1000.000	135.7	V	325.0	3.4	25.8	82.2
8093.566667	54.5	1000.0	1000.000	327.2	V	5.0	6.6	27.7	82.2
17018.10000	53.2	1000.0	1000.000	236.4	V	210.0	17.7	29.0	82.2

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1618.633333	95.9	1000.0	1000.000	312.2	V	333.0	-5.6		
1618.766667	94.1	1000.0	1000.000	306.2	V	2.0	-5.6		Fundamental Carrier
2488.266667	38.2	1000.0	1000.000	103.7	V	26.0	-0.5	44	82.2
3237.400000	71.7	1000.0	1000.000	111.7	H	322.0	1.0	10.5	82.2
4663.900000	53.9	1000.0	1000.000	135.7	V	325.0	3.4	28.3	82.2
8093.566667	47.9	1000.0	1000.000	327.2	V	5.0	6.6	34.3	82.2
17018.10000	40.0	1000.0	1000.000	236.4	V	210.0	17.7	42.2	82.2

2.5 FREQUENCY STABILITY

2.5.1 Specification Reference

FCC CFR Part 25, Section 25.202(d) as required by Part 2, Section 2.1055
RSS-170 issue 3, Section 5.2

2.5.2 Standard Applicable

FCC CFR Part 25, Section 25.202:

(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.

RSS-170 issue 3, Section 5.2:

For mobile earth station equipment, the carrier frequency shall not depart from the reference frequency by more than ± 10 ppm.

2.5.3 Equipment Under Test and Modification State

Serial No: 2904578 / Test Configuration A

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

February 09, 2018 / XYZ

2.5.5 Test Equipment Used

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

2.5.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

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

2.5.7 Additional Observations

- This is a conducted test.
- For the channel investigated, the reference is the frequency @ 20°C/nominal voltage.
- Limit is 0.001% of reference. Frequency differential higher than this level is considered a failure.
- The frequency stability of the EUT was observed with voltage ranging from 3.1 VDC to 4.2 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.

2.5.8 Test Results

Temperature Variations		
Voltage (VDC)	Temperature (°C)	Frequency Deviation (kHz/ppm)
3.7	-30	1.85 / 1.14
	-20	2.6 / 1.61
	-10	1.15 / 0.71
	0	0.5 / 0.31
	+10	-0.1 / -0.06
	+20	0 / 0
	+30	-0.55 / -0.34
	+40	-0.2 / -0.12
	+50	0.45 / 0.28

Voltage Variations		
Temperature (°C)	Voltage (VDC)	Frequency Deviation (Hz/ppm)
20	3.1	-0.6 / -0.37
	4.2	0 / 0



2.5.9 Sample Test Plot



$$\text{Reference Center Frequency @ } 20^\circ\text{C:} = \frac{T_1 + T_2}{2}$$

(T₂ and T₁ are Marker Points on the plot based on 99% OBW)

$$= \frac{1615.2453 \text{ MHz} + 1617.2475 \text{ MHz}}{2}$$

$$= 1616.2464 \text{ MHz}$$



$$\text{Reference Center Frequency @ } -30^\circ\text{C:} = \frac{1615.2482 \text{ MHz} + 1617.2483 \text{ MHz}}{2}$$

$$= 1616.24825 \text{ MHz}$$

$$\text{Therefore Frequency Deviation:} = 1616.24825 \text{ MHz} - 1616.2464 \text{ MHz}$$

$$= 0.00185 \text{ MHz}$$

2.6 PROTECTION OF AERONAUTICAL RADIO NAVIGATION SATELLITE SERVICE

2.6.1 Specification Reference

FCC CFR Part 25, Section 25.216(f) and (i)
RSS-170 Issue 3, Section 5.4.3.2.1 and 5.4.4

2.6.2 Standard Applicable

Part 25 Subpart C §25.216:

(f) Mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies in the 1610–1660.5 MHz band shall suppress the power density of emissions in the 1605–1610 MHz band to an extent determined by linear interpolation from -70 dBW/MHz at 1605 MHz to -10 dBW/MHz at 1610 MHz.

(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.

RSS-170 Issue 3:

5.4.3.2.1. Band 1610-1660.5 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: 2904578 / Test Configuration A

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

February 07, 2018 / XYZ

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 22.2°C
Relative Humidity 42.4%
ATM Pressure 99.7kPa

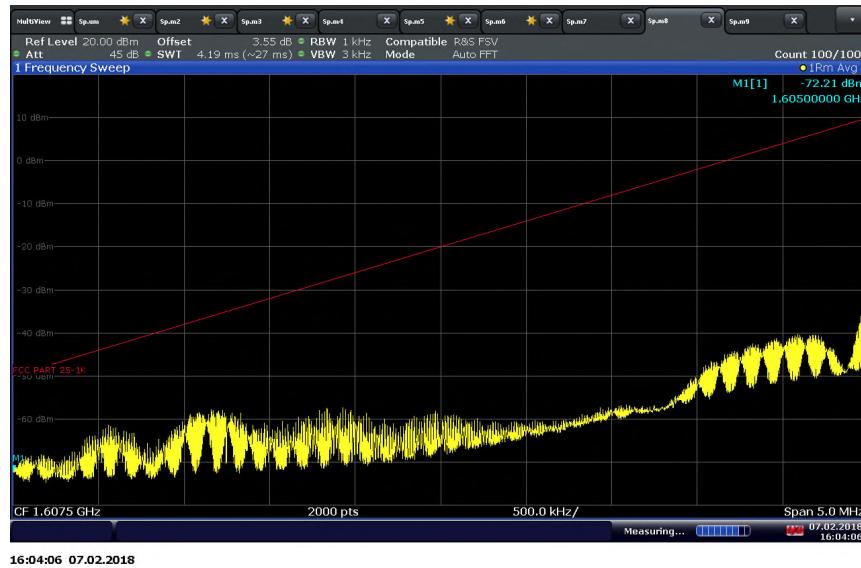
2.6.7 Additional Observations

- 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.
- The verification was performed with 1MHz and 1 kHz RBW settings.
- The spectrum was investigated from 1605MHz to 1610MHz (carrier-on state) and from 1559 MHz to 1610 MHz (carrier-off state).
- There are no emissions observed from the EUT at the frequency range investigated.

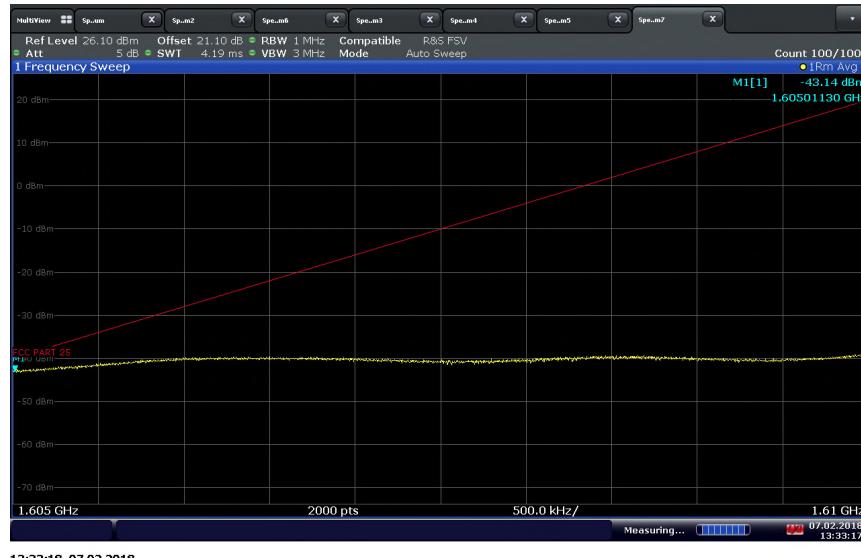
2.6.8 Test Results



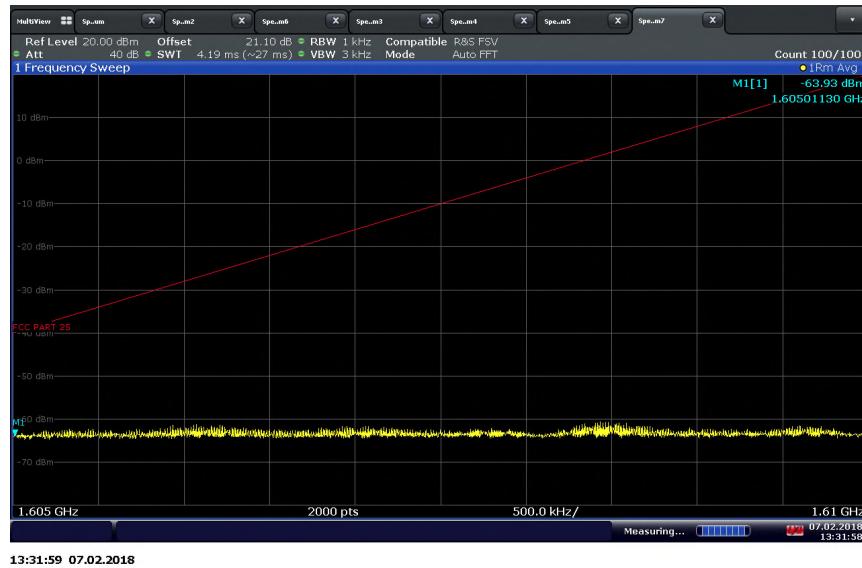
Low Channel (1 MHz RBW)



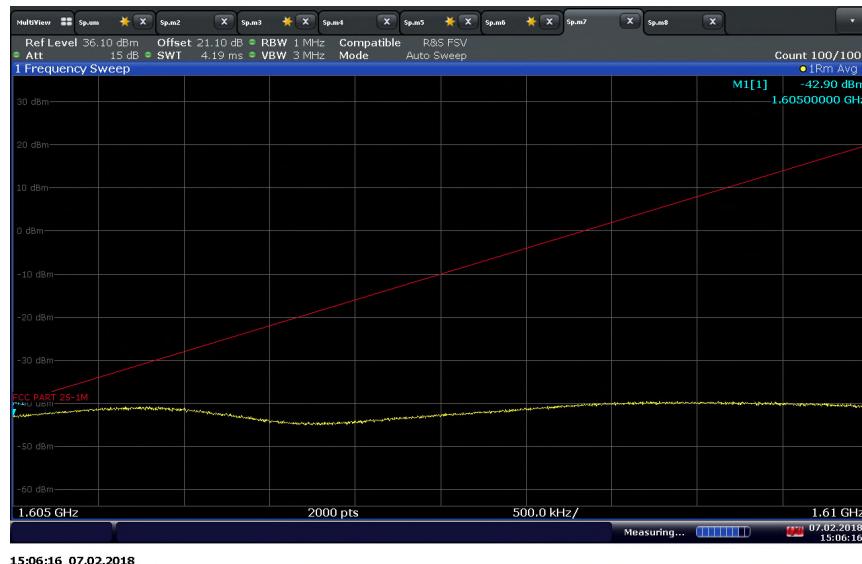
Low Channel (1 kHz RBW)



Mid Channel (1 MHz RBW)



Mid Channel (1 kHz RBW)

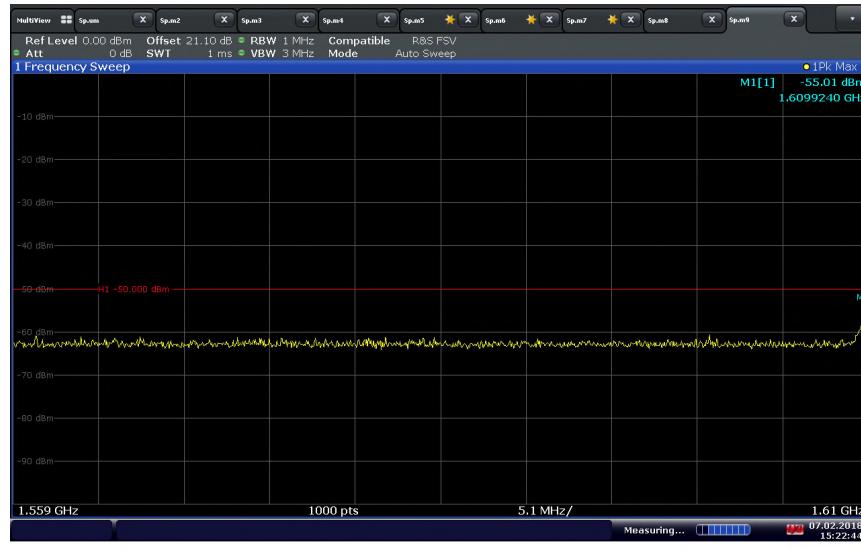


High Channel (1 MHz RBW)



14:59:29 07.02.2018

High Channel (1 kHz RBW)



15:22:45 07.02.2018

Carrier-off state

FCC ID: L2V-SPOTXB
IC: 3989A-SPOTXB
Report No. 72142941K



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						
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	04/25/17	04/25/18
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
8871	20dB Attenuator	18N10W-20dB	-	INMET	Verified by 7611 and 7608	
8769	3dB Attenuator	606-03-1F4/DR	N/A	Meca	Verified by 7611 and 7608	
Radiated Test Setup						
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/25/17	10/25/18
1016	Pre-amplifier	PAM-0202	187	PAM	02/06/18	02/06/19
1033	Bilog Antenna	3142C	00044556	EMCO	10/11/16	10/11/18
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	06/01/17	06/01/18
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/19/17	02/19/18
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	07/13/17	07/13/18
TUV783	2.0GHz High Pass Filter	FF6549-2	008	Sage	Verified by 1049	
Miscellaneous						
6708	Multimeter	34401A	US36086974	Hewlett Packard	07/05/17	07/05/18
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	02/26/28	02/26/19
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Conducted Antenna Port Measurement

	Input Quantity (Contribution) X_i	Value	Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10 dB	Normal, k=1	1.000	0.10	0.01
2	Cable attenuation	1.00 dB	Normal, k=2	2.000	0.50	0.25
3	Receiver sinewave accuracy	0.08 dB	Normal, k=2	2.000	0.04	0.00
4	Receiver pulse amplitude	0.00 dB	Rectangular	1.732	0.00	0.00
5	Receiver pulse repetition rate	0.00 dB	Rectangular	1.732	0.00	0.00
6	Noise floor proximity	0.00 dB	Rectangular	1.732	0.00	0.00
7	Frequency interpolation	0.10 dB	Rectangular	1.732	0.06	0.00
8	Mismatch	0.07 dB	U-shaped	1.414	0.05	0.00
Combined standard uncertainty				Normal	0.52 dB	
Expanded uncertainty				Normal, k=2	1.03 dB	

3.2.2 Radiated Emission Measurements (Below 1GHz)

	Input Quantity (Contribution) X_i	Value	Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10 dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.20 dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.75 dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	0.45 dB	Normal, k=2	2.000	0.23	0.05
5	Receiver pulse amplitude	1.50 dB	Rectangular	1.732	0.87	0.75
6	Receiver pulse repetition rate	1.50 dB	Rectangular	1.732	0.87	0.75
7	Noise floor proximity	0.50 dB	Rectangular	1.732	0.29	0.08
8	Mismatch: antenna-receiver	0.95 dB	U-shaped	1.414	0.67	0.45
9	AF frequency interpolation	0.30 dB	Rectangular	1.732	0.17	0.03
10	AF height deviations	0.10 dB	Rectangular	1.732	0.06	0.00
11	Directivity difference at 3 m	3.12 dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 3 m	1.00 dB	Rectangular	1.732	0.58	0.33
13	Cross-polarisation	0.90 dB	Rectangular	1.732	0.52	0.27
14	Balance	0.00 dB	Rectangular	1.732	0.00	0.00
15	Site imperfections	3.76 dB	Triangular	2.449	1.54	2.36
16	Separation distance at 3 m	0.30 dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.77 dB	Rectangular	1.732	0.44	0.20
18	Table height at 3 m	0.10 dB	Normal, k=2	2.000	0.05	0.00
19	Near-field effects	0.00 dB	Triangular	2.449	0.00	0.00
20	Effect of ambient noise on OATS	0.00 dB				0.00
Combined standard uncertainty				Normal	2.95 dB	
Expanded uncertainty				Normal, k=2	5.90 dB	

3.2.3 Radiated Emission Measurements (Above 1GHz)

	Input Quantity (Contribution) X_i	Value	Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10 dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.20 dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.75 dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	0.45 dB	Normal, k=2	2.000	0.23	0.05
5	Receiver pulse amplitude	1.50 dB	Rectangular	1.732	0.87	0.75
6	Receiver pulse repetition rate	1.50 dB	Rectangular	1.732	0.87	0.75
7	Noise floor proximity	0.50 dB	Rectangular	1.732	0.29	0.08
8	Mismatch: antenna-receiver	0.95 dB	U-shaped	1.414	0.67	0.45
9	AF frequency interpolation	0.30 dB	Rectangular	1.732	0.17	0.03
10	AF height deviations	0.10 dB	Rectangular	1.732	0.06	0.00
11	Directivity difference at 3 m	3.12 dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 3 m	1.00 dB	Rectangular	1.732	0.58	0.33
13	Cross-polarisation	0.90 dB	Rectangular	1.732	0.52	0.27
14	Balance	0.00 dB	Rectangular	1.732	0.00	0.00
15	Site imperfections	3.25 dB	Triangular	2.449	1.33	1.76
16	Separation distance at 3 m	0.30 dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.77 dB	Rectangular	1.732	0.44	0.20
18	Table height at 3 m	0.10 dB	Normal, k=2	2.000	0.05	0.00
19	Near-field effects	0.00 dB	Triangular	2.449	0.00	0.00
20	Effect of ambient noise on OATS	0.00 dB				0.00
Combined standard uncertainty		Normal	2.85 dB			
Expanded uncertainty		Normal, k=2	5.70 dB			

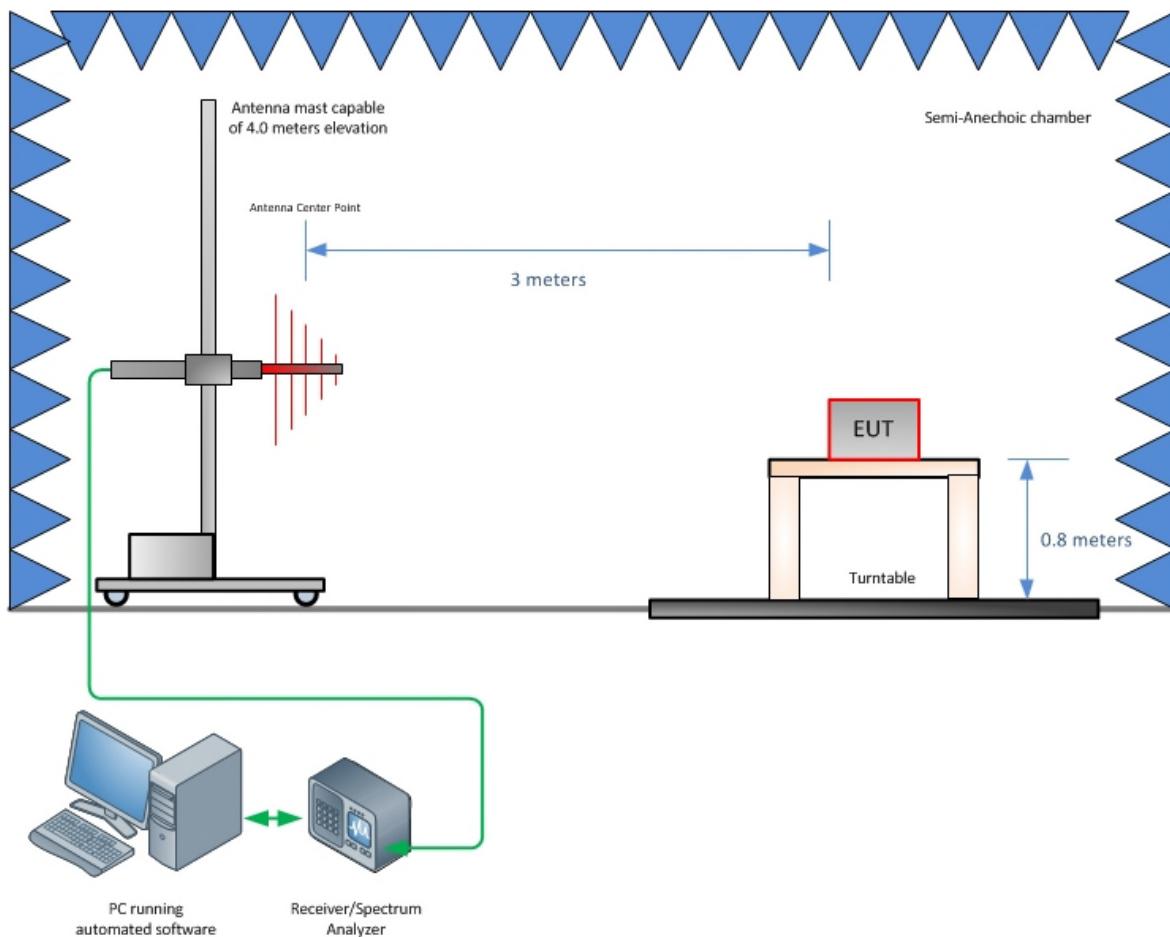
FCC ID: L2V-SPOTXB
IC: 3989A-SPOTXB
Report No. 72142941K



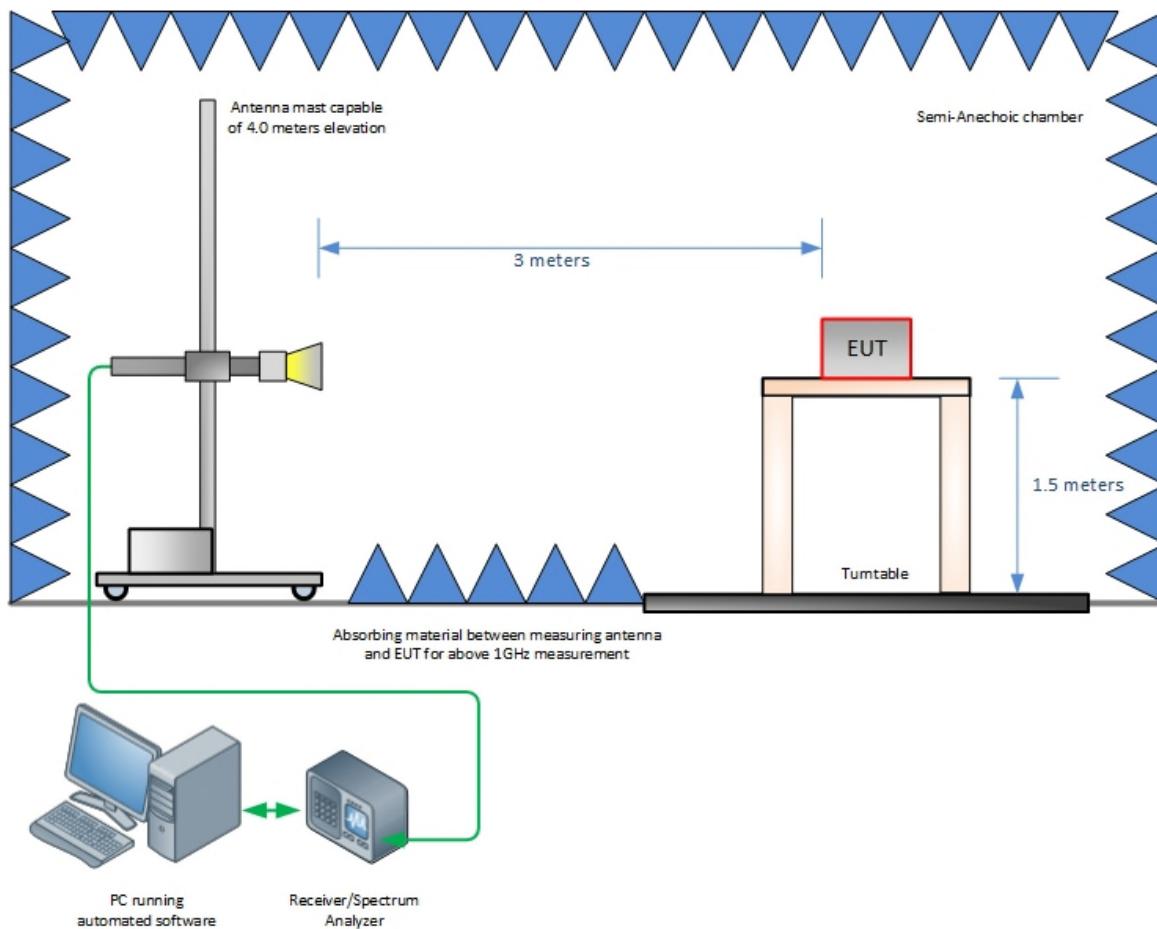
SECTION 4

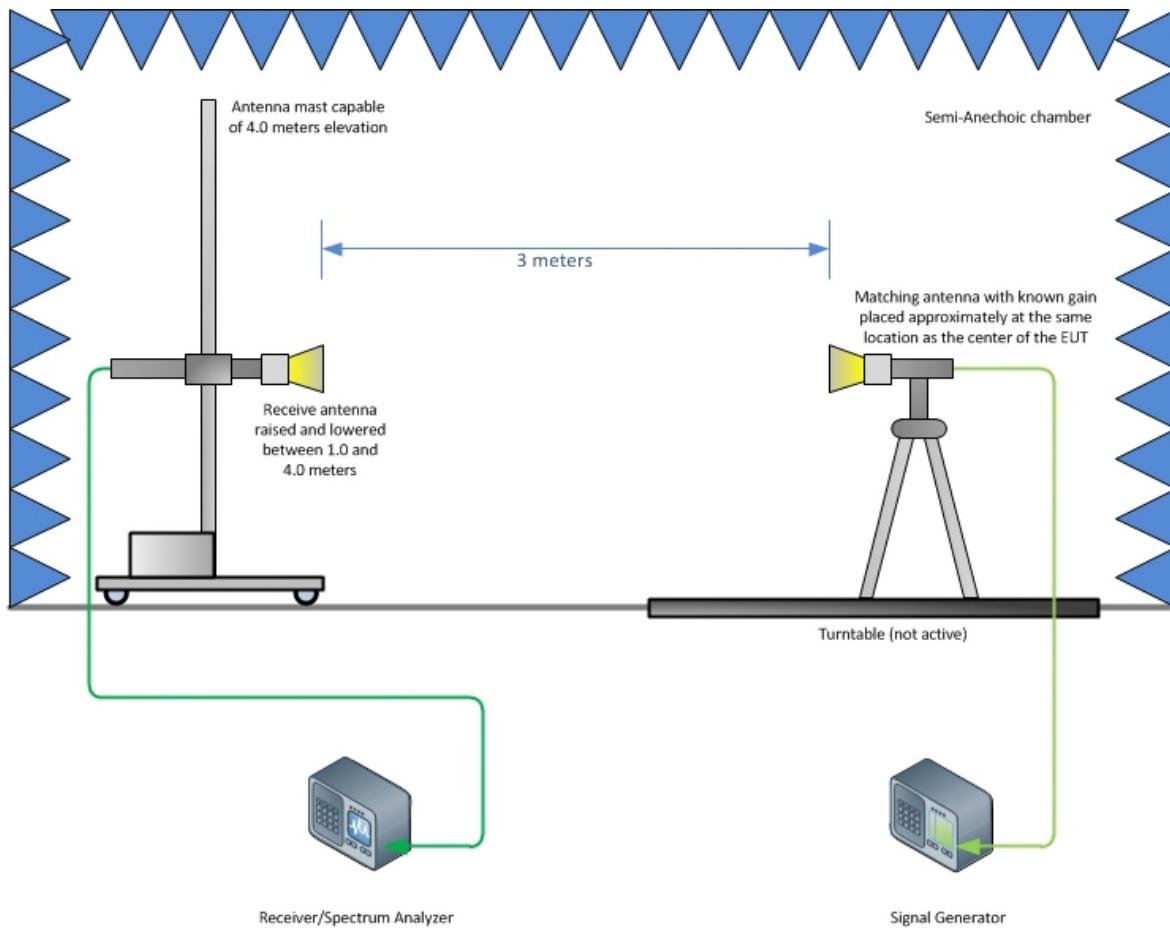
DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM

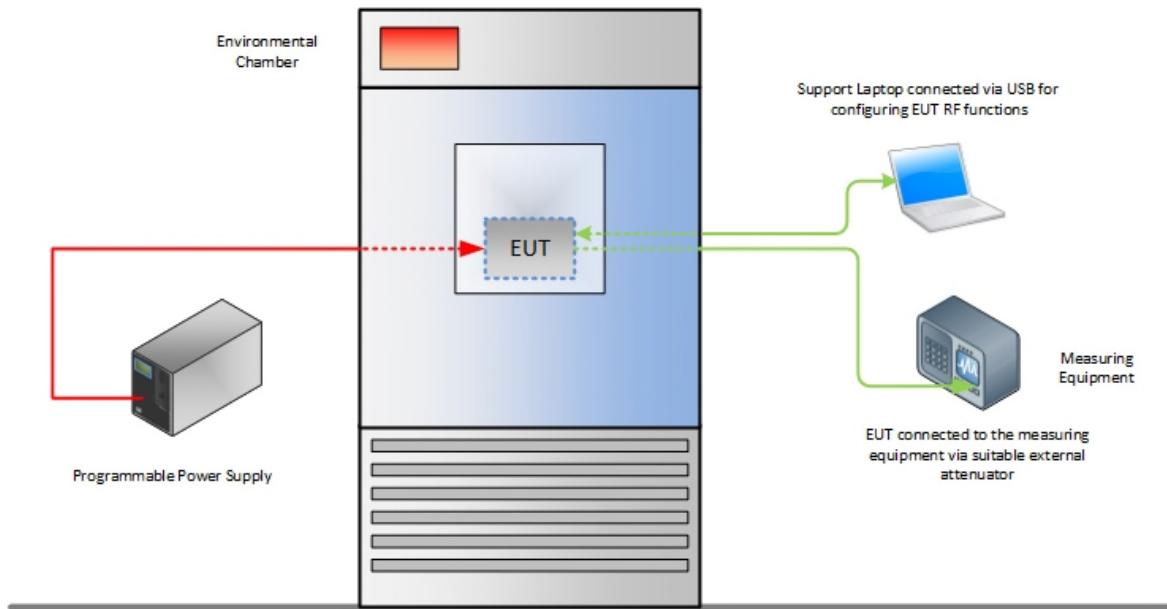


Radiated Emission Test Setup (Below 1GHz)





Substitution Test Method (Above 1GHz, if applicable)



Frequency Stability Test Configuration

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SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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