



Certification Test Report

**FCC ID: L2V-SPOTX
IC: 3989A-SPOTX**

**FCC Rule Part: 25 Subpart C
ISED Canada Radio Standards Specification: RSS-170 Issue 3**

Report Number: AT72142584-1P2

**Manufacturer: Globalstar USA LLC
Model: SpotX Satellite GPS Messenger**

**Test Begin Date: October 3, 2018
Test End Date: October 17, 2018**

Report Issue Date: January 17, 2019



FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

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This report contains 19 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 25 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-170 Certification for a Class II Permissive Change. The latest revision of the SpotX device included an added shield as well as filtering on the transmit path.

1.2 Product Description

The Equipment Under Test (EUT) was a Globalstar USA LLC Model SpotX Satellite GPS Messenger. The SpotX provides two-way communication utilizing the 1610-1626.5MHz satellite service band.

Technical Information:

Detail	Description
Frequency Range	1610 – 1626.5 MHz Satellite Service
Emission Designator	G1W
Operating Voltage	3.1 VDC- 4.2VDC Lithium-Polymer 3400mAh Battery (External DC power used for testing)
Antenna Type / Gain	Integral; -0.34dBi Max
Dimensions	158.75mm x 76.2mm x 23.5mm (6.25" x 3" x 0.925")

Manufacturer Information:

Globalstar USA LLC
300 Holiday Square Blvd
Covington, LA 70433

Test Sample Serial Number: Antenna Port Cond and Radiated Emissions: 2904598
AC Conducted Emissions: 1000030

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was X-position. The EUT was programmed to generate a continuously modulated signal on each channel evaluated. The antenna port was replaced with an SMA pigtail which was terminated into a 50-Ohm load.

For RF Conducted measurements, the EUT was fitted with a short SMA pigtail and connected to the test equipment. The EUT was programmed to generate a continuously modulated signal on each channel evaluated. For the purposes of this Class II Permissive Change only RF output power and radiated spurious emissions were performed.

For AC power line conducted emissions the EUT was evaluated with a commercially available USB power supply.

Software power setting during test: Not configurable

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following addresses:

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

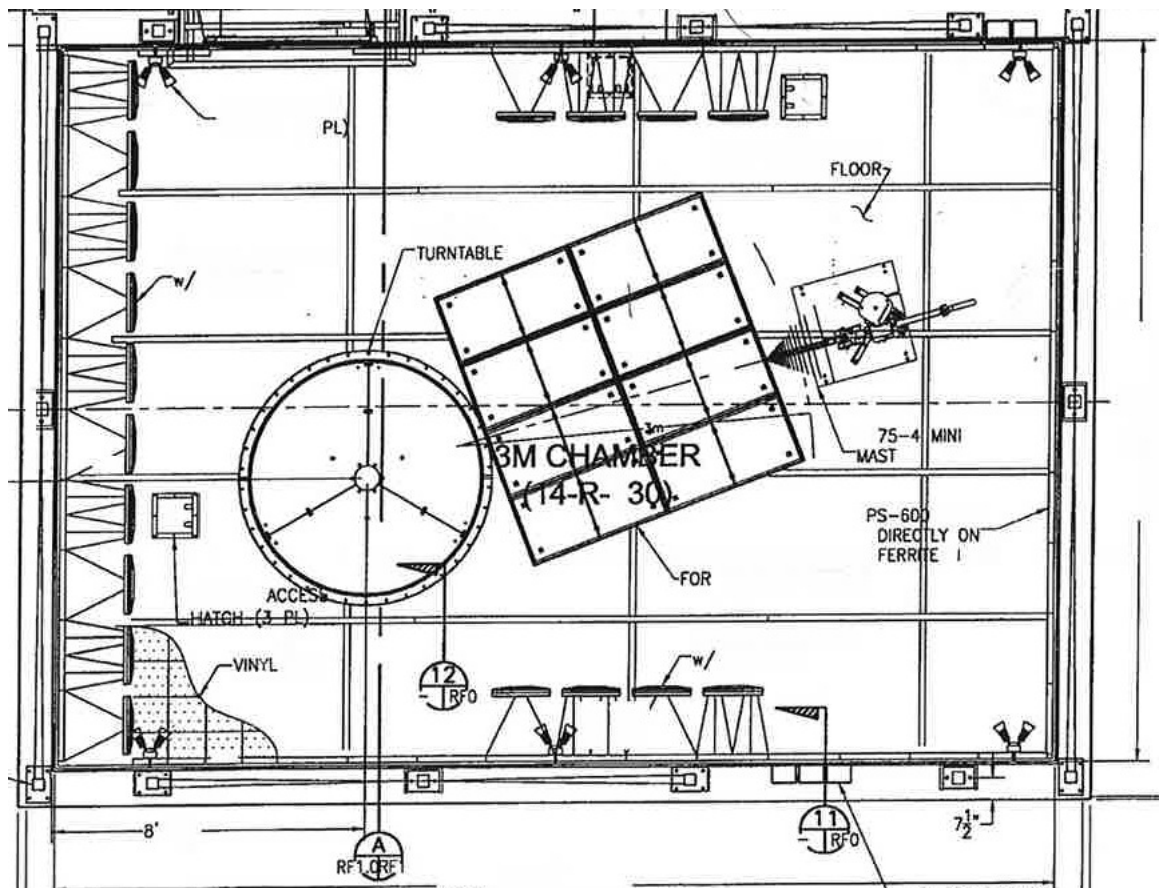
2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.



2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane(HCP) as well as a 12'x8' vertical coupling plane(VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

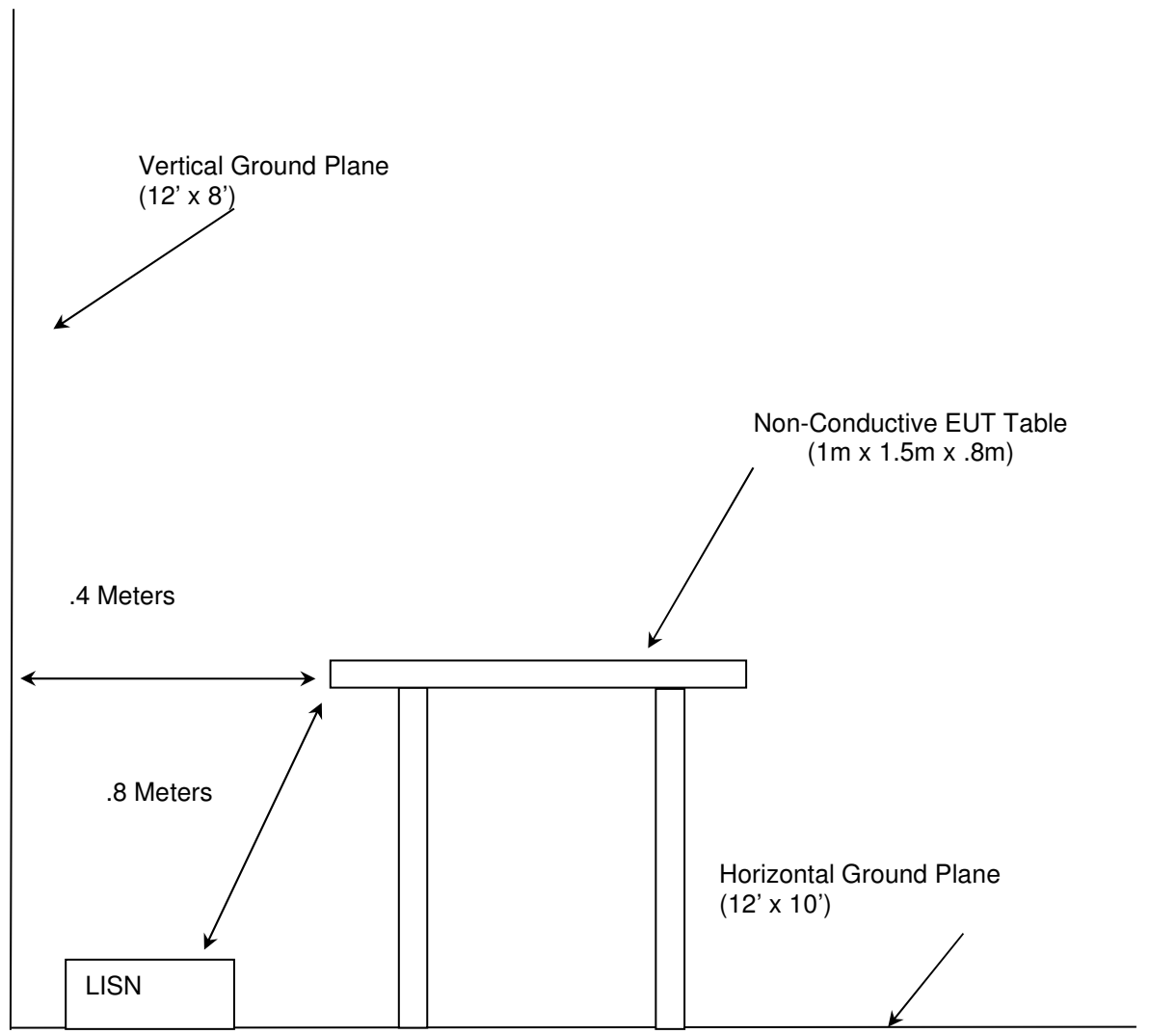


Figure 2.4.1-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.26-2015: American National Standard of Procedures for Compliance Testing of Transmitters Used in Licensed Radio Services.
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2018
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 25, Subpart C: Satellite Communications
- ❖ ISED Canada Radio Standards Specification: RSS-170 – Mobile Earth Stations (MESs) and Ancillary Terrestrial Component (ATC) Equipment Operating in the Mobile-Satellite Service (MSS) Bands, Issue 3, July 2015.
- ❖ ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, March 2015.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/09/2017	05/09/2019
213	TEC	PA 102	Amplifier	44927	7/19/2018	7/19/2019
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/11/2017	07/11/2019
412	Electro Metrics	LPA-25	Log Periodic Antenna	1241	08/22/2018	08/22/2020
432	Microwave Circuits	H3G020G4	Highpass Filter	264066	05/16/2018	05/16/2019
731	EMCO	3104	Bicon Antenna	2659	11/09/2016	11/09/2018
831	Rohde & Schwarz	FSP38	Spectrum Analyzer 9kHz-40GHz	100380	04/26/2018	04/26/2019
851	TUV ATLANTA	FMC0101951-100CM	ASAC Cable Set Consisting of 566, 619, and 643	N/A	09/26/2018	09/26/2019

5 SUPPORT EQUIPMENT

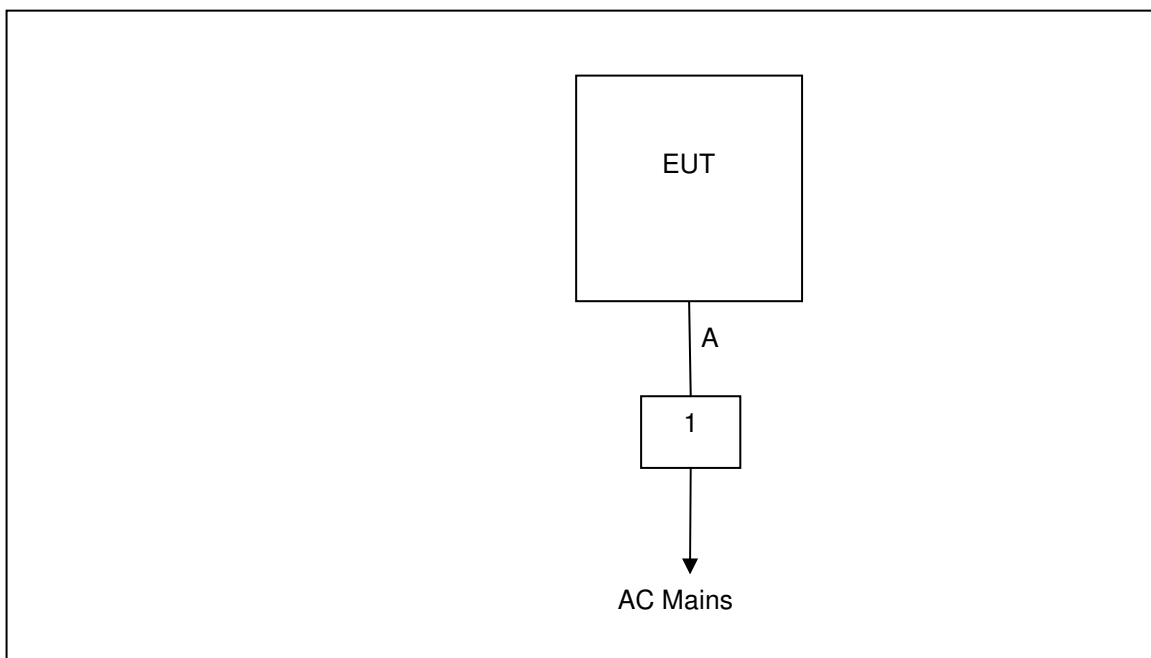
Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	DC Power Supply	Hewlett Packard	E3630A	KR64308603

Table 5-2: Cable Description

Cable	Cable Type	Length	Shield	Termination
A	DC Power Cable	1.6 m	No	EUT to Power Supply

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

**Figure 6-1: Test Setup Block Diagram**

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Power Line Conducted Emissions – FCC 15.207, ISED Canada: RSS-Gen 8.8

7.1.1 Measurement Procedure

Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss

Margin = Applicable Limit - Corrected Reading

7.1.2 Measurement Results

Performed by: Eugene Sello

Power Line, L1							
Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.162	38.19	23.32	65.36	55.36	-27.17	-32.04	9.58
0.174	37.83	22.82	64.77	54.77	-26.94	-31.95	9.58
0.186	38.36	24.08	64.21	54.21	-25.85	-30.13	9.58
0.206	37.58	22.62	63.37	53.37	-25.79	-30.75	9.58
0.226	38.07	24.23	62.6	52.6	-24.53	-28.37	9.58
0.258	37.1	23.06	61.5	51.5	-24.4	-28.44	9.58
0.286	37.1	22.37	60.64	50.64	-23.54	-28.27	9.58
0.298	39.67	23.57	60.3	50.3	-20.63	-26.73	9.58
0.33	39.83	26.2	59.45	49.45	-19.62	-23.25	9.59
0.486	45.24	36.44	56.24	46.24	-11	-9.8	9.6

Power Line, N							
Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.15	43.18	28.78	66	56	-22.82	-27.22	9.59
0.166	38.17	27.16	65.16	55.16	-26.99	-28	9.58
0.186	39.87	27.8	64.21	54.21	-24.34	-26.41	9.58
0.198	38.85	27.85	63.69	53.69	-24.84	-25.84	9.58
0.218	38.15	25.53	62.89	52.89	-24.74	-27.36	9.58
0.23	39.11	25.48	62.45	52.45	-23.34	-26.97	9.58
0.406	38.84	31.4	57.73	47.73	-18.89	-16.33	9.59
0.514	32.09	21.13	56	46	-23.91	-24.87	9.59
0.638	35.17	27.91	56	46	-20.83	-18.09	9.6
3.386	31.2	29.88	56	46	-24.8	-16.12	9.63

7.2 Fundamental Emission Output Power – FCC: Part 25 Subpart C §25.204(a); ISED Canada: RSS-170 Section 5.3

7.2.1 Measurement Procedure

The antenna port conducted power was measured with the output of the equipment under test directly connected to the input of the spectrum analyzer applying suitable attenuation.

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 $\Theta \leq 0^\circ$

+40 + 3 Θ 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.

Note: Since a 4kHz resolution bandwidth was not available, a 5kHz RBW was applied.

7.2.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.2.2-1: Maximum Conducted Output Power (AVG)

Frequency [MHz]	Level [dBm]
1611.25	22.92
1616.25	22.59
1618.75	22.78

Note: The original power results reported remain applicable, and the differences in power are attributable to Measurement Uncertainty between test sites and differences in manufacturing.

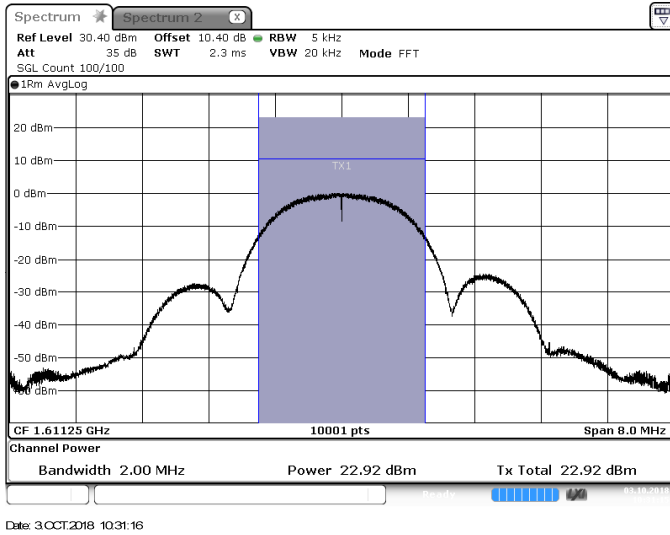


Figure 7.2.2-1: Conducted Output Power – Low Channel

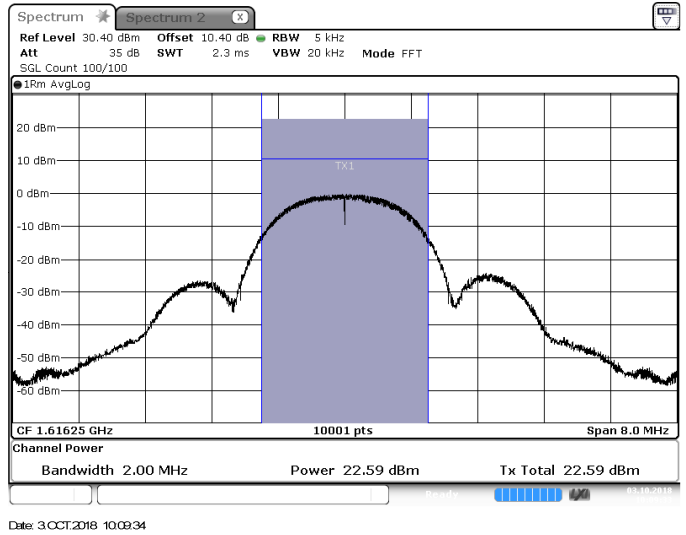


Figure 7.2.2-2: Conducted Output Power – Middle Channel

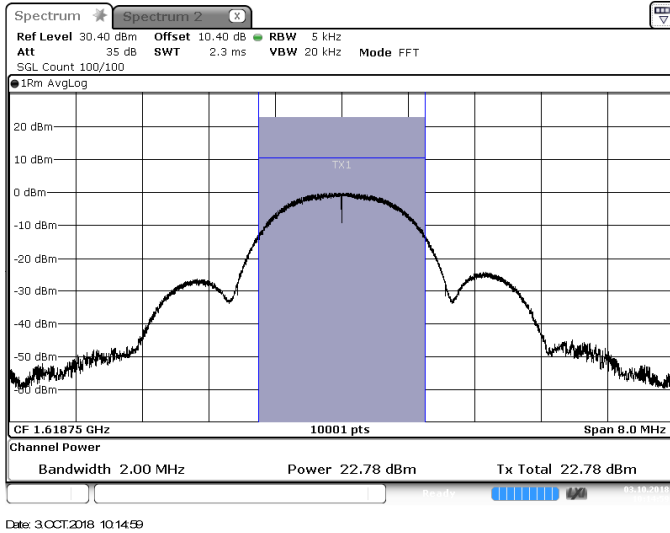


Figure 7.2.2-3: Conducted Output Power – High Channel

7.3 Emission Levels

7.3.1 Spurious Emissions at Antenna Terminals – FCC: Section 25.202(f); ISED Canada: RSS-170 issue 3, Section 5.4.3

7.3.1.1 Measurement Procedure

The antenna port emissions were measured with the output of the equipment under test directly connected to the input of the spectrum analyzer applying suitable attenuation.

Compliance was determined using the following guidance from the specifications:

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.

Note: Since a 4kHz resolution bandwidth was not available, a 5kHz RBW was applied.

7.3.1.2 Measurement Results

Performed by: Jeremy Pickens

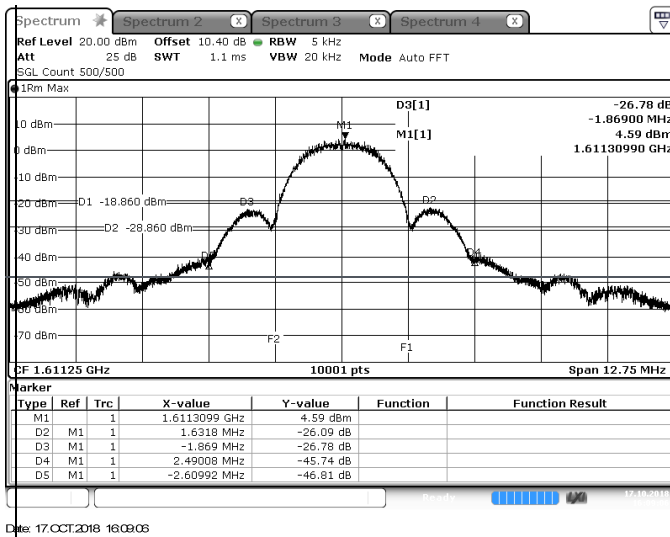


Figure 7.3.1.2-1: Fundamental – Low Channel

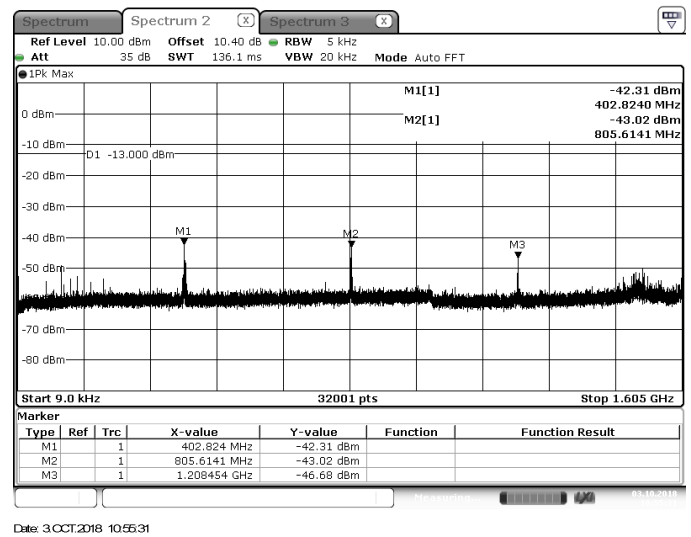


Figure 7.3.1.2-2: 9 kHz – 1.605 GHz – Low Channel

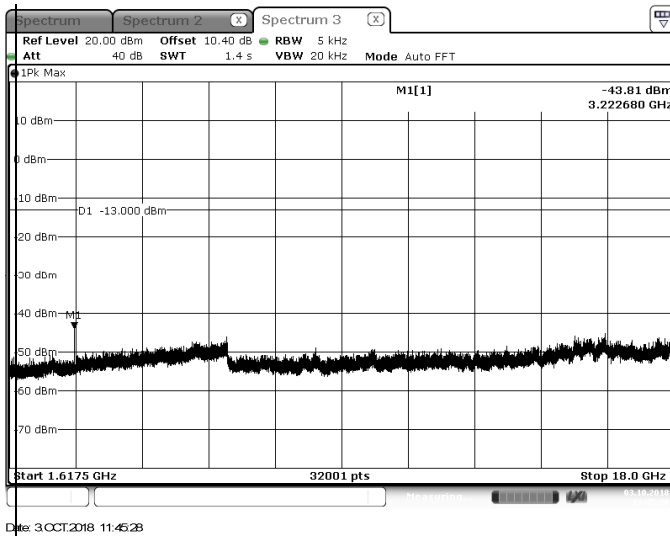


Figure 7.3.1.2-3: 1.6175 GHz – 18 GHz –Low Channel

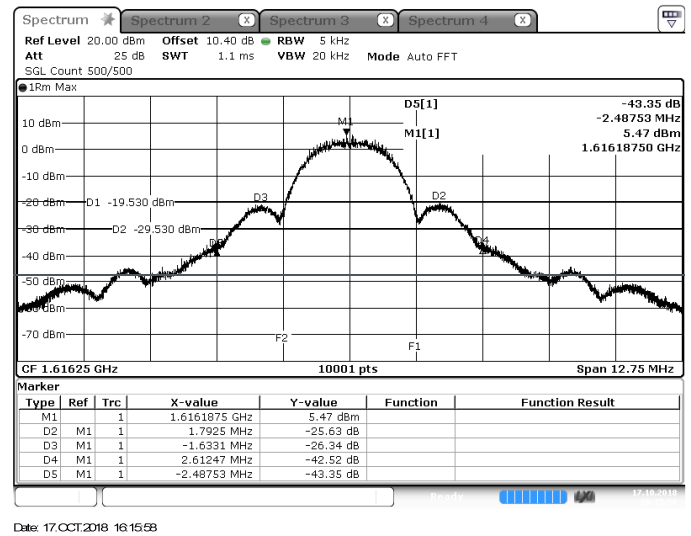


Figure 7.3.1.2-4: Fundamental – Middle Channel

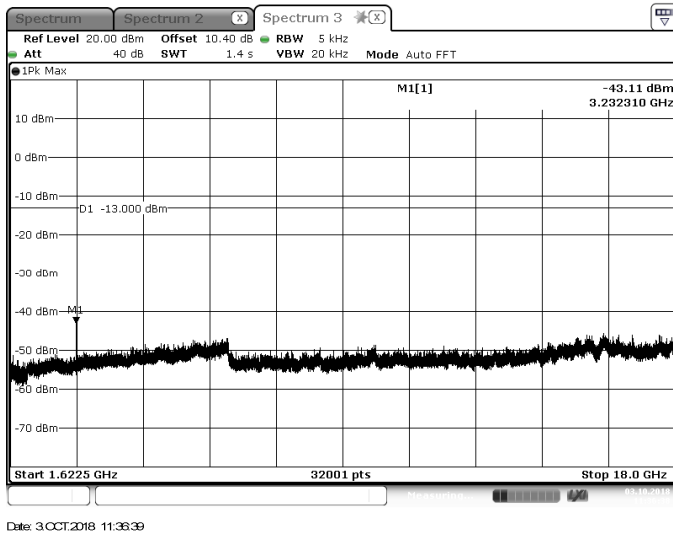


Figure 7.3.1.2-5: 1.6225 GHz – 18 GHz –Middle Channel

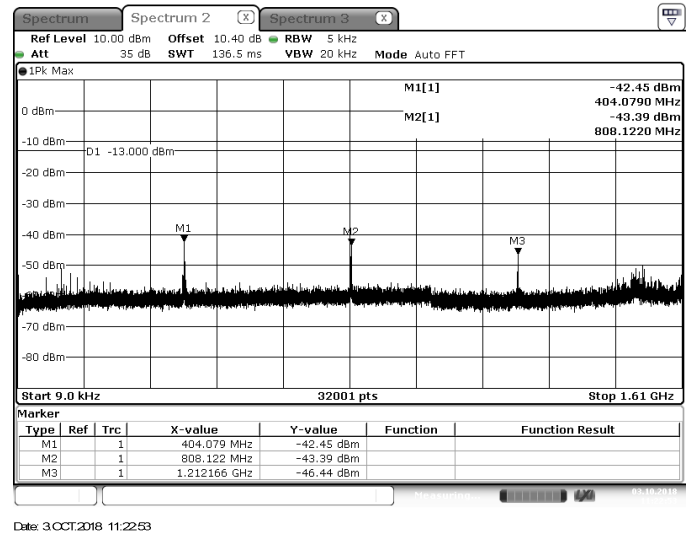


Figure 7.3.1.2-6: 9 kHz – 1.61 GHz – Middle Channel

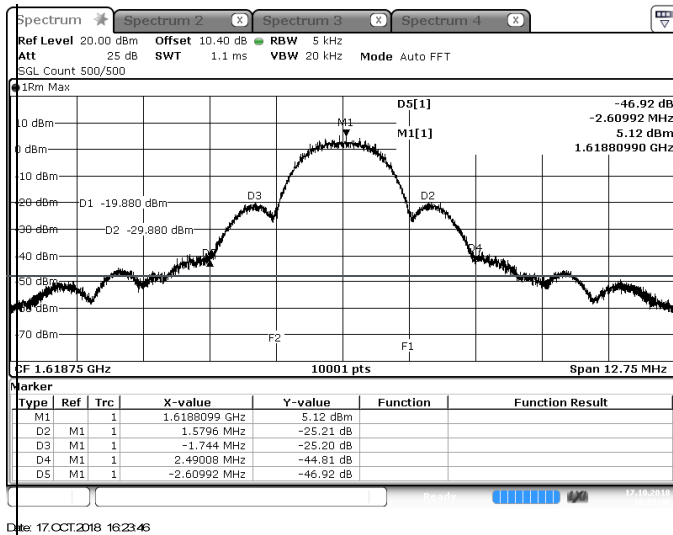


Figure 7.3.1.2-7: Fundamental – High Channel

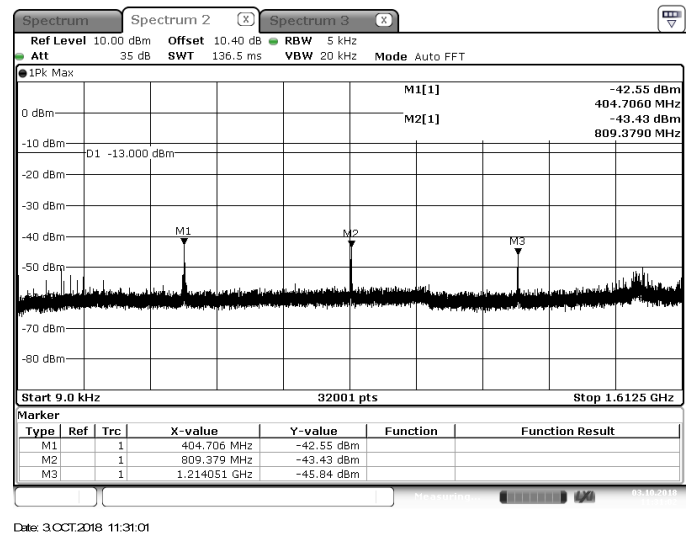


Figure 7.3.1.2-8: 9 kHz – 1.6125 GHz – High Channel

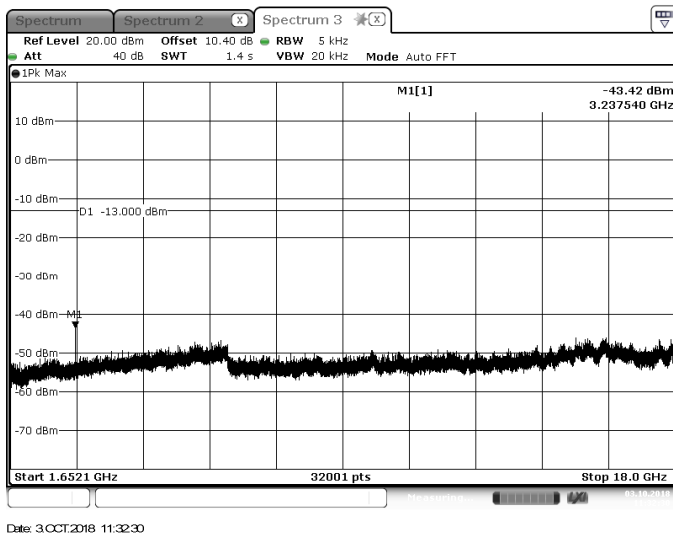


Figure 7.3.1.2-9: 1.6521 GHz – 18 GHz –High Channel

7.3.2 Field Strength of Radiated Spurious Emissions – Section 25.202(f) as required by Part 2 Section 2.1053; ISSED Canada: RSS-170, Section 5.4.3

7.3.2.1 Measurement Procedure

The unwanted emissions were measured radiated over the frequency range of 30 MHz to 18 GHz, more than 10 times the highest fundamental frequency using the methods defined in ANSI C63.26.

The EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, peak measurements were made using a resolution bandwidth (RBW) of 100 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Compliance was determined using the following guidance from the specifications:

FCC CFR Part 25, Section 25.202(f):

(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;

RSS-170 issue 3, Section 5.4.3:

(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.

Note: Although a 4kHz resolution bandwidth is stated in the specification, the higher bandwidth settings mentioned above were applied to facilitate testing.

7.3.2.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.3.2.2-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
	pk			pk	pk	pk
Low Channel						
3222.5	53.01	H	-0.32	52.69	82.2	29.5
3222.5	50.73	V	-0.32	50.41	82.2	31.8
4665	53.17	H	3.94	57.11	82.2	25.1
4665	55.18	V	3.94	59.12	82.2	23.1
8056.25	51.79	H	10.48	62.27	82.2	19.9
8056.25	49.26	V	10.48	59.74	82.2	22.5
Middle Channel						
3232.5	54.19	H	1.84	56.03	82.2	26.2
3232.5	52.73	V	1.84	54.57	82.2	27.6
4665	52.12	H	4.93	57.05	82.2	25.2
4665	55.87	V	4.93	60.80	82.2	21.4
8081.25	51.60	H	10.48	62.08	82.2	20.1
High Channel						
3237.5	54.10	H	1.84	55.94	82.2	26.3
3237.5	52.88	V	1.84	54.72	82.2	27.5
4665	52.45	H	4.93	57.38	82.2	24.8
4665	55.48	V	4.93	60.41	82.2	21.8
8093.75	51.2	H	10.46	61.66	82.2	20.5

7.3.2.3 Sample Calculation:

$$R_C = R_U + CF_T$$

Where:

CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)

R_U = Uncorrected Reading

R_C = Corrected Level

AF = Antenna Factor

CA = Cable Attenuation

AG = Amplifier Gain

DC = Duty Cycle Correction Factor

Example Calculation: Peak

Corrected Level: $51.79 + 10.48 = 62.27\text{dBuV/m}$

Margin: $82.2\text{dBuV/m} - 62.27\text{dBuV/m} = 19.9\text{dB}$

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) $k = 1.96$ which provide confidence levels of 95%.

Table 8-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	$\pm 0.009 \%$
RF Conducted Output Power	$\pm 0.349 \text{ dB}$
Power Spectral Density	$\pm 0.372 \text{ dB}$
Antenna Port Conducted Emissions	$\pm 1.264 \text{ dB}$
Radiated Emissions $\leq 1 \text{ GHz}$	$\pm 5.814 \text{ dB}$
Radiated Emissions $> 1 \text{ GHz}$	$\pm 4.318 \text{ dB}$
Temperature	$\pm 0.860 \text{ }^{\circ}\text{C}$
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	$\pm 3.360 \text{ dB}$

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the SpotX, manufactured by Globalstar USA LLC meets the requirements of FCC Part 25 subpart C and ISED Canada's Radio Standards Specification RSS-170 for the tests documented herein.

END REPORT