MEASUREMENT REPORT

FCC PART 25 / RSS-170 Satellite

FCC ID:	2ATHQZL1
IC:	25141-ZL1
APPLICANT:	Zoleo Incorporated

Application Type:	Certification
Product:	Global Satellite Communicator
Model No.:	ZL1000
Brand Name:	Zoleo
FCC Classification:	Licensed Non-Broadcast Transmitter Worn on Body (TNT)
FCC Rule Part(s):	FCC CFR 47 Part 2, FCC CFR 47 Part 25
IC Rule(s):	RSS-170 Issue 3, RSS-Gen Issue 5
Test Procedure(s):	ANSI C63.4-2014, ANSI C63.26-2015, KDB 971168 D01v03r01
Test Date:	July 03 ~ 22, 2019

Reviewed By: Jame Yuan
(Jame Yuan)

Approved By: Robin Wu
(Robin Wu)

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.26-2015. Test results reported herein relate only to the item(s) tested.

Revision History

Report No.	Version	Description	Issue Date	Note
1907RSU001-U1	Rev. 01	Initial Report	09-13-2019	Valid

CONTENTS

Description Page

§2.1033 General Information

Applicant:	Zoleo Incorporated
Applicant Address:	7A Taymall Avenue, Toronto, Ontario M8Z 3Y8, Canada
Manufacturer:	Zoleo Incorporated
Manufacturer Address:	7A Taymall Avenue, Toronto, Ontario M8Z 3Y8, Canada
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- **MRT facility is a FCC registered (MRT Reg. No. 893164) test facility with the site description report on file and has met all the requirements specified in ANSI C63.4-2014.**
- **MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.**
- **MRT facility is a VCCI registered (R-20025, G-20034, C-20020, T-20020) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications, Radio and SAR testing.**

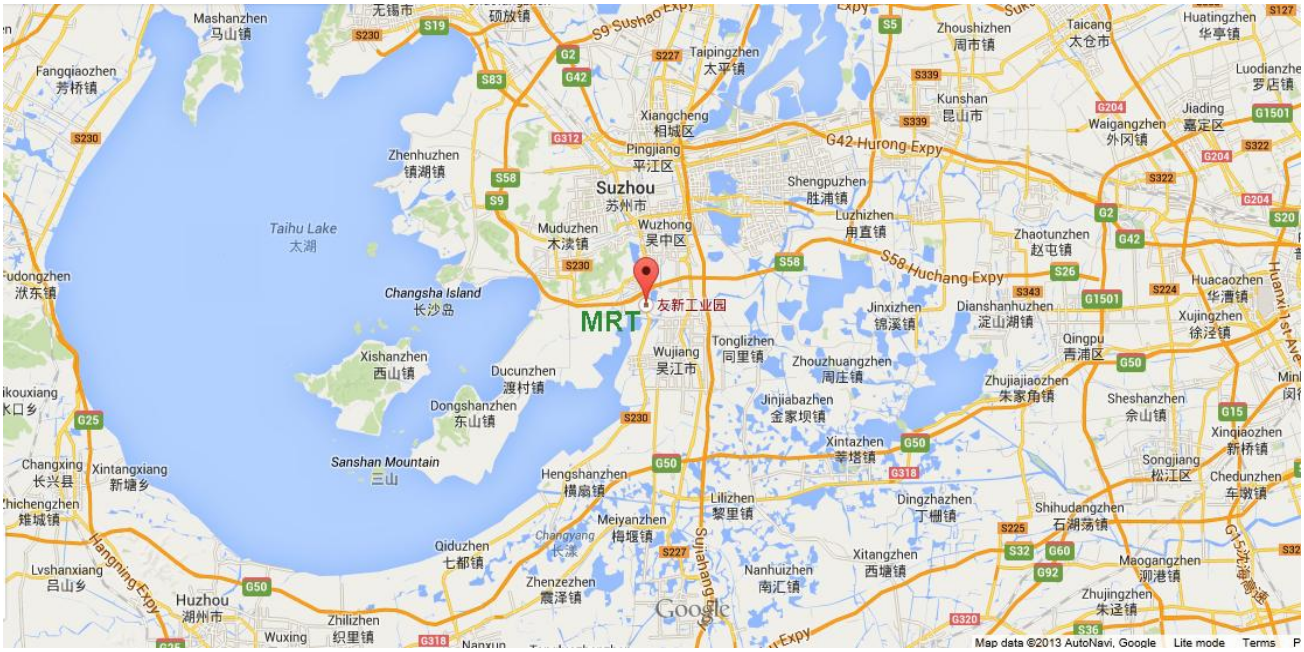
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada and Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The measurement facility compliant with the test site requirements specified in ANSI C63.4-2014.



2. PRODUCT INFORMATION

2.1. Feature of Equipment under Test

Product Name:	Global Satellite Communicator
Model No.:	ZL1000
Brand Name:	Zoleo
Bluetooth Version:	v4.1 (single mode only for BLE)
Satellite Specification:	1616.020833MHz ~ 1625.979167MHz
GNSS Specification:	GPS: 1575.42MHz SBAS: 1575.42MHz BDS: 1561.098MHz GLONASS: 1602 + n*0.5625 MHz (“n” is a satellite's frequency channel number from -7 ~ 6)
Power Supply:	By Rechargeable Lithium Battery
Battery Specification:	3.7V, 1.48Ah, 5.4Wh

2.2. Product Specification Subjective to this Report

Frequency Range:	1616MHz ~ 1626.5MHz
Test Frequency:	Low channel 1: 1616.020833MHz Mid channel 121: 1621.020833MHz High channel 240: 1625.979167MHz
Channel Spacing:	41.667kHz
Channel Number:	240
Duplexing Method:	TDD (Time Domain Duplex)
Antenna Type:	Ceramic Antenna
Antenna Gain:	5.1dBi

Note: For other features of this EUT, test report will be issued separately.

2.3. Test Mode

Test Mode	Mode 1: Transmit at channel 1616.020833MHz Mode 2: Transmit at channel 1621.020833MHz Mode 3: Transmit at channel 1625.979167MHz

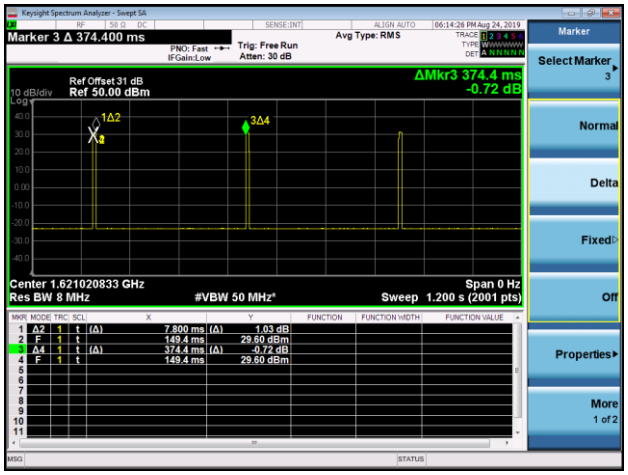
2.4. Device Capabilities

This device contains the following capabilities:

1.6GHz Satellite, Bluetooth v4.1 (single mode only for BLE), GPS, SBAS, BDS, GLONSS.

Note: The maximum achievable duty cycles was determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
1.6GHz Satellite	2.08%

Duty Cycle	
 Duty Cycle = 2.08%	

2.5. Test Configuration

The device was tested per the guidance of ANSI C63.26-2015. ANSI C63.4-2014 was used to reference the appropriate EUT setup for radiated emissions testing.

2.6. Description of Test Software

The test utility software used during testing was “Tera Term”, and the version was 4.103.

2.7. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.8. Labeling Requirements

FCC Part 25.285(b)

No portable device of any type identified in §25.285(a) (including transmitter or transceiver units installed in other devices that are themselves portable) may be sold or distributed to users unless it conspicuously bears the following warning: “This device must be turned off at all times while on board aircraft.” For purposes of this section, a device is portable if it is a “portable device” as defined in §2.1093(b) of this chapter or is designed to be carried by hand.

The device is so small to place the warning. Please see attachment for user manual.

RSP-100 Issue 11 Section 3

The manufacturer, importer or distributor shall meet the labeling requirements set out in this section for every unit:

(i) prior to marketing in Canada, for products manufactured in Canada

(ii) prior to importation into Canada, for imported products

For information regarding the e-labeling option, see Notice 2014–DRS1003. The label for the certified product represents the manufacturer’s or importer’s compliance with Innovation, Science and Economic Development Canada’s (ISED) regulatory requirements.

Please see attachment for label and label location.

3. TEST EQUIPMENT CALIBRATION DATE

Radiated Emissions - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2019/08/13
PXA Signal Analyzer	Keysight	N9030B	MRTSUE06395	1 year	2019/09/25
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2019/11/09
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2020/03/31
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2019/10/19
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06024	1 year	2019/12/17
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2019/11/16
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2020/06/11
Thermohygrometer	Testo	608-H1	MRTSUE06403	1 year	2019/08/14
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2020/04/30

Radiated Emission - AC2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Keysight	N9038A	MRTSUE06125	1 year	2019/08/13
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2019/11/09
Bilog Period Antenna	Schwarzbeck	VULB 9162	MRTSUE06022	1 year	2019/10/19
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06171	1 year	2019/11/09
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06024	1 year	2019/12/17
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06176	1 year	2019/11/16
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2020/06/11
Temperature/Humidity Meter	Minggao	ETH529	MRTSUE06170	1 year	2019/12/13
Anechoic Chamber	RIKEN	Chamber-AC2	MRTSUE06213	1 year	2020/04/30

Conducted Test Equipment - TR3

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2020/04/15
PXA Signal Analyzer	Keysight	N9030B	MRTSUE06395	1 year	2019/09/25
EXA Signal Analyzer	Keysight	N9010B	MRTSUE06452	1 year	2020/07/11
Signal Analyzer	R&S	FSV40	MRTSUE06218	1 year	2020/04/15
Power Meter	Agilent	U2021XA	MRTSUE06030	1 year	2019/11/16
USB wideband power sensor	Keysight	U2021XA	MRTSUE06446	1 year	2020/06/30
USB wideband power sensor	Keysight	U2021XA	MRTSUE06447	1 year	2020/06/30
Bluetooth Test Set	Anritsu	MT8852B-042	MRTSUE06389	1 year	2020/06/13
Audio Analyzer	Agilent	U8903B	MRTSUE06143	1 year	2020/06/13
Modulation Analyzer	HP	8901A	MRTSUE06098	1 year	2019/10/18
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2019/11/16
DC Power Supply	GWINSTEK	DPS-3303C	MRTSUE06064	N/A	N/A
Temperature & Humidity Chamber	BAOYT	BYH-150CL	MRTSUE06051	1 year	2019/11/16
Thermohygrometer	testo	608-H1	MRTSUE06401	1 year	2019/08/14

Software	Version	Function
EMI Software	V3	EMI Test Software

4. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Radiated Emission Measurement - AC1
Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): Horizontal: 30MHz~300MHz: 4.07dB 300MHz~1GHz: 3.63dB 1GHz~30GHz: 4.16dB Vertical: 30MHz~300MHz: 4.18dB 300MHz~1GHz: 3.60dB 1GHz~30GHz: 4.76dB
Radiated Emission Measurement - AC2
Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): Horizontal: 30MHz~300MHz: 3.75dB 300MHz~1GHz: 3.53dB 1GHz~30GHz: 4.28dB Vertical: 30MHz~300MHz: 3.86dB 300MHz~1GHz: 3.53dB 1GHz~30GHz: 4.33dB

5. TEST RESULT

5.1. Summary

FCC Part Section(s)	IC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	RSS-Gen [6.7]	Occupied Bandwidth	N/A	Conducted	Pass	Section 5.2
2.1046(a), 25.203(c)(ix) 25.204	RSS-170 [5.3.2]	Power Spectral Density & Output Power	Refer to section 5.3		Pass	Section 5.3
2.1051, 25.202(f)	RSS-170 [5.4.3.1]	Unwanted Emission at Antenna Terminal.	Refer to section 5.4		Pass	Section 5.4
2.1055, 25.202(d)	RSS-170 [5.2]	Frequency Stability	±10ppm		Pass	Section 5.5
2.1053, 25.202(f) 25.216	RSS-170 [5.4.3.1] [5.4.3.2.1]	Radiated Spurious Emission	Refer to section 5.6	Radiated	Pass	Section 5.6
25.216	RSS-170 [5.4.3.2.1] [5.4.4]	Protection of Aeronautical Radio navigation-Satellite Service	Refer to section 5.7	Conducted	Pass	Section 5.7

Notes:

1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
2) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.

5.2. Occupied Bandwidth Measurement

5.2.1.Test Limit

N/A

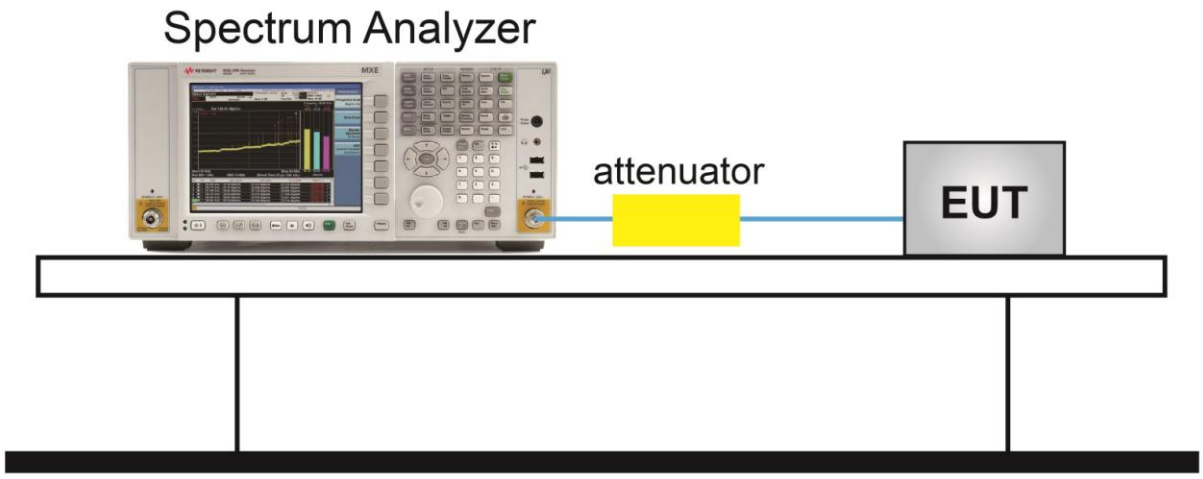
5.2.2.Test Procedure used

ANSI C63.26-2015 - Section 5.4.4

5.2.3.Test Setting

1. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient)
2. Set RBW = 1% to 5% of the OBW
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep = Auto couple
7. Allow the trace was allowed to stabilize

5.2.4.Test Setup



5.2.5.Test Result

Product	Global Satellite Communicator	Temperature	25℃
Test Engineer	Bruce Wang	Relative Humidity	52%
Test Site	TR3	Test Date	2019/07/18

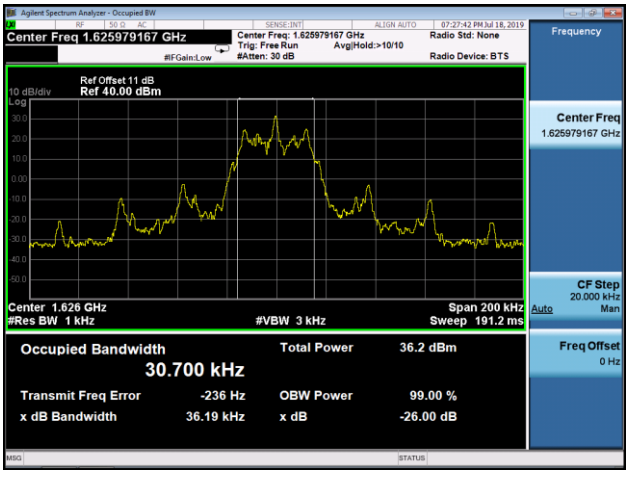
Test Mode	Channel No.	Test Frequency (MHz)	99% Bandwidth (kHz)	Result
Mode 1	1	1616.020833	30.298	Pass
Mode 2	121	1621.020833	30.180	Pass
Mode 3	240	1625.979167	30.700	Pass

6dB Bandwidth

Channel 1 (1616.020833MHz)

Channel 121 (1621.020833MHz)

Channel 240 (1625.979167MHz)



5.3. Power Spectral Density & Output Power Measurement

5.3.1.Test Limit

Part 25.203(c)(ix)

Maximum equivalent isotropically radiated power (e.i.r.p.) density in the main beam in any 4kHz band, (dBW/4kHz) for frequency bands below 15GHz or in any 1MHz band (dBW/MHz) for frequency band above 15GHz.

FCC Part 25.204(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 15GHz, shall not exceed the following limits except as provided for in paragraph(c) of this section:

+ 40dBW in any 4 kHz band for $\theta \leq 0°$

+ 40 + 3θdBW in any 4 kHz band for $0° < \theta \leq 5°$

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.

RSS-170 Section 5.3.2

The application for MES certification shall state the MES e.i.r.p. that is necessary for satisfactory communication. The maximum permissible e.i.r.p. will be the stated e.i.r.p. plus a 2dB margin. If a detachable antenna is used, the certification application shall state the recommended antenna type and manufacturer, the antenna gain and the maximum transmitter output power at the antenna terminal. The antenna of the device is permanently attached.

5.3.2.Test Procedure Used

ANSI C63.26-2015 - Section 5.2.4.5 & 5.2.4.4.2 (Power Spectral Density Measurement)

ANSI C63.26-2015 - Section 5.2.4.2 (Output Power Measurement)

5.3.3.Test Setting

Power Spectral Density Measurement using spectrum analyzer

1. Set span to 2 × to 3 × the OBW
2. Set RBW = 1% to 5% of the OBW

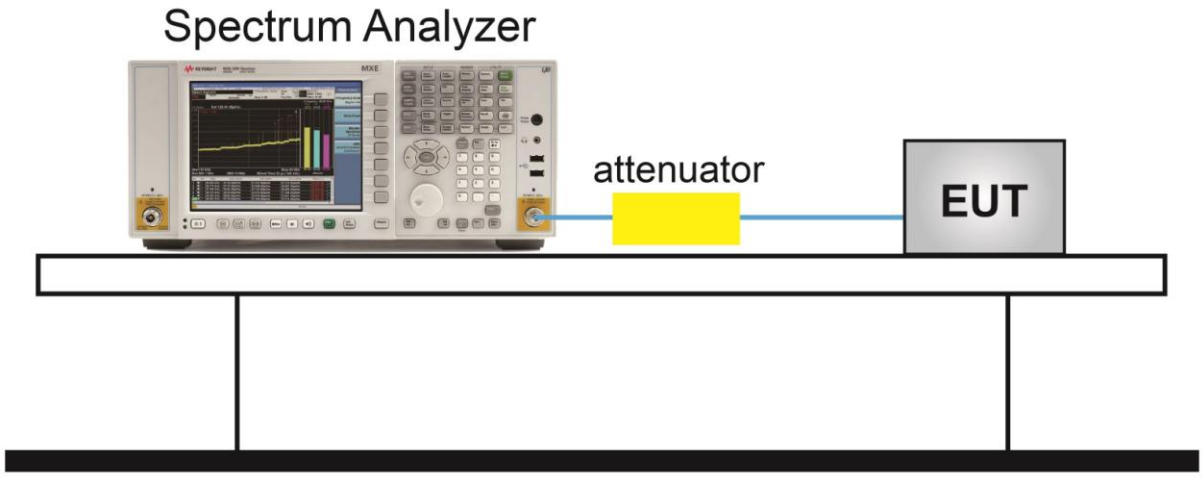
   (RBW shall set to the reference bandwidth specified by the applicable regulatory requirement, so set RBW = 3 kHz herein for measurement)
3. Set VBW ≥ 3 × RBW
4. Set number of measurement points in sweep ≥ 2 × span / RBW
5. Detector = power averaging (RMS)
6. Trace mode = Trace average
7. Trace was allowed to stabilize
8. 10*log(4kHz/3kHz) = 1.25dB was added to the reference offset for in-band mask measurement to correct the result relative to any 4kHz band as per the requirement in 25.202(f)(1).
9. Add 10 log (1/duty cycle) to the measured power spectral density level.

Output Power Measurement using a gated RF average-reading power meter

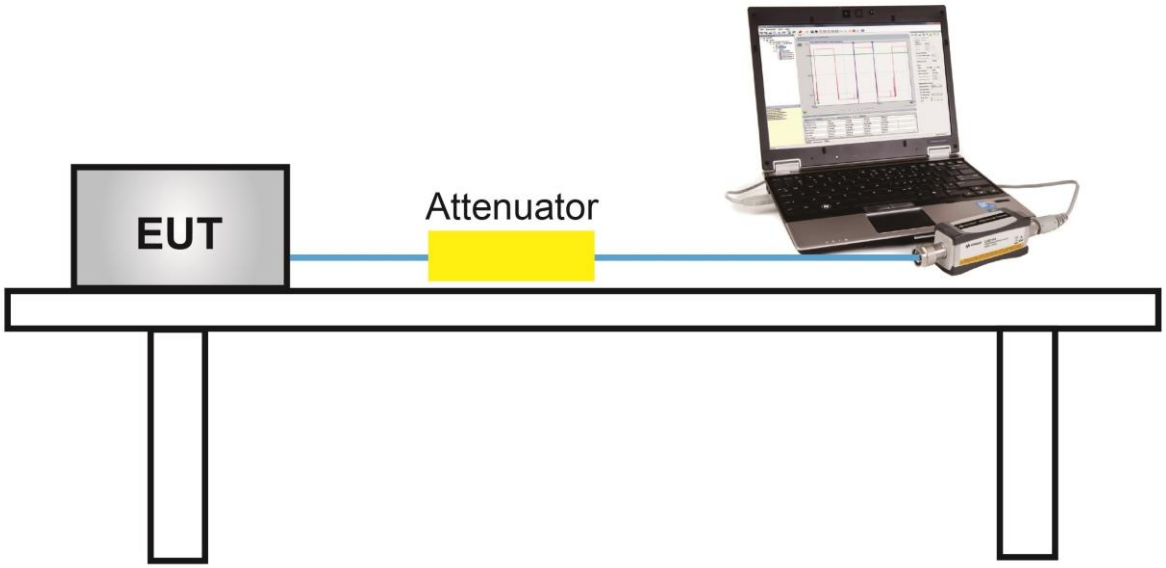
Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

5.3.4.Test Setup

For Power Spectral Density Measurement



For Output Power Measurement



5.3.5.Test Result

Product	Global Satellite Communicator	Temperature	25℃
Test Engineer	Bruce Wang	Relative Humidity	52%
Test Site	TR3	Test Date	2019/07/13 ~ 2019/08/01

Test Result of Average Power Spectral Density

Test Mode	Channel No.	Test Frequency (MHz)	Average Power Spectral Density (dBm/4kHz)	Final Average Power Spectral Density (dBm/4kHz)	Limit (dBm)	Result
Mode 1	1	1616.020833	32.91	54.83	≤ 70	Pass
Mode 2	121	1621.020833	32.75	54.67	≤ 70	Pass
Mode 3	240	1625.979167	32.69	54.61	≤ 70	Pass

Note 1: Final Average Power Spectral Density (dBm/4kHz) = Average Power Spectral Density (dBm/4kHz) + Constant Factor + Antenna Gain (dBi), Antenna Gain = 5.1dBi.

Note 2: Constant Factor = 10*log (1/Duty Cycle) = 16.82 dB.

Test Result of Average Output Power

Test Mode	Channel No.	Test Frequency (MHz)	Average Power (dBm)	E.I.R.P (dBm)
Mode 1	1	1616.020833	30.48	35.58
Mode 2	121	1621.020833	30.60	35.70
Mode 3	240	1625.979167	30.46	35.56

Note 1: E.I.R.P (dBm) = Average Power (dBm) + Antenna Gain (dBi), Antenna Gain = 5.1dBi.

Note 2: The result of E.I.R.P complied the RSS-170 Section 5.3.2 requirement.

Average Power Spectral Density	
1616.020833MHz	1621.020833MHz
	
1625.979167MHz	
	

5.4. Unwanted Emission at Antenna Terminal Measurement

5.4.1.Test Limit

FCC Part 25.202(f)

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule:

(1) In any 4kHz 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: 25dB;

(2) In any 4kHz 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: 35dB;

(3) In any 4kHz 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 43dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts.

RSS-170 Section 5.4.3.1

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

(1) 25dB in any 4kHz 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) 35dB in any 4kHz 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 4kHz 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.

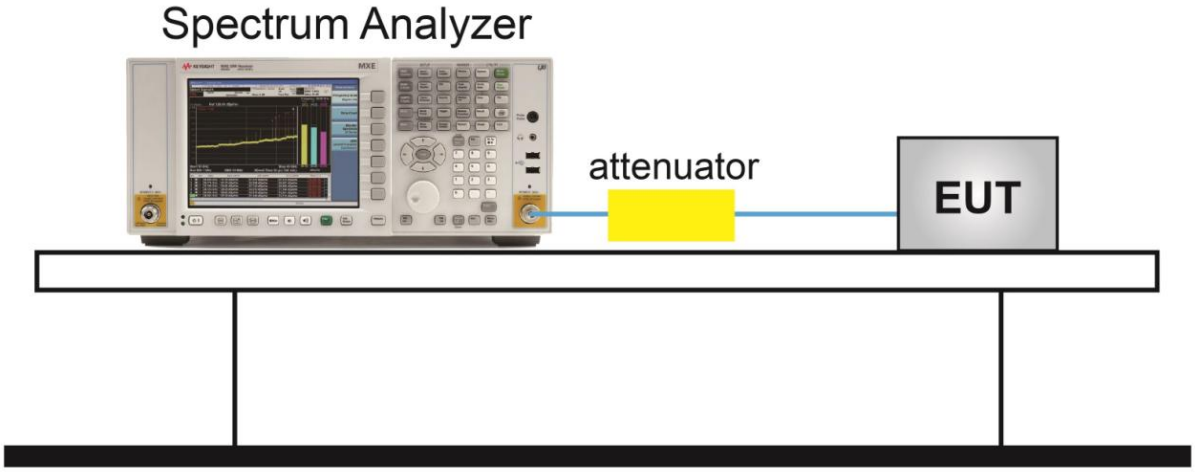
5.4.2.Test Procedure Used

ANSI C63.26-2015 - Section 5.7

5.4.3.Test Setting

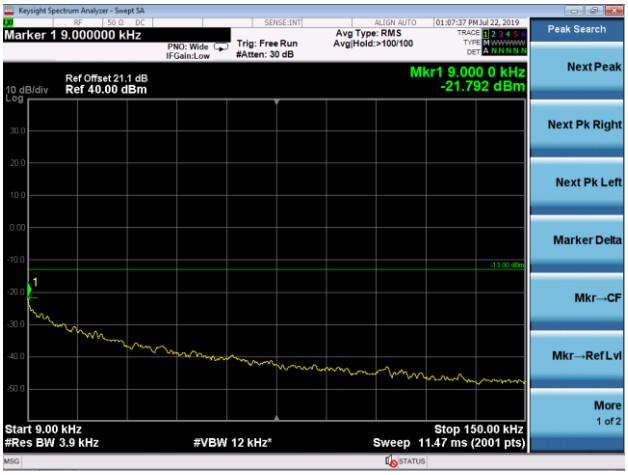
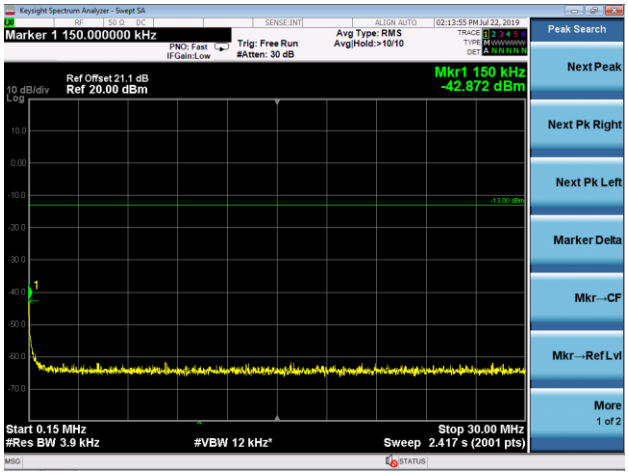
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Set RBW to the reference bandwidth specified by the applicable regulatory requirement.
3. VBW ≥ 3 × RBW
4. Detector = RMS
5. Sweep time = Auto couple
6. Trace mode = Max hold
7. Trace was allowed to stabilize
8. 10*log(4kHz/RBW) was added to the reference offset to correct the result relative to any 4kHz band as per the requirement in 25.202(f).

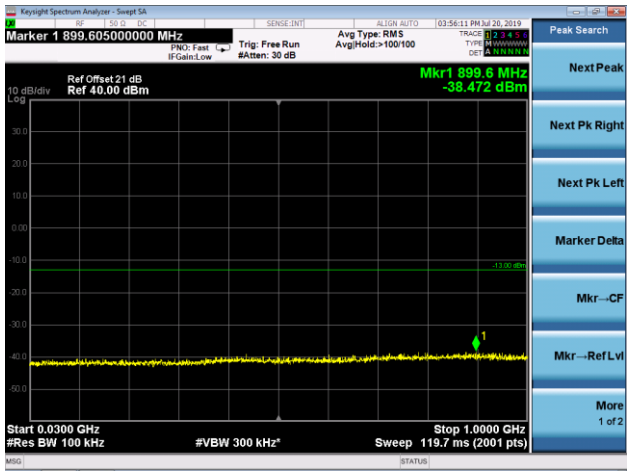
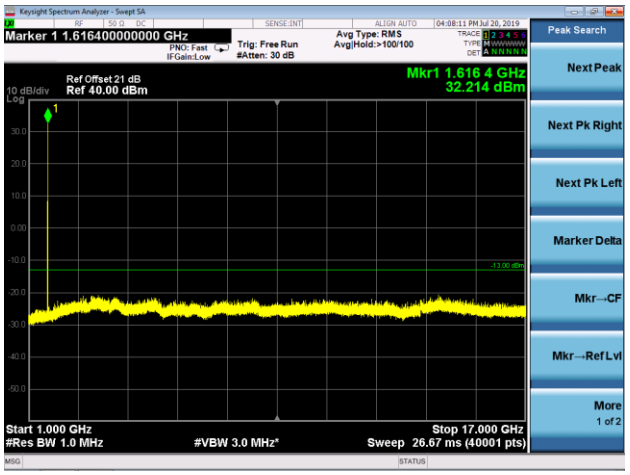
5.4.4.Test Setup



5.4.5.Test Result

Product	Global Satellite Communicator	Temperature	25℃
Test Engineer	Bruce Wang	Relative Humidity	52%
Test Site	TR3	Test Date	2019/07/20 ~ 2019/08/01

Unwanted Emission at Antenna Terminal - 1616.020833MHz	
In-band Mask	
	
9kHz - 150kHz	150kHz - 30MHz
	

30MHz - 1GHz	1GHz - 17GHz
	

Note 1: Authorization Bandwidth = 41.667 kHz.

Note 2: Emission limits are calculated based on following:

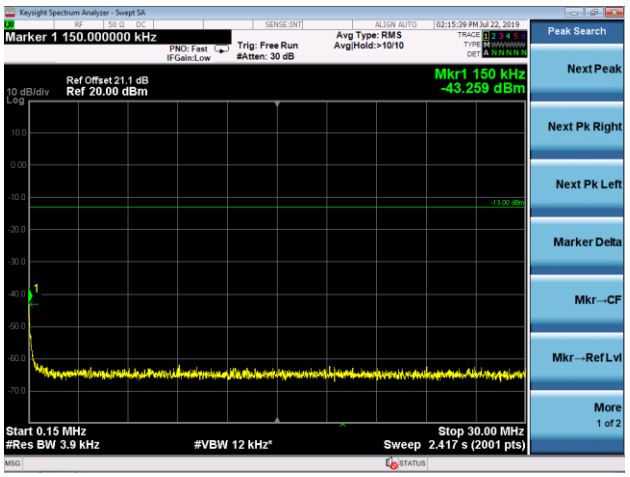
For 50% - 100% of Authorization Bandwidth = 30.48 - 25 = 5.48dBm;

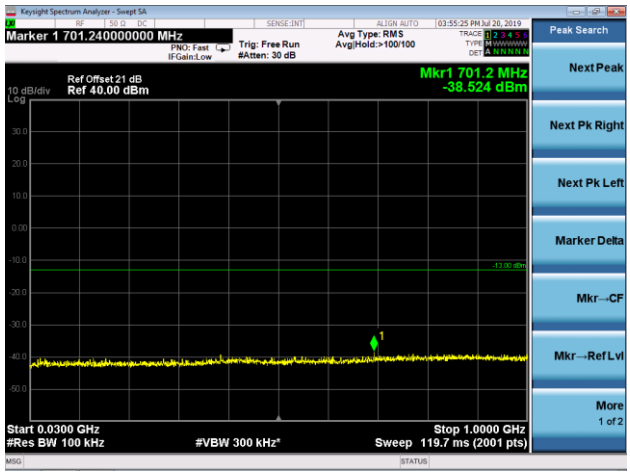
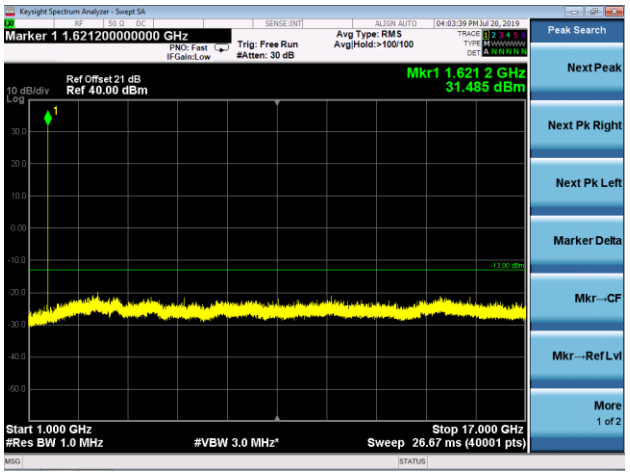
For 100% - 250% of Authorization Bandwidth = 30.48 - 35 = -4.52dBm;

For above 250% of Authorization Bandwidth = 30.48 - [43 + 10 log10 (1.032)] = -13dBm.

Note 3: Constant factor 10*log (4kHz / 3kHz) = 1.25dB was added to the reference offset for in-band mask measurement.

Constant factor 10*log (4kHz / 3.9kHz) = 0.1dB was added to the reference offset for 9kHz ~ 30MHz measurement.

Unwanted Emission at Antenna Terminal - 1621.020833MHz	
In-band Mask	
	
9kHz - 150kHz	150kHz - 30MHz
	

30MHz - 1GHz	1GHz - 17GHz
	

Note 1: Authorization Bandwidth = 41.667 kHz.

Note 2: Emission limits are calculated based on following:

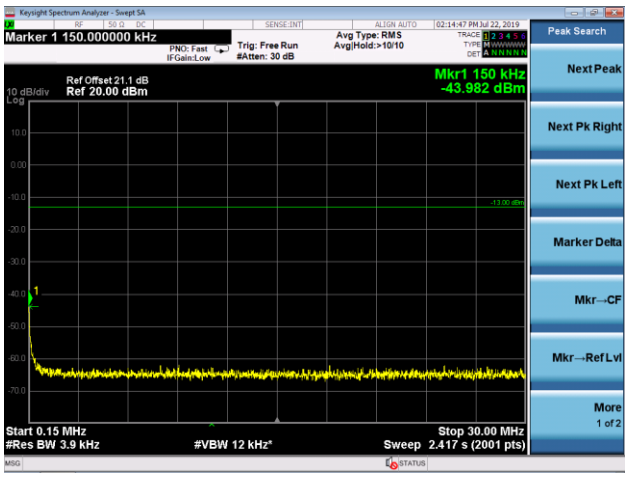
For 50% - 100% of Authorization Bandwidth = 30.60 - 25 = 5.60dBm;

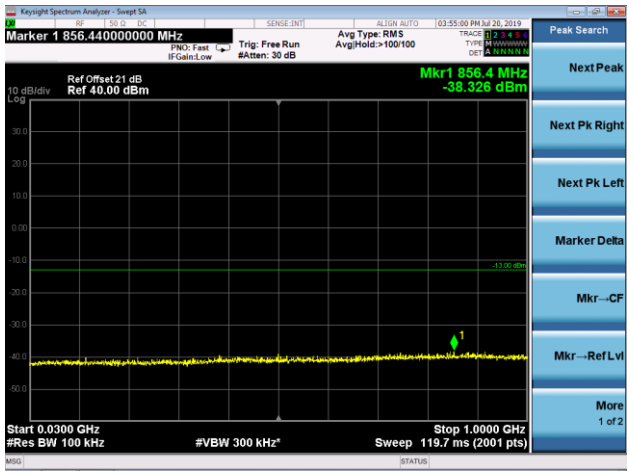
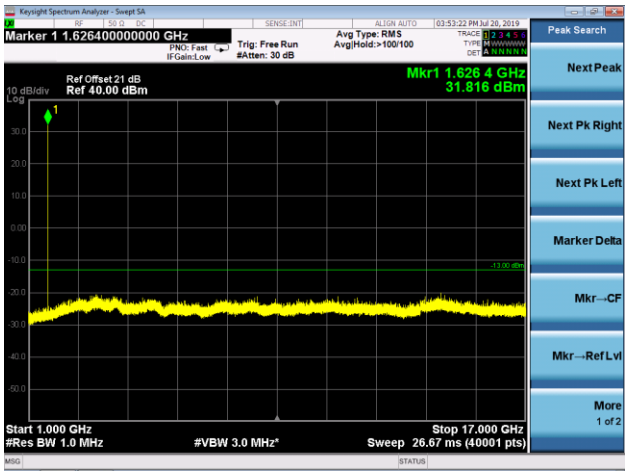
For 100% - 250% of Authorization Bandwidth = 30.60 - 35 = -4.40dBm;

For above 250% of Authorization Bandwidth = 30.60 - [43 + 10 log10 (1.037)] = -13dBm.

Note 3: Constant factor 10*log (4kHz / 3kHz) = 1.25dB was added to the reference offset for in-band mask measurement.

Constant factor 10*log (4kHz / 3.9kHz) = 0.1dB was added to the reference offset for 9kHz ~ 30MHz measurement.

Unwanted Emission at Antenna Terminal - 1625.979167MHz	
In-band Mask	
	
9kHz - 150kHz	150kHz - 30MHz
	

30MHz - 1GHz	1GHz - 17GHz
	

Note 1: Authorization Bandwidth = 41.667 kHz.

Note 2: Emission limits are calculated based on following:

For 50% - 100% of Authorization Bandwidth = 30.46 - 25 = 5.46dBm;

For 100% - 250% of Authorization Bandwidth = 30.46 - 35 = -4.54dBm;

For above 250% of Authorization Bandwidth = 30.46 - [43 + 10 log10 (1.028)] = -13dBm.

Note 3: Constant factor 10*log (4kHz / 3kHz) = 1.25dB was added to the reference offset for in-band mask measurement.

Constant factor 10*log (4kHz / 3.9kHz) = 0.1dB was added to the reference offset for 9kHz ~ 30MHz measurement.

5.5. Frequency Stability under Temperature & Voltage Varions

5.5.1.Test Limit

FCC Part 25.202(d)

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 Section 5.2

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

5.5.2.Test Procedure Used

ANSI C63.26-2015 - Section 5.6.3 & 5.6.4 & 5.6.5

5.5.3.Test Setting

The EUT was set to transmit an unmodulated carrier. The EUT was connected to a spectrum analyser via a cable and attenuator.

Adjust the temperature and supply voltage follow below:

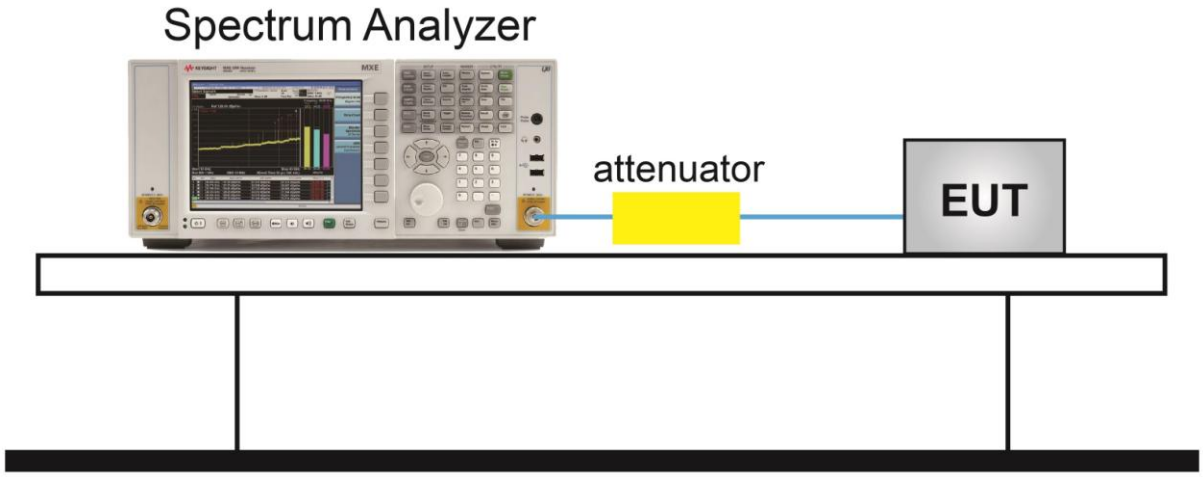
a) At 10℃ intervals of temperatures between -30℃ and +50℃ at the manufacturer's rated supply voltage, and

b) At +20℃ temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage then the -15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

Adjust the detector bandwidth and span settings to achieve a resolution capable of accurate frequency measurements over the applicable frequency stability limits. Mark the highest point and record it.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy).

5.5.4.Test Setup



5.5.5.Test Result

Product	Global Satellite Communicator	Temperature	-30℃ ~ +50℃
Test Engineer	Bruce Wang	Relative Humidity	52%
Test Site	TR3	Test Date	2019/07/20

Test Frequency (MHz)	Voltage (V_{DC})	Temperature (℃)	Upper Frequency (MHz)	Lower Frequency (MHz)	Calculated Center Frequency (MHz)	Frequency Stability (ppm)	Limit (ppm)	Result
1621.020833	3.7	-30	1621.03378	1621.00703	1621.020405	-0.26403	≤ 10	Pass
		-20	1621.03378	1621.00693	1621.020355	-0.29488	≤ 10	Pass
		-10	1621.03373	1621.00698	1621.020355	-0.29488	≤ 10	Pass
		0	1621.03373	1621.00698	1621.020355	-0.29488	≤ 10	Pass
		+10	1621.03388	1621.00708	1621.020480	-0.21776	≤ 10	Pass
		+20	1621.03378	1621.00698	1621.020380	-0.27945	≤ 10	Pass
		+30	1621.03378	1621.00703	1621.020405	-0.26403	≤ 10	Pass
		+40	1621.03388	1621.00693	1621.020405	-0.26403	≤ 10	Pass
		+50	1621.03378	1621.00698	1621.020380	-0.27945	≤ 10	Pass
	3.145	+20	1621.03373	1621.00693	1621.020330	-0.31030	≤ 10	Pass
	4.255	+20	1621.03383	1621.00698	1621.020405	-0.26403	≤ 10	Pass

Note: Frequency Stability (ppm) = {[Calculated Center Frequency (MHz) - Test Frequency (MHz)] / Test Frequency (MHz)} * 10^6.

5.6. Radiated Spurious Emission Measurement

5.6.1.Test Limit

FCC Part 25.202(f)

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule:

(3) In any 4kHz 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 43dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts.

FCC Part 25.216(c)(f)(g)

(c) The EIRP density of emissions from mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies between 1610MHz and 1660.5MHz shall not exceed -70dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1559-1605MHz. The EIRP of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed -80dBW, averaged over any 2 millisecond active transmission interval, in the 1559-1605MHz band.

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

(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 1610-1626.5MHz band shall suppress the power density of emissions in the 1605-1610MHz band-segment to an extent determined by linear interpolation from -70dBW/MHz at 1605MHz to -10dBW/MHz at 1610MHz averaged over any 2 millisecond active transmission interval. The EIRP of discrete emissions of less than 700Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from -80dBW at 1605MHz to -20dBW at 1610MHz, averaged over any 2 millisecond active transmission interval.

RSS-170 Section 5.4.3.1, 5.4.3.2.1

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

(3) 43 + 10 log P (watts) in any 4kHz 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.

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

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

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

Table 1		
Frequency (MHz)	Carrier-on	
	EIRP (dBm/MHz)	Measured Bandwidth
0.009 ~ 30	-13	10kHz
30 ~ 1000	-13	100kHz
1000 ~ 1559	-13	100kHz
1559 ~ 1605	-40	1MHz
1605 ~ 1610	-40 ~ +10	1MHz
1610 ~ 1628.5	Not applicable	Not applicable
1628.5 ~ 17000	-13	100kHz

5.6.2.Test Procedure Used

ANSI C63.26-2015 - Section 5.7

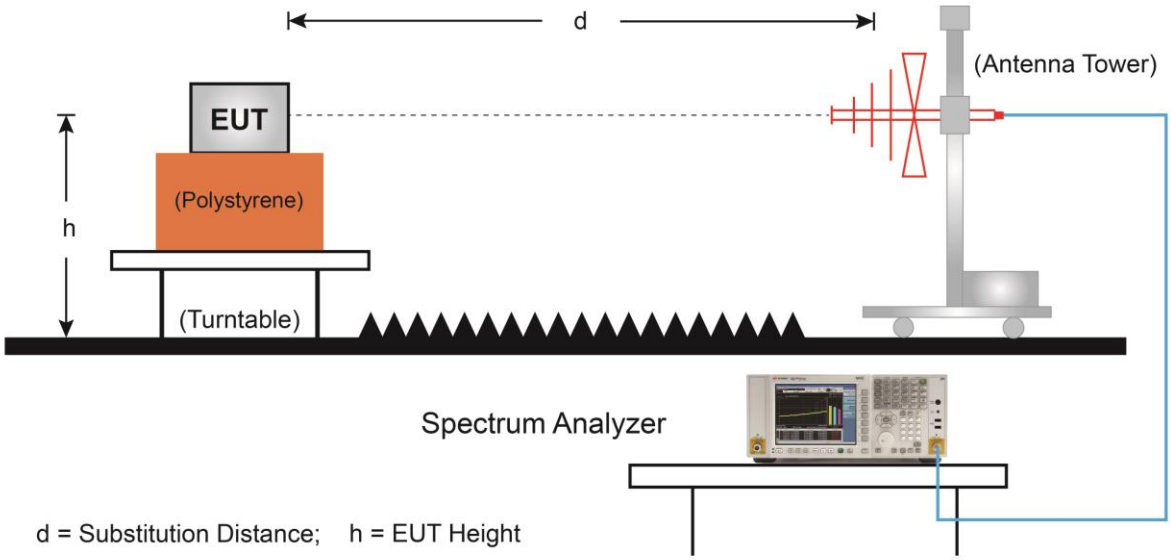
5.6.3.Test Setting

The EUT is placed on a non-conducting table above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

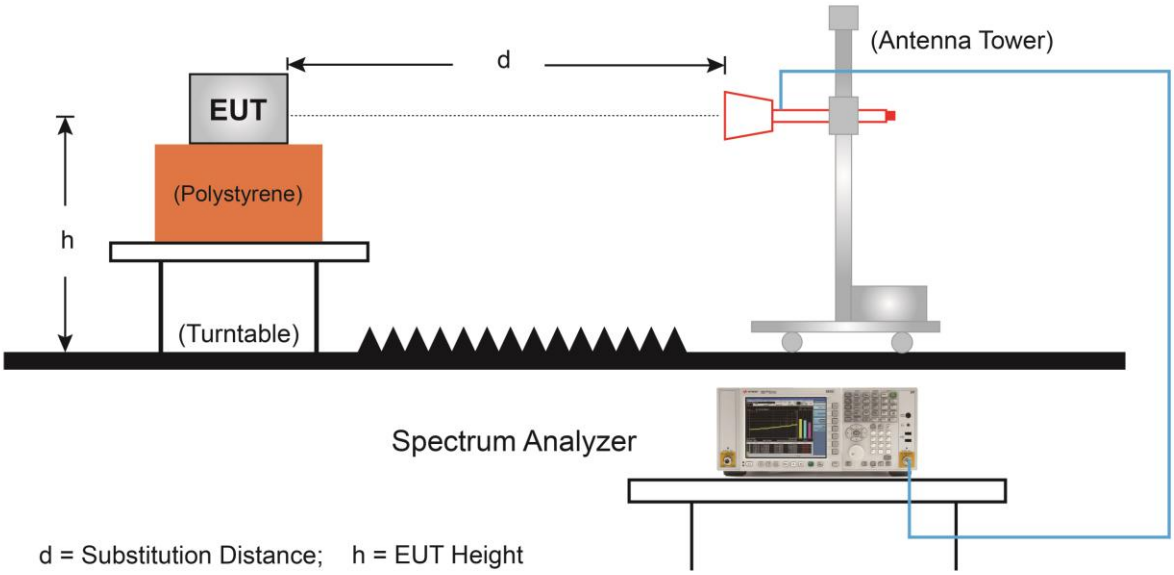
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in Table 1
3. VBW = 3 * RBW
4. Detector = RMS
5. Sweep time = Auto couple
6. Trace mode = Max hold
7. Trace was allowed to stabilize
8. 10*log(4kHz/RBW) was added to the reference offset to correct the result relative to any 4kHz band as per the requirement in 25.202(f).

5.6.4.Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



5.6.5.Test Result

Product	Global Satellite Communicator	Temperature	25℃
Test Engineer	Snake Ni	Relative Humidity	54%
Test Site	AC2	Test Date	2019/07/12
Test Mode	Transmit at channel 1616.020833MHz		

Frequency (MHz)	Reading Level (dBm)	Substitution Factor (dB)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
39.2	-87.6	27.8	-59.8	-13.0	-46.8	Average	Horizontal
179.4	-78.9	24.1	-54.8	-13.0	-41.8	Average	Horizontal
37.8	-71.3	23.9	-47.4	-13.0	-34.4	Average	Vertical
95.5	-84.5	34.2	-50.3	-13.0	-37.3	Average	Vertical
1037.5	-54.1	9.0	-45.1	-13.0	-32.1	Average	Horizontal
1369.8	-55.1	11.2	-43.9	-13.0	-30.9	Average	Horizontal
1595.5	-54.7	9.0	-45.7	-40.0	-5.7	Average	Horizontal
1599.3	-52.2	8.9	-43.3	-40.0	-3.3	Average	Horizontal
1605.0	-57.4	8.8	-48.6	-40.0	-8.6	Average	Horizontal
3234.8	-55.3	11.8	-43.5	-13.0	-30.5	Average	Horizontal
16815.5	-81.8	36.4	-45.4	-13.0	-32.4	Average	Horizontal
1130.2	-55.1	9.0	-46.1	-13.0	-33.1	Average	Vertical
1285.9	-55.2	11.3	-43.9	-13.0	-30.9	Average	Vertical
1566.8	-54.1	8.2	-45.9	-40.0	-5.9	Average	Vertical
1589.4	-55.9	9.0	-46.9	-40.0	-6.9	Average	Vertical
1605.0	-57.7	9.0	-48.7	-40.0	-8.7	Average	Vertical
3234.8	-58.8	11.7	-47.1	-13.0	-34.1	Average	Vertical
4848.8	-75.4	16.3	-59.1	-13.0	-46.1	Average	Vertical
Note 1: Measure Level (dBm) = Reading Level (dBm) + Substitution Factor (dB)							
Note 2: Substitution Factor (dB) = Cable Loss (dB) + Space Attenuation (dB) + Antenna Factor (dB/m)							

Product	Global Satellite Communicator	Temperature	25℃
Test Engineer	Snake Ni	Relative Humidity	54%
Test Site	AC2	Test Date	2019/07/12
Test Mode	Transmit at channel 1621.020833MHz		

Frequency (MHz)	Reading Level (dBm)	Substitution Factor (dB)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
39.7	-87.1	28.0	-59.1	-13.0	-46.1	Average	Horizontal
179.9	-78.9	24.2	-54.7	-13.0	-41.7	Average	Horizontal
37.8	-71.4	23.9	-47.5	-13.0	-34.5	Average	Vertical
95.5	-84.3	34.2	-50.1	-13.0	-37.1	Average	Vertical
1037.2	-55.4	9.0	-46.4	-13.0	-33.4	Average	Horizontal
1359.4	-56.5	11.0	-45.5	-13.0	-32.5	Average	Horizontal
1595.8	-55.4	9.0	-46.4	-40.0	-6.4	Average	Horizontal
1604.3	-54.7	8.8	-45.9	-40.0	-5.9	Average	Horizontal
1605.0	-63.4	8.8	-54.6	-40.0	-14.6	Average	Horizontal
3242.5	-55.1	11.8	-43.3	-13.0	-30.3	Average	Horizontal
4802.7	-75.8	16.9	-58.9	-13.0	-45.9	Average	Horizontal
1117.4	-54.2	9.1	-45.1	-13.0	-32.1	Average	Vertical
1370.1	-55.8	11.6	-44.2	-13.0	-31.2	Average	Vertical
1595.9	-60.9	9.2	-51.7	-40.0	-11.7	Average	Vertical
1604.3	-61.0	9.0	-52.0	-40.0	-12.0	Average	Vertical
1605.0	-63.6	9.0	-54.6	-40.0	-14.6	Average	Vertical
3242.5	-61.7	11.9	-49.8	-13.0	-36.8	Average	Vertical
4864.2	-74.4	16.5	-57.9	-13.0	-44.9	Average	Vertical

Note 1: Measure Level (dBm) = Reading Level (dBm) + Substitution Factor (dB)

Note 2: Substitution Factor (dB) = Cable Loss (dB) + Space Attenuation (dB) + Antenna Factor (dB/m)

Product	Global Satellite Communicator	Temperature	25℃
Test Engineer	Snake Ni	Relative Humidity	54%
Test Site	AC2	Test Date	2019/07/12
Test Mode	Transmit at channel 1625.979167MHz		

Frequency (MHz)	Reading Level (dBm)	Substitution Factor (dB)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
39.2	-88.2	27.8	-60.4	-13.0	-47.4	Average	Horizontal
179.4	-79.8	24.1	-55.7	-13.0	-42.7	Average	Horizontal
37.8	-71.3	23.9	-47.4	-13.0	-34.4	Average	Vertical
95.5	-84.6	34.2	-50.4	-13.0	-37.4	Average	Vertical
1285.4	-55.3	10.9	-44.4	-13.0	-31.4	Average	Horizontal
1445.8	-54.9	10.3	-44.6	-13.0	-31.6	Average	Horizontal
1592.4	-58.7	8.9	-49.8	-40.0	-9.8	Average	Horizontal
1600.8	-55.2	8.9	-46.3	-40.0	-6.3	Average	Horizontal
1605.0	-62.9	8.8	-54.1	-40.0	-14.1	Average	Horizontal
3250.2	-58.4	11.9	-46.5	-13.0	-33.5	Average	Horizontal
16777.1	-81.6	35.7	-45.9	-13.0	-32.9	Average	Horizontal
1287.0	-55.9	11.4	-44.5	-13.0	-31.5	Average	Vertical
1375.1	-56.5	11.6	-44.9	-13.0	-31.9	Average	Vertical
1592.4	-60.5	9.1	-51.4	-40.0	-11.4	Average	Vertical
1600.8	-59.1	9.1	-50.0	-40.0	-10.0	Average	Vertical
1605.0	-63.8	9.0	-54.8	-40.0	-14.8	Average	Vertical
3250.2	-62.1	11.9	-50.2	-13.0	-37.2	Average	Vertical
4879.6	-72.0	16.9	-55.1	-13.0	-42.1	Average	Vertical

Note 1: Measure Level (dBm) = Reading Level (dBm) + Substitution Factor (dB)

Note 2: Substitution Factor (dB) = Cable Loss (dB) + Space Attenuation (dB) + Antenna Factor (dB/m)

5.7. Protection of Aeronautical Radio navigation-Satellite Service

5.7.1.Test Limit

FCC Part 25.216(c)(f)(g)(i)(j)

(c) The EIRP density of emissions from mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies between 1610MHz and 1660.5MHz shall not exceed -70dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1559-1605MHz. The EIRP of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed -80dBW, averaged over any 2 millisecond active transmission interval, in the 1559-1605MHz band.

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

(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 1610-1626.5MHz band shall suppress the power density of emissions in the 1605-1610MHz band-segment to an extent determined by linear interpolation from -70dBW/MHz at 1605MHz to -10dBW/MHz at 1610MHz averaged over any 2 millisecond active transmission interval. The EIRP of discrete emissions of less than 700Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from -80dBW at 1605MHz to -20dBW at 1610MHz, averaged over any 2 millisecond active transmission interval.

(i) The EIRP 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 3GHz shall not exceed -80dBW/MHz in the 1559-1610MHz band averaged over any two millisecond interval.

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

RSS-170 Section 5.4.3.2.1, 5.4.4

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

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

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

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

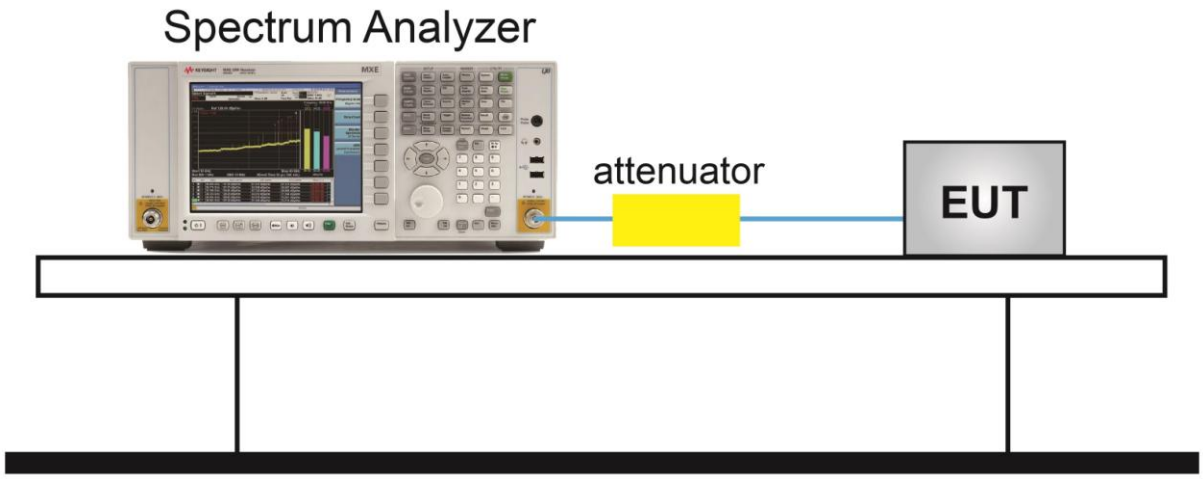
5.7.2.Test Procedure Used

ANSI C63.26-2015 - Section 5.7

5.7.3.Test Setting

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = RMS
5. Sweep time = Auto couple
6. Trace mode = Max hold
7. Trace was allowed to stabilize

5.7.4.Test Setup

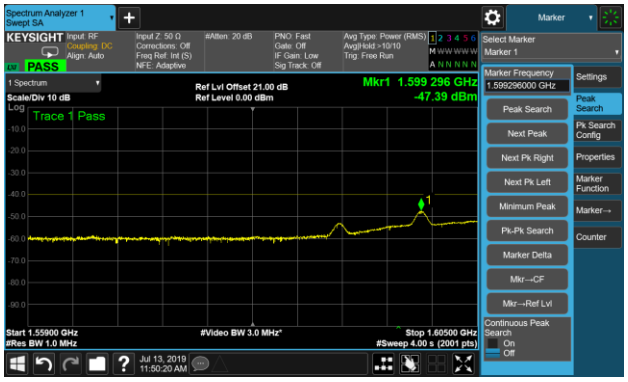
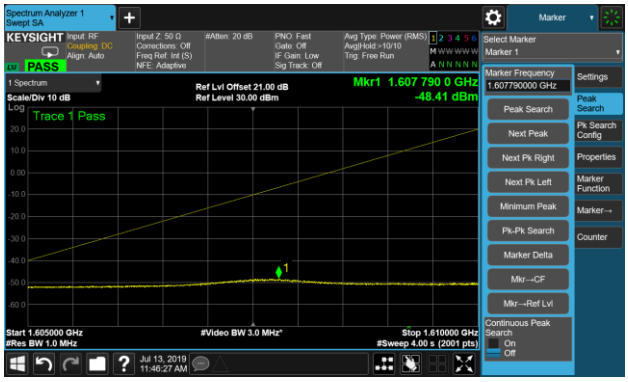
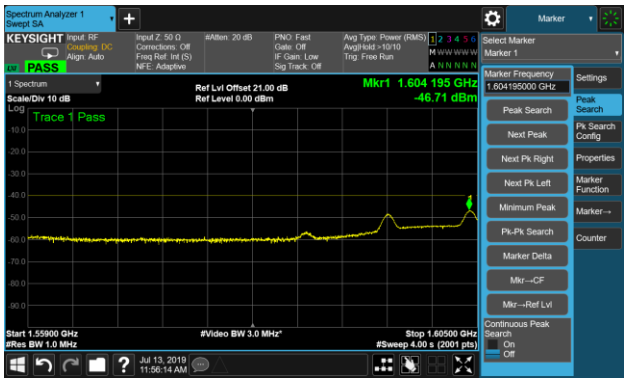
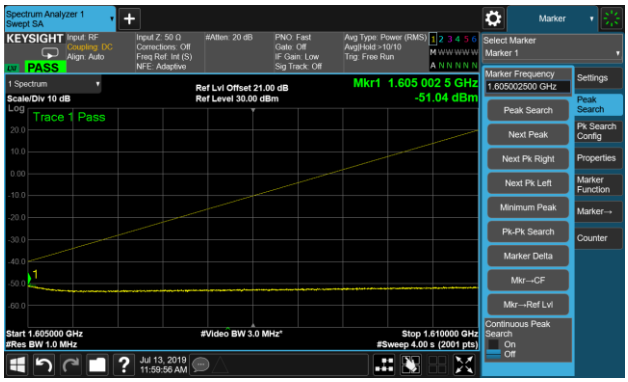


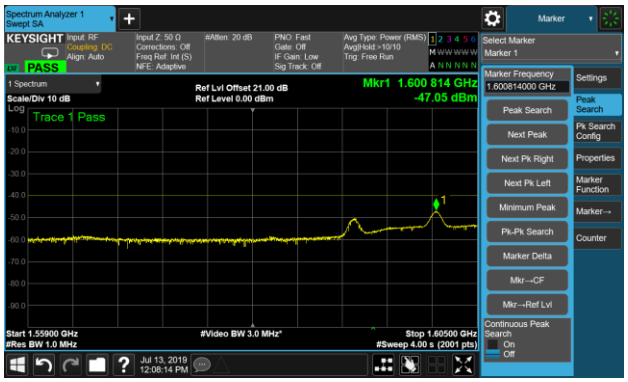
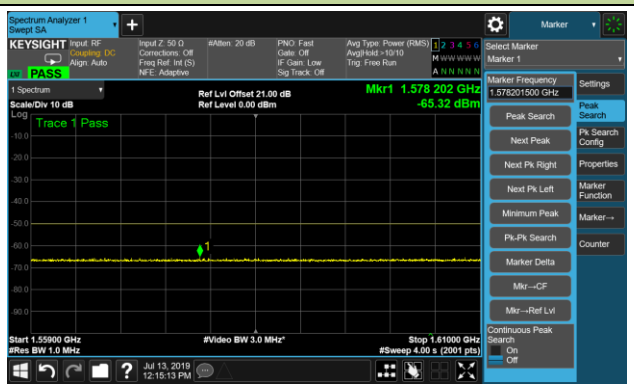
5.7.5.Test Result

Product	Global Satellite Communicator	Temperature	25℃
Test Engineer	Bruce Wang	Relative Humidity	52%
Test Site	TR3	Test Date	2019/07/13

Test Frequency (MHz)	Frequency Range (MHz)	Measure Level (dBm)	EIRP Level (dBm)	Result
1616.020833	1559 ~ 1605	-47.39	-42.29	Pass
	1605 ~ 1610	-48.41	-43.31	Pass
1621.020833	1559 ~ 1605	-46.71	-41.61	Pass
	1605 ~ 1610	-51.04	-45.94	Pass
1625.979167	1559 ~ 1605	-47.05	-41.95	Pass
	1605 ~ 1610	-47.76	-42.66	Pass
Carrier-off	1559 ~ 1610	-65.32	-60.22	Pass

Note: EIRP Level = Measure Worst Level + Antenna Gain, Antenna Gain = 5.1dBi.

Protection of Aeronautical Radio navigation-Satellite Service - 1616.020833MHz	
1559 ~ 1605MHz	1605 ~ 1610MHz
	
Protection of Aeronautical Radio navigation-Satellite Service - 1621.020833MHz	
1559 ~ 1605MHz	1605 ~ 1610MHz
	

Protection of Aeronautical Radio navigation-Satellite Service - 1625.979167MHz	
1559 ~ 1605MHz	1605 ~ 1610MHz
	
Protection of Aeronautical Radio navigation-Satellite Service - Carrier-off	
Carrier-off	
	

6. CONCLUSION

The data collected relate only the item(s) tested and show that the device is in compliance with Part 25 of the FCC rules and ISED rules.

The End

Appendix A - Test Setup Photograph

Refer to “1907RSU001-UT” file.

Appendix B - EUT Photograph

Refer to “1907RSU001-UE” file.