

Choose certainty. Add value.

# Report On

FCC and Industry Canada Testing of the Iridium Core 9523N In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN

COMMERCIAL-IN-CONFIDENCE

FCC ID: Q639523N IC: 4629A-9523N

Document 75932207 Report 07 Issue 2

November 2015



**Product Service** 

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North, Fareham, Hampshire, United Kingdom, PO15 5RL Tel: +44 (0) 1489 558100. Website: <u>www.tuv-sud.co.uk</u>

COMMERCIAL-IN-CONFIDENCE

**REPORT ON** 

FCC and Industry Canada Testing of the Iridium Core 9523N In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN

Document 75932207 Report 07 Issue 2

November 2015

PREPARED FOR

Iridium Satellite LLC 1750 Tysons Boulevard Suite 1400 McLean VA 22102 United States

PREPARED BY

Natalie Bennett Senior Administrator, Project Support

APPROVED BY

Ahenner

Simon Bennett Authorised Signatory

DATED

13 November 2015

This report has been up-issued to Issue 2 to correct the manufacturer and model names.

#### ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

M Russell



Document 75932207 Report 07 Issue 2

Page 1 of 55



## CONTENTS

#### Section

# Page No

1	REPORT SUMMARY	3
1.1 1.2 1.3 1.4 1.5 1.6 1.7	Introduction Brief Summary of Results Application Form Product Information Test Conditions Deviations from the Standard Modification Record	4 5 8 8 8
2	TEST DETAILS	9
2.1 2.2 2.3 2.4 2.5 2.6 2.7	Modulation Characteristics Occupied Bandwidth Frequency Tolerance Spurious Emissions at Antenna Terminals Radiated Spurious Emissions Conducted Output Power Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigatio Satellite Service	10 11 15 17 25 35 n- 37
3	TEST EQUIPMENT USED	49
3.1 3.2	Test Equipment Used Measurement Uncertainty	50 53
4	ACCREDITATION, DISCLAIMERS AND COPYRIGHT	54
4.1	Accreditation, Disclaimers and Copyright	. 55



# **SECTION 1**

# **REPORT SUMMARY**

FCC and Industry Canada Testing of the Iridium Core 9523N In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN



#### 1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC and Industry Canada Testing of the Iridium Core 9523N to the requirements of FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN.

Objective	To perform FCC and Industry Canada Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Iridium Satellite LLC
Model Number(s)	9523N
Serial Number(s)	30 24
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 25 (2014) FCC 47 CFR Part 2 (2014) Industry Canada RSS-170 (Issue 3, 2015) Industry Canada RSS-GEN (Issue 4, 2014)
Incoming Release Date	Application Form 13 October 2015
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	31734 5 October 2015
Start of Test	16 October 2015
Finish of Test	28 October 2015
Name of Engineer(s)	M Russell
Related Document(s)	ANSI C63.4 (2009)



#### 1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN is shown below.

Section		Specificat	on Clause		Test Description	Deput	Commonte/Paso Standard
Section	Pt 25	Pt 2	RSS-170	RSS-GEN	Test Description	Result	Comments/Base Standard
Transmit							
2.1	-	2.1047(d)	-	-	Modulation Characteristics	-	
2.2	-	2.1049	-	6.6	Occupied Bandwidth	Pass	
2.3	25.202(d)	2.1055	5.2	-	Frequency Tolerance	Pass	
2.4	25.202(f)	2.1051	5.4.3.1	6.13	Spurious Emissions at Antenna Terminals	Pass	
2.5	25.202(f)	2.1053	5.4.3.1	6.13	Radiated Spurious Emissions	Pass	
2.6	25.204	-	5.3	-	Conducted Output Power	Pass	
2.7	25.216	-	5.4.3	-	Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service	Pass	



#### 1.3 APPLICATION FORM

EQUIPMENT DESCRIPTION					
Model Name/Number Iridium Core 9523N					
Part Number 9523N					
Hardware Version	Rev B/V1 a	at modifcation state: P1638-CN-024 V0.8			
Software Version	DB15006				
FCC ID (if applicable)		Q639523N			
Industry Canada ID (if applicable)		4629A-9523N			
Technical Description (Please provid description of the intended use of the equ	le a brief iipment)	Voice and data satellite transceiver module.			

		PO	WER SO	OURCE			
	AC mains		State	voltage	•		
AC su	oply frequency (Hz)						
	VAC						
	Max Current						
	Hz						
	Single phase			Three	phase		
And / (	Dr						
	External DC supply						
	Nominal voltage		VBAT VBOO 27V V	: 3.7V ST: /	Max Current	VBAT: 0.5A VBOO ST: 2.0A	A
	Extreme upper voltage		VBAT VBOO 35V \	: 6.0V /ST: /			
	Extreme lower voltage		VBAT VBOO 16V \	: 3.2V ST: /			
Batter	y						
	Nickel Cadmium			Lead	acid (Vehicle reg	ulated)	
	Alkaline			Lecla	nche		
	Lithium			Other	Details :		
	Volts nominal.						
End p	oint voltage as quoted by equipment	nt manufacturer			V		

FREQUENCY INFORMATION							
Frequency Range	1616.0 to16	26.5 M	Hz				
Channel Spacing (where applicable)	41.667kHz						
Receiver Frequency Range (if different)	to	Μ	Hz				
Channel Spacing (if different)							
Test Frequencies*	Bottom	1616.02 0833	MHz	Channel Number (if applicable)	1		
	Middle	1621.02 0833	MHz	Channel Number (if applicable)	121		
c.	Тор	1625.97 9167	MHz	Channel Number (if applicable)	240		
Intermediate Frequencies 0.2, 0.4, 0.6, 0.8, 16.8 MHz							
Highest Internally Generated Frequence	y:	32	52 MHz				

#### COMMERCIAL-IN-CONFIDENCE



			POWER	CHARACT	ERISTICS					
Maxi	mum TX power	6.60	7 W							
Minir	num TX power	1.04	7 W (if	variable)						
ls tra	nsmitter intended for :									
Cont	nuous duty							Yes	$\boxtimes$	No
Inter	nittent duty						$\boxtimes$	Yes		No
If inte	ermittent state DUTY CYCLE	E								
Tran	smitter ON	8.28	m seconds							
Tran	smitter OFF,	81.72	2m seconds							
			ANTENN		TERISTICS	to a constant				
	Antonno connector		ANTENN	ACHARAC	State impedance	50	Ohm			
		otor			State impedance	50	Ohm			
	Integral antenna conne	Tupo			State impedance		dBi			
	External antenna	Туре	Passivo		State impedance	3.0	dBi			
		туре	Passive		State impedance	5.0	UBI			
,			MODULATI	ON CHAR	ACTERISTICS	ngan kata dan genta kata da kat				
	Amplitude				Frequency					
	Phase			$\boxtimes$	Other (please pr	ovide deta	ails): DE-Q	PSK/DE	-BPSK	
Can	the transmitter operate un-m	nodulated?					$\boxtimes$	Yes	; □	] No
CLASS OF EMISSION USED										
			CLASS	OF EMISS	ON USED					
			CLASS	OF EMISS	ON USED s of Emission:					
			CLASS ITU designat	OF EMISS	ON USED as of Emission: (7Q7W					
			CLASS ITU designat (if applicab	OF EMISSI tion or Class 1 41P ble) 2	ON USED s of Emission: (7Q7W					
			CLASS ITU designat (if applicab	OF EMISS ion or Clas 1 41k ble) 2 ble) 3	ON USED is of Emission: (7Q7W					
lfmc	re than three classes of emi	ission, list se	CLASS ITU designat (if applicab (if applicab parately:	OF EMISSI ion or Class 1 41k ole) 2 ole) 3	ON USED is of Emission: K7Q7W					
lfmc	re than three classes of emi	ission, list sej	CLASS ITU designat (if applicab (if applicab parately: BATTE	OF EMISS ion or Clas 1 41k ole) 2 ole) 3	ON USED s of Emission: (7Q7W					
lf mc	re than three classes of emi	ission, list sej	CLASS ITU designat (if applicab (if applicab parately: BATTEI	OF EMISS ion or Clas 1 41H ole) 2 ole) 3 RY POWEF	ON USED ss of Emission: (7Q7W R SUPPLY	ier				
lf mc Mod	re than three classes of emi el name/number	ission, list sej	CLASS ITU designat (if applicab (if applicab parately: BATTEI	OF EMISS ion or Class 1 41k ble) 2 ble) 3 RY POWER Ide	ON USED is of Emission: (7Q7W R SUPPLY ntification/Part numb	ier				
If mo Mod Man	ore than three classes of emi el name/number ufacturer	ission, list sej	CLASS ITU designat (if applicab (if applicab parately: BATTEI	OF EMISSI ion or Clas 1 41P de) 2 de) 3 RY POWER Ide Co	ON USED is of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin	ier				
lf mo Mod Man	re than three classes of emi el name/number ufacturer	ission, list sej	CLASS ITU designat (if applicab (if applicab parately: BATTEI	OF EMISSI ion or Clas 1 41P de) 2 de) 3 RY POWEF Ide Co	ON USED is of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin	ier				
lf mo Mod Man	el name/number el name/number	ission, list sej	CLASS ITU designat (if applicab (if applicab parately: BATTEI ANCILL	OF EMISSI ion or Clas 1 41P de) 2 de) 3 RY POWER Ide Co ARIES (If a Ide	ON USED is of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin pplicable) ntification/Part numb	er				
If mo Mod Man Mod Man	el name/number el name/number ufacturer el name/number ufacturer	ission, list sej	CLASS ITU designat (if applicab (if applicab parately: BATTEI ANCILL	OF EMISSI ion or Clas 1 41P le) 2 le) 3 RY POWER Ide Co ARIES (If a Ide Co	ON USED is of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin pplicable) ntification/Part numb untry of Origin	er ver				
lf mo Mod Man Mod Man	el name/number ufacturer el name/number ufacturer	ission, list se	CLASS ITU designat (if applicab (if applicab parately: BATTEI ANCILL	OF EMISSI ion or Clas 1 411 de) 2 de) 3 RY POWEF Ide Co ARIES (If a Ide Co	ON USED s of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin pplicable) ntification/Part numb untry of Origin	er er				
lf mod Mod Man Mod	re than three classes of emi el name/number ufacturer el name/number ufacturer	ission, list se	CLASS ITU designat (if applicab (if applicab parately: BATTEI ANCILL EXTR	OF EMISS ion or Clas 1 41H de) 2 de) 3 RY POWER Ide Co ARIES (If a Ide Co	ON USED is of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin pplicable) ntification/Part numb untry of Origin DITIONS	ver				
If mo Mod Man Mod Man	el name/number ufacturer el name/number ufacturer el name/number ufacturer	VBAT:	CLASS ITU designat (if applicab (if applicab parately: BATTEL ANCILL EXTR	OF EMISSI ion or Clas 1 411 ile) 2 ile) 3 RY POWEF Ide Co ARIES (If a Ide Co EME CONI	ON USED ss of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin pplicable) ntification/Part numb untry of Origin DITIONS treme test voltages (	eer eer Mix)				
If mo Mod Man Man Extra	el name/number ufacturer el name/number ufacturer el name/number ufacturer eme test voltages (Max)	VBAT: 6.0V VBOOS	CLASS ITU designat (if applicab oarately: BATTEL ANCILL EXTR	OF EMISS ion or Clas 1 411 de) 2 de) 3 RY POWEF Ide Co ARIES (If a Ide Co EME CONI	ON USED s of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin ntificable) ntificable) ntification/Part numb untry of Origin DITIONS treme test voltages (	eer eer Mix)				
If mod Mod Man Extre	el name/number ufacturer el name/number ufacturer el name/number ufacturer eme test voltages (Max)	VBAT: 6.0V VBOOS T: 35V	CLASS ITU designat (if applicab (if applicab Darately: BATTEL ANCILL EXTR	OF EMISS ion or Clas 1 411 ile) 2 ile) 3 RY POWEF Ide Co ARIES (If a Ide Co	ON USED s of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin ntificable) ntification/Part numb untry of Origin DITIONS Irreme test voltages (	ver ver Mix)				
If mo Mod Man Extra Norr	re than three classes of emi el name/number ufacturer el name/number ufacturer eme test voltages (Max) inal DC Voltage	VBAT: 6.0V VBOOS T: 35V VBAT: 2 7V	CLASS ITU designat (if applicab (if applicab barately: BATTEI ANCILL EXTR	OF EMISS ion or Clas 1 41H de) 2 de) 3 RY POWER Ide Co ARIES (If a Ide Co EME CONI EX	ON USED s of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin pplicable) ntification/Part numb untry of Origin DITIONS treme test voltages ( Maximum Current	ver Mix)		3AT:	   V	
If mo Mod Man Extra Norr	re than three classes of emi el name/number ufacturer el name/number ufacturer eme test voltages (Max) inal DC Voltage	VBAT: 6.0V VBOOS T: 35V VBAT: 3.7V VBOOS	CLASS ITU designat (if applicab (if applicab parately: BATTEI ANCILL EXTR	OF EMISSI ion or Clas 1 41P ile) 2 ile) 3 RY POWER Ide Co ARIES (If a Ide Co EXECONI	ON USED as of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin pplicable) ntification/Part numb untry of Origin DITIONS treme test voltages ( Maximum Current	ver Mix)	VI 	BAT: 53 300S	  V	
If mo Mod Man Man Extro	ere than three classes of emi el name/number ufacturer el name/number ufacturer eme test voltages (Max) inal DC Voltage	VBAT: 6.0V VBOOS T: 35V VBAT: 3.7V VBOOS T: 27V	CLASS ITU designat (if applicab oarately: BATTEI ANCILL EXTR	OF EMISS ion or Clas 1 41P ile) 2 ile) 3 RY POWEF Ide Co ARIES (If a Ide Co EME CONI	ON USED is of Emission: (7Q7W R SUPPLY ntification/Part numb untry of Origin intification/Part numb untry of Origin DITIONS Ireme test voltages ( Maximum Current	ver ver Mix)	VI 0. VI T:	3AT: 5A 300S 2.0A	  V	

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplie correct and complete.

Name:Jonathan JonesPosition held:Senior Engineer

Date:

: 13/10/2015



#### 1.4 **PRODUCT INFORMATION**

#### 1.4.1 Technical Description

The Equipment Under Test (EUT) was a Iridium Core 9523N. A full technical description can be found in the manufacturer's documentation.

#### 1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure.

The EUT was powered from a Vbat = 3.7 V DC, Vboost = 27.0 V DC supply.

FCC Measurement Facility Registration Number 90987 Octagon House, Fareham Test Laboratory

Industry Canada Company Address Code IC2932B-1 Octagon House, Fareham Test Laboratory

#### 1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standard were made during testing.

#### 1.7 MODIFICATION RECORD

Modification 0 - No modifications were made to the test sample during testing.



**SECTION 2** 

# **TEST DETAILS**

FCC and Industry Canada Testing of the Iridium Core 9523N In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN



#### 2.1 MODULATION CHARACTERISTICS

#### 2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1047(d)

#### 2.1.2 Equipment Under Test

9523N

#### 2.1.3 Test Results

#### Transmit, Modulation Characteristics, Customer Description

Traffic, broadcast, and ring alert channels use differentially encoded quaternary phase shift keyed (DE-QPSK) modulation with 40% square root raised cosine pulse shaping. The burst transmission rate is 25ksps or 50 kbps. The phase of the QPSK symbol states relative to the carrier phase is (Symbol State/Phase in deg): 00/0, 01/-90, 10/+90, 11/180. The acquisition channel uses differentially encoded binary phase shift keyed (DE-BPSK) with 40% square root raised cosine pulse shaping. The burst rate on these channels is 25 kbps. The sync channel uses 25 kbps DE-BPSK on the uplink and 50 kbps DE-QPSK on the downlink. Both with 40% square root raised cosine pulse shaping.

#### FCC 47 CFR Part 2, Limit Clause 2.1047 (d)

A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

#### Industry Canada RSS-GEN, Limit Clause Annex A (i)(2)

The type of modulation, with a brief description giving any useful information to aid prospective users in understanding the device, such as (but not limited to) the bit rate and symbol rate.



#### 2.2 OCCUPIED BANDWIDTH

#### 2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049 Industry Canada RSS-GEN, Clause 6.6

#### 2.2.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

#### 2.2.3 Date of Test

28 October 2015

#### 2.2.4 Test Equipment Used

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

#### 2.2.5 Test Procedure

The EUT was connected to a spectrum analyser via a cable and attenuator. The EUT was configured to transmit on bottom, middle and top channels at maximum power. The settings of the analyser were configured with an RBW of 1.1 kHz and VBW of 3.3 kHz using a Peak detector and max hold. The Occupied bandwidth measurement function of the analyser was then utilized to make the measurement and the 99% occupied bandwidth was recorded.

#### 2.2.6 Environmental Conditions

Ambient Temperature	24.6°C
Relative Humidity	40.8%



#### 2.2.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, Occupied Bandwidth Results

1616.020833 MHz	1621.020833 MHz	1625.979167 MHz
kHz	kHz	kHz
31.508	31.181	31.584



Transmit, 1616.020833 MHz, Occupied Bandwidth Plot



📕 Keysight Spec	trum Analyzer - Occu	pied BW							
Contor Er	RF 50 Ω		Cer	SENSE:EXT SOUR	CE OFF	ALIGN AUTO	05:08:52 Pt	MOct 28, 2015	Peak Search
Center Pr	eq 1.621020	IOSS GHZ	Trie	g: Free Run	Avg Hold	:>10/10	Rudio ota.	None	
		#IFGain:	Low #At	ten: 28 dB			Radio Dev	ice: BTS	
						Mkr1	1.62102	52 GHz	
10 dB/div	Ref 50.00	dBm	·				36.4	93 dBm	
40.0				<sup>1</sup>					
30.0			m	man man	m				
20.0		C	٢		$\sim$				
10.0		الم م			Nr.				
0.00	Anna	Am mark				mm. w	man		
10.00							· · · ·	mar	
20.0								- 10V	
-20.0									
-30.0									
-40.0									
Center 1.6	621 GHz						Spar	100 kHz	
#Res BW	1.1 kHz			#VBW 3.3 ki	lz		Swee	ep 79 ms	
0				Total P	owor	49.4	dBm		
Occup	lea Banav	viath		TOLATE	Ower	40.1	ubili		
		31.18	1 kHz						
Transm	nit Freq Erro	r	-95 Hz	% of O	3W Pow	er 99	.00 %		
v dB Ba	andwidth	3(	0 40 kHz	v dB		-26	00 dB		
			7.40 KHZ	A GD		-20.			
MSG						STATUS	5		

#### Transmit, 1621.020833 MHz, Occupied Bandwidth Plot

Transmit, 1625.979167 MHz, Occupied Bandwidth Plot





#### FCC 47 CFR Part 2, Limit Clause 2.1049

None specified.

Industry Canada RSS-GEN, Limit Clause

None specified.



#### 2.3 FREQUENCY TOLERANCE

#### 2.3.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.202(d) FCC 47 CFR Part 2, Clause 2.1055 Industry Canada RSS-170, Clause 5.2

#### 2.3.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

#### 2.3.3 Date of Test

20 October 2015 & 21 October 2015

#### 2.3.4 Test Equipment Used

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

#### 2.3.5 Test Procedure

The EUT was connected to a spectrum analyser via a cable and attenuator. The spectrum analyser's frequency reference was locked to an external 10 MHz frequency reference from a Rubidium standard. The EUT was set to transmit at maximum power with an unmodulated carrier. The unmodulated frequency was set +6.25 kHz offset from the middle channel.

For measurements of frequency variation with respect to temperature, the procedure as described in FCC 47 CFR Part 2, clause 2.1055 (b) was followed.

Variations in voltage were performed at the extreme voltage conditions as specified the manufacturer as these voltages exceeded the conditions specified in FCC 47 CFR Part 2, clause 2.1055(d).

#### 2.3.6 Environmental Conditions

Ambient Temperature	24.1 - 24.2°C
Relative Humidity	38.6 - 44.6%



#### 2.3.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, 1621.020833 MHz, Frequency Stability Under Temperature Variations Results

	Frequency Error				
remperature interval	%	ppm			
-30 °C	-0.000066	-0.66			
-20 °C	-0.000102	-1.02			
-10 °C	-0.000143	-1.43			
0°C	-0.000164	-1.64			
+10 °C	-0.000140	-1.40			
+20 °C	-0.000153	-1.53			
+30 °C	-0.000142	-1.42			
+40 °C	-0.000149	-1.49			
+50 °C	-0.000163	-1.63			

Transmit, 1621.020833 MHz, Frequency Stability Under Voltage Variations Results

DC Voltage	Frequency Error			
DC Voltage	%	ppm		
Vbat = 3.7 V DC, Vboost = 27.0 V DC	-0.000145	-1.45		
Vbat = 3.2 V DC, Vboost = 16 V DC	-0.000150	-1.50		
Vbat = 6.0 V DC, Vboost = 35.0 V DC	0.000047	0.47		

#### FCC 47 CFR Part 2, Limit Clause 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.

#### Industry Canada RSS-170, Limit Clause 5.2

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



#### 2.4 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

#### 2.4.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.202(f) FCC 47 CFR Part 2, Clause 2.1051 Industry Canada RSS-170, Clause 5.4.3.1 Industry Canada RSS-GEN, Clause 6.13

#### 2.4.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

#### 2.4.3 Date of Test

16 October 2015 and 28 October 2015

#### 2.4.4 Test Equipment Used

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

#### 2.4.5 Test Procedure

For emissions removed less than 250 % of the authorised bandwidth:

The EUT was connected to a spectrum analyser via a cable and attenuator. The EUT was transmitting at maximum power, for bottom, middle and top channels. The EUT was modulated as stated in the manufactures application form. The path loss between the EUT and analyser was calibrated using a network analyser and entered in to the spectrum analyser as a reference level offset. The analyser was configured with an RBW and VBW of 1 kHz and 3 kHz respectively with the trace set to average using an RMS detector. 10Log(4) = 6 dB was added to the reference level offset to make the result relative to any 4 kHz band as per the requirement in 25.202(f). The mask as specified in clause 25.202(f) was then applied using a necessary bandwidth of 41.667 kHz as declared by the manufacturer.

For emissions removed more than 250 % of the authorised bandwidth:

Conducted: A network analyser was used to measure the path loss and the worst case was entered as a reference level offset in to the spectrum analyser. The EUT was configured to maximum power on bottom, middle or top channel with modulation. The spectrum analyser was configured with an RBW and VBW of 1 MHz and 3 MHz respectively as this is worst case as opposed to 4 kHz RBW. The trace was set to average using an RMS detector with the gate settings configured so that average measurements were only performed over the active part of the burst.

#### 2.4.6 Environmental Conditions

Ambient Temperature23.8°CRelative Humidity42.1%



#### 2.4.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, 1616.020833 MHz, Mask, Spurious Emissions at Antenna Terminals Plot



Transmit, 1616.020833 MHz, 9 kHz to 3 GHz, Spurious Emissions at Antenna Terminals Plot





#### Transmit, 1616.020833 MHz, 3 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot

Keysight Spectrum Analyzer - Sw	ept SA				- F
arker 1 3.2340000	00000 GHz	SENSE:EXT SO	Avg Type: RMS	09:57:57 AM Oct 19, 2015 TRACE 1 2 3 4 5 6	Save
Gate: LO	PNO: Fast ← IFGain:Low	#Atten: 10 dB	Avg Hold: 100/100	DETANNNNN	
Ref Offset 38 dB/div Ref 20.00 d	.48 dB dBm		I	Mkr1 3.234 GHz -35.317 dBm	Sta
9					Tra
.0					(+ Sta
10					
.0				-13.00 dBm	
o					D
					(Exp Trac
° • 1					
	·				Scre
					Ima
0					
art 3.000 GHz				Stop 12.000 GHz	
es BW 1.0 MHz	#VB	№ 3.0 MHz*	Sweep 9	0.00 ms (1001 pts)	
			STATU	5	

Transmit, 1616.020833 MHz, 12 GHz to 17 GHz, Spurious Emissions at Antenna Terminals Plot







#### Transmit, 1621.020833 MHz, Mask, Spurious Emissions at Antenna Terminals Plot







09:54:07 AM Oct 19, 2015 TRACE 1 2 3 4 5 6 TYPE A DET A NNNNN Avg Type: RMS Avg|Hold: 100/100 Peak Search Marker 1 3.243000000000 GHz Gate: LO PNO: Fast ----IFGain:Low HAtten: 10 dB Next Peak Mkr1 3.243 GHz -31.914 dBm Ref Offset 38.48 dB Ref 20.00 dBm 0 Next Pk Right Next Pk Left Marker Delta 1 Mkr→CF Mkr→RefLvl More 1 of 2 Stop 12.000 GHz Sweep 90.00 ms (1001 pts) Start 3.000 GHz #Res BW 1.0 MHz #VBW 3.0 MHz\*

Transmit, 1621.020833 MHz, 3 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot

Transmit, 1621.020833 MHz, 12 GHz to 17 GHz, Spurious Emissions at Antenna Terminals Plot







#### Transmit, 1625.979167 MHz, Mask, Spurious Emissions at Antenna Terminals Plot







Transmit, 1625.979167 MHz, 3 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot

📕 Keysight Spe	ctrum Analyzer - Swept SA						
Marker 1	RF 50 Ω DC 3.2520000000000	GHz	SENSE:EXT SOU	AVg Type: RM	10:01:50 A S TRA	M Oct 19, 2015 CE 1 2 3 4 5 6	Peak Search
	Gate: LO	PNO: Fast	Trig: External1 #Atten: 10 dB	Avg Hold: 100	/100 TY D		NextPeak
10 dB/div	Ref Offset 38.48 dB Ref 20.00 dBm				Mkr1 3.2 -33.8	252 GHz 67 dBm	Nextreak
10.0							Next Pk Right
0.00							
10.0							Next Pk Left
-10.0						-13.00 dBm	
-20.0							Marker Delta
-30.0							
-40.0		~~~~~					Mkr→CF
-50.0							
-60.0							Mkr→RefLvi
-70.0							More
Start 3.000 #Res BW	0 GHz 1.0 MHz	#VBW	3.0 MHz*	Swe	Stop 12 ep 90.00 ms	2.000 GHz (1001 pts)	1 of 2
MSG					STATUS		

Transmit, 1625.979167 MHz, 12 GHz to 17 GHz, Spurious Emissions at Antenna Terminals Plot





#### FCC 47 CFR Part 2, Limit Clause 25.202(f)

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

- 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 authorised bandwidth;
- 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 authorised bandwidth;
- 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 authorised bandwidth.

Industry Canada RSS-170, Limit Clause 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:

- 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
- 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
- 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.



#### 2.5 RADIATED SPURIOUS EMISSIONS

#### 2.5.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.202(f) FCC 47 CFR Part 2, Clause 2.1053 Industry Canada RSS-170, Clause 5.4.3.1 Industry Canada RSS-GEN, Clause 6.13

#### 2.5.2 Equipment Under Test and Modification State

9523N S/N: 24 - Modification State 0

#### 2.5.3 Date of Test

21 October 2015 & 25 October 2015

#### 2.5.4 Test Equipment Used

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

#### 2.5.5 Test Procedure

For radiated testing, a preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semianechoic chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both horizontal and vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation. The plots shown in this report shows the characterisation of the EUT. A 100 kHz RBW was used for measurements as this is worst case compared to 4 kHz.

Using the information from the preliminary profiling of the EUT, the list of emissions was then confirmed or updated under Alternative Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

The EUT was set to transmit on maximum power with both channels operating simultaneously.

For any emissions found the EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result was determined by a calculation using the signal generator level, antenna gain and cable loss.

The measurements were performed at a 3 m distance unless otherwise stated.

#### 2.5.6 Environmental Conditions

Ambient Temperature	20.3 - 20.8°C
Relative Humidity	34.0 - 51.0%



#### 2.5.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, 1616.020833 MHz, 30 MHz to 18 GHz, Radiated Spurious Emissions Results

Frequency (MHz)	Final Peak (dBm)
*	

\* No emissions were detected within 10 dB of the limit.

Transmit, 1616.020833 MHz, 30 MHz to 1 GHz, Radiated Spurious Emissions Plot



Date: 21.0CT.2015 18:56:48



#### \*RBW 100 kHz \*VBW 300 kHz SWT 200 ms Marker 1 [T1 ] -47.70 dBm 1.616020752 GHz Ref -30 dBm \*Att 5 dB -30 A 40 1 PK MAXH MEIRE -50-70 80 DB mount And 1985 -100 -110 -120 -130 Start 1 GHz 200 MHz/ Stop 3 GHz

#### Transmit, 1616.020833 MHz, 1 GHz to 3 GHz, Radiated Spurious Emissions Plot

Date: 21.0CT.2015 19:13:03



#### Transmit, 1616.020833 MHz, 3 GHz to 8 GHz, Radiated Spurious Emissions Plot

Date: 21.0CT.2015 21:50:27

#### COMMERCIAL-IN-CONFIDENCE





#### Transmit, 1616.020833 MHz, 8 GHz to 18 GHz, Radiated Spurious Emissions Plot

#### COMMERCIAL-IN-CONFIDENCE



#### Transmit, 1621.020833 MHz, 30 MHz to 18 GHz, Radiated Spurious Emissions Results

Frequency (MHz)	Final Peak (dBm)
*	

\* No emissions were detected within 10 dB of the limit.

Transmit, 1621.020833 MHz, 30 MHz to 1 GHz, Radiated Spurious Emissions Plot



Date: 21.0CT.2015 19:23:04



#### \*RBW 100 kHz \*VBW 300 kHz SWT 200 ms Marker 1 [T1 ] -43.19 dBm 1.621794872 GHz Ref -30 dBm \*Att 5 dB -30 A 40 1 PK MAXH MEIRE -50-70 80 J. Margaret deman ment DE -100 -110 -120 -130 Start 1 GHz 200 MHz/ Stop 3 GHz

#### Transmit, 1621.020833 MHz, 1 GHz to 3 GHz, Radiated Spurious Emissions Plot

Date: 21.0CT.2015 19:21:24



#### Transmit, 1621.020833 MHz, 3 GHz to 8 GHz, Radiated Spurious Emissions Plot

Date: 21.0CT.2015 20:56:19

#### COMMERCIAL-IN-CONFIDENCE





#### Transmit, 1621.020833 MHz, 8 GHz to 18 GHz, Radiated Spurious Emissions Plot



#### Transmit, 1625.979167 MHz, 1 GHz to 18 GHz, Radiated Spurious Emissions Results

Frequency (MHz)	Final Peak (dBm)
4877.936	-20.18

\* No other emissions were detected within 10 dB of the limit.

Transmit, 1625.979167 MHz, 30 MHz to 1 GHz, Radiated Spurious Emissions Plot



Date: 21.0CT.2015 19:27:07

#### Transmit, 1625.979167 MHz, 1 GHz to 3 GHz, Radiated Spurious Emissions Plot



Date: 21.0CT.2015 19:28:47



# Transmit, 1625.979167 MHz MHz, 3 GHz to 8 GHz, Radiated Spurious Emissions Plot



Date: 21.0CT.2015 20:01:29



#### Transmit, 1625.979167 MHz, 8 GHz to 18 GHz, Radiated Spurious Emissions Plot



#### FCC 47 CFR Part 2, Limit Clause 25.202(f)

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

- 4) 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 authorised bandwidth;
- 5) 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 authorised bandwidth;
- 6) 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 authorised bandwidth.

Industry Canada RSS-170, Limit Clause 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:

- 4) 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
- 5) 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
- 6) 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.



#### 2.6 CONDUCTED OUTPUT POWER

#### 2.6.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.204 Industry Canada RSS-170, Clause 5.3

#### 2.6.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

#### 2.6.3 Date of Test

16 October 2015

#### 2.6.4 Test Equipment Used

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

#### 2.6.5 Test Procedure

The EUT was connected to a spectrum analyser via a cable and 30dB attenuator. The path loss was measured using a network analyser and entered as a reference level offset into the instrumentation. The spectrum analyser was configured with an RBW of 3.9 kHz and VBW of 12 kHz. 10Log(4/3.9) = 0.11 dB was added to the reference level offset to make the result relative to any 4 kHz band as per the requirement in 25.204(a). The transmit power was measured over the active part of the burst using an RMS detector, the spectrum analyser trace was set to average and the maximum result recorded. Results include 3 dBi antenna gain.

#### 2.6.6 Environmental Conditions

Ambient Temperature	25.0°C
Relative Humidity	37.1%



#### 2.6.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmitter Output Power: 6.607 W

Transmit, EIRP, Conducted, Power Limits Results

1616.020833 MHz	1621.020833 MHz	1625.979167 MHz
dBW	dBW	dBW
4.213	4.150	4.777

#### FCC 47 CFR Part 25, Limit Clause 25.204

+40 dBW in any 4 kHz band for  $\theta \le 0^{\circ}$ +40 + 30 dBW in any 4 kHz band for  $0^{\circ} < \theta \le 5^{\circ}$ For angles of elevation of the horizon greater than 5° there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.

#### Industry Canada RSS-170, Limit Clause 5.3

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 necessary e.i.r.p. plus a 2 dB 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.



#### 2.7 LIMITS ON EMISSIONS FROM MOBILE EARTH STATIONS FOR PROTECTION OF AERONAUTICAL RADIONAVIGATION-SATELLITE SERVICE

#### 2.7.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.216 Industry Canada RSS-170, Clause 5.4.3

#### 2.7.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

#### 2.7.3 Date of Test

19 October 2015, 21 October 2015 & 28 October 2015

#### 2.7.4 Test Equipment Used

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

#### 2.7.5 Test Procedure

The EUT was set to transmit at maximum power using modulation as described in the manufacturers application form. The EUT was connected to a spectrum analyser via a cable and attenuator. The path loss was measured using a vector network analyser and entered as a reference level offset in the EUT. The gated trigger of the analyser was used so that average measurements were taken over at least a 2 ms period of the active burst. The spectrum analyser was adjusted to show the frequency range of interest on screen with an RBW & VBW of 1 MHz and 3 MHz respectfully with an RMS detector and average trace.

All emissions were investigated further to determine the bandwidth of the emission by reducing the RBW of the analyser to allow an approximation of the emission bandwidth of the spur. It was confirmed that all discrete emissions have a power density less than -80 dBW. Any emissions shown exceeding -80 dBW on the following plots were confirmed as broadband emissions (i.e. BW > 700Hz).

#### 2.7.6 Environmental Conditions

Ambient Temperature	23.6 - 24.5°C
Relative Humidity	40.6 – 43.7%



#### 2.7.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

<u>Transmit, EIRP Density – Broadband Emissions, Limits on Emissions from Mobile Earth</u> <u>Stations for Protection of Aeronautical Radionavigation-Satellite Service Results</u>

1616.020833 MHz	1621.020833 MHz	1625.979167 MHz
dBW/MHz	dBW/MHz	dBW/MHz
*	*	*

\* No emissions within 6 dB of the limit were observed.

<u>Transmit, 1616.020833 MHz, EIRP Density – Broadband Emissions, 1559 MHz to 1605 MHz,</u> <u>Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-</u> <u>Satellite Service Plot</u>

🔰 Key	sight Spectrum Analyzer - Swept SA					
<mark>ux</mark> Mari	RF 50 Ω DC	) GHz	SENSE:EXT SOUR	Avg Type: RMS	12:12:44 PM Oct 19, 2015 TRACE 1 2 3 4 5 6	Peak Search
	Gate: LO	PNO: Fast +++ IFGain:Low	Trig: External1 #Atten: 8 dB	Avg Hold: 100/100	TYPE A WWWWW DET A NNNNN	NextBook
10 dE	Ref Offset 32.94 dB 3/div Ref 0.00 dBm			Mkr1	1.599 112 GHz -43.755 dBm	NextPeak
-10.0						Next Pk Right
-20.0						Next Pk Left
-40.0					-40.00 dBm	Marker Delta
-50.0		al the age of the case of the		and a second	and have a second	Mkr.,CE
-70.0						
-80.0						Mkr→RefLvl
Star	t 1.55900 GHz				Stop 1.60500 GHz	More 1 of 2
#Res	SBW 1.0 MHz	#VBW 3	.0 MHz*	Sweep 1	.000 ms (1001 pts)	
MSG				STATUS	5	



Transmit, 1616.020833 MHz, EIRP Density – Broadband Emissions, 1605 MHz to 1610 MHz, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot

鱦 Kej	ysight Spec	trum Analyzer - Sw	vept SA									
Ref	Level	RF   50 Ω 20.00 dBr	n DC		SEN	ISE:EXT  SOUR	CE OFF Avg Type	ALIGN AUTO : RMS	08:45:18 A	MOct 21, 2015	Ar	nplitude
PAS	S	Gate: LO		PNO: Wide	Trig: Free Atten: 6	Run dB	Avg Hold	: 100/100	TYI Di			<b>Ref Level</b>
10 dE	3/div	Ref Offset 32 Ref 20.00 (	2.94 dB dBm					Mkr	1 1.609 9 -44.3	05 GHz 65 dBm		20.00 dBm
40.0	Trace	1 Pass									At	tenuation
10.0												[6 dB]
0.00												Scale/Div
-10.0												10 dB
-20.0											:	Scale Type
-30.0											<u>Log</u>	Lin
-40.0											Dre	asel Center
-50.0					~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		-			~~~~~		. Ser o'eriter
60.0		an for the general day of general to									Pr	esel Adjust
-80.0												0 Hz
-70.0												More
Star	t 1.605	000 GHz							Stop 1.61	0000 GHz		1 of 2
#Re	s BW 1	.0 MHz		#VBW	3.0 MHz			Sweep	2.533 ms (	1001 pts)		
MSG								STAT	rus			



<u>Transmit, 1621.020833 MHz, EIRP Density – Broadband Emissions, 1559 MHz to 1605 MHz,</u> <u>Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-</u> <u>Satellite Service Plot</u>



<u>Transmit, 1621.020833 MHz, EIRP Density – Broadband Emissions, 1605 MHz to 1610 MHz,</u> <u>Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-</u> <u>Satellite Service Plot</u>





<u>Transmit, 1625.979167 MHz, EIRP Density – Broadband Emissions, 1559 MHz to 1605 MHz,</u> <u>Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-</u> <u>Satellite Service Plot</u>



<u>Transmit, 1625.979167 MHz, EIRP Density – Broadband Emissions, 1605 MHz to 1610 MHz,</u> <u>Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-</u> <u>Satellite Service Plot</u>





<u>Transmit, EIRP Density – Discrete Emissions, Limits on Emissions from Mobile Earth Stations</u> for Protection of Aeronautical Radionavigation-Satellite Service Results

1616.020833 MHz	1621.020833 MHz	1625.979167 MHz		
dBW/MHz	dBW/MHz	dBW/MHz		
*	*	*		

\* No emissions within 6 dB of the limit were observed.

<u>Transmit, 1616.020833 MHz, EIRP Density – Discrete Emissions, Limits on Emissions from</u> <u>Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot</u>

📕 Keysight Sp	ectrum Analyzer - Swept SA				1			- 6 <b>-</b>
Marker 1	1.59920400000	) GHz	SENSE:EX	TI SOURCE OFF	Type: RMS	11:58:31 AM	E 1 2 3 4 5 6	Peak Search
	Gate: LO	PNO: Fast +++ IFGain:Low	#Atten: 2 dB	Avg	Hold: 100/100	DE		
10 dB/div	Ref Offset 32.94 dB Ref 0.00 dBm				Mkr	1 1.599 2 -50.9	04 GHz 67 dBm	Next Peak
-10.0								Next Pk Right
-20.0								Next Pk Left
-40.0						<b>●</b> <sup>1</sup>	-50.00 dBm	Marker Delta
-60.0							l.	Mkr→CF
-70.0	- tom was be seen than a	hten of here and here	an an fao an tao an	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				Mkr→RefLvl
-90.0	5900 GHz					Stop 1.60	500 GHz	More 1 of 2
#Res BW	30 kHz	#VBW	100 kHz*		Sweep	20.13 ms (	1001 pts)	
MSG					STAT	US		



03:41:27 PM Oct 28, 2015 Avg Type: RMS Avg|Hold: 1/1 Marker Marker 1 Δ 30.000000 kHz TYPE A WWW DET A NNN Trig: External1 #Atten: 2 dB PNO: Close IFGain:Low Select Marker ΔMki 1 30.0 kHz -1.831 dB Ref Offset 33.9 dB Ref 0.00 dBm Normal Delta **Fixed**D 1Δ2 Off  $X_2$ New Marke herry himpone water and the state of Wilter Properties • More 1 of 2 Center 1.5992280 GHz #Res BW 3.0 kHz Span 200.0 kHz #Sweep 5.000 s (1001 pts) VBW 9.1 kHz\*

Transmit, 1616.020833 MHz, EIRP Density – Identified Discrete Emission, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot



<u>Transmit, 1621.020833 MHz, EIRP Density – Discrete Emissions, Limits on Emissions from</u> <u>Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot</u>



<u>Transmit, 1621.020833 MHz, EIRP Density – Identified Discrete Emission 1, Limits on</u> <u>Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite</u> <u>Service Plot</u>





<u>Transmit, 1621.020833 MHz, EIRP Density – Identified Discrete Emission 2, Limits on</u> <u>Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite</u> <u>Service Plot</u>

📕 Keysight Spe	ectrum Analyzer - Swept SA								
Marker 1	RF 50 Ω DC	,	SEN	ISE:EXT  SOUR	CE OFF Avg Type	ALIGN AUTO	03:50:26 PM TRAC	Oct 28, 2015	Marker
	Gate: LO	PNO: Close +++ IFGain:Low	Trig: Exte #Atten: 2	ernal1 dB	Avg Hold	: 1/1	TYP		Select Marker
10 dB/div	Ref Offset 33.9 dB Ref 0.00 dBm					4	2 Mkr1 3 -0.	1.0 kHz 489 dB	1
-10.0									Normal
-20.0									_
-30.0									Delta
-40.0									Eivad
-50.0									Fixed
-60.0			wed the	12 12	<u>\</u> 2				Off
-70.0	enter-telletre-telletre-telletre-telletre-telletre-telletre-telletre-telletre-telletre-telletre-telletre-tellet	no manta man		h	Malman	u w u w u w u w u w u w u w u w u w u w	yu <del>Maanaa</del> aa	www.lowe	Properties►
-90.0									
									More 1 of 2
Center 1.: #Res BW	3.0 kHz	VBW 9	.1 kHz*			#Sweep	Span 2 5.000 s (	00.0 kHz 1001 pts)	
MSG						STATUS	-	/	



<u>Transmit, 1625.979167 MHz, EIRP Density – Discrete Emissions, Limits on Emissions from</u> <u>Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot</u>



<u>Transmit, 1625.979167 MHz, EIRP Density – Identified Discrete Emission 1, Limits on</u> <u>Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite</u> <u>Service Plot</u>





Transmit, EIRP Density – Carrier-off State Emissions, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service

1621.020833 MHz	
dBW/MHz	
-	

\* No emissions within 6 dB of the limit were observed.

<u>Transmit, 1621.020833 MHz, EIRP Density – Carrier-off State Emissions, Limits on Emissions</u> from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot

🚺 Key	ysight Spe	ctrum Analyzer	- Swept SA								- 6 -
Mari	ker 1	<sup>R</sup> 1.58641	<sup>60 Ω</sup> DC 6000000	GHz	SEN	ISE:EXT  SOUR	Avg Type	RMS	01:50:01 PI	MOct 19, 2015	Peak Search
				PNO: Fast G	#Atten: 6	dB	Avginoid.	.>100/100	DE	ANNNN	Next Deck
10 dE	3/div	Ref Offset Ref -20.0	13.8 dB 0 <b>0 dBm</b>					Mkr1	1.586 4	16 GHz 53 dBm	NextPeak
203											Next Pk Picht
-30.0											Next F K Right
-40.0											
-50.0										-50.00 dBm	Next Pk Left
~~~~											
-6U.U							4				Marker Delta
-70.0			manun.		e <sup>1</sup> 075744-657004		1 1				
-80.0											Mkr→CF
-90.0											
-100											Mkr→RefLvl
-110											
											More 1 of 2
Star #Res	t 1.55 s BW	900 GHz 1.0 MHz		#VBW	3.0 MHz			Sweep 1	Stop 1.60 .000 ms (	0500 GHz 1001 pts)	
MSG								STATU	5		



#### FCC 47 CFR Part 25, Limit Clause 25.216

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

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

25.216(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.

#### Industry Canada RSS-170, Limit Clause 5.4.3.2

#### Band 1610 to 1626.5 MHz

- -70 dBW/MHz at 1605 MHz, linearly interpolated to -10 dBW/MHz at 1610 MHz for broadband emissions.
- -80 dBW/MHz at 1605 MHz, linearly interpolated to -20 dBW/MHz at 1610 MHz for discrete emissions.

#### Band 1626.5 to 1660.5 MHz

- -70 dBW/MHz at 1605 MHz, linearly interpolated to -46 dBW/MHz at 1610 MHz for broadband emissions.
- -80 dBW/MHz at 1605 MHz, linearly interpolated to -56 dBW/MHz at 1610 MHz for discrete emissions.



**SECTION 3** 

# **TEST EQUIPMENT USED**



#### 3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period	Calibration Due
Or other C.C. Or or is I Day to				(months)	
Section 2.2 - Occupied Bandw		75 MI20	455	40	10.0 2010
Multimeter	Fluke	75 IVIK3	455	12	10-Sep-2016
Power Supply Unit			1092	-	
Rubidium Standard	Ronue & Schwarz		1310	0	13-Feb-2010
Power Supply	Hewlett Packard	0104A	1948	-	10
Attenuator (30dB/50W)	Aeronex / Weinschei	47-30-34	3164	12	12-Dec-2015
Function Generator	Instruments	1G2000	3334	-	10
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016
Section 2.3 - Frequency Tolera	ance				
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016
Digital Temperature Indicator	Fluke	51	1385	12	23-Sep-2016
Power Supply	Hewlett Packard	6104A	1948	-	TU
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2015
Function Generator	Thurlby Thandar Instruments	TG2000	3334	-	TU
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016
Section 2.4 - Spurious Emission	ons at Antenna Termina	ls			
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016
Power Supply	Hewlett Packard	6104A	1948	-	TU
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2015
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Function Generator	Thurlby Thandar Instruments	TG2000	3334	-	TU
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016

#### COMMERCIAL-IN-CONFIDENCE



Instrument	Manufacturer	Type No.	TE No.	Calibration	Calibration Due
				Period	
				(months)	
Section 2.5 - Radiated Emissio	ns				
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	29-Apr-2016
Antenna (Double Ridge Guide,	EMCO	3115	235	22	28-Nov-2015
Antenna (Bilog)	Schaffner	CBI 6143	287	24	3-Feb-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Pre-Amplifier	Phase One	PS04-0086	1533	12	30-Jul-2016
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Power Supply	Hewlett Packard	6104A	1948	-	TU
FMI Test Receiver	Rohde & Schwarz	ESIB26	2028	12	16-Jun-2016
Hydromer	Rotronic	A1	2138	12	3-Dec-2015
Multimeter	Iso-tech	IDM101	2417	12	29-Sep-2016
Filter (Hi Pass)	Lorch	9HP7-7000-SR	2833	12	5-Feb-2016
Power Supply	Famell	1 T30-2	2903	-	TU
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	12	11-Aug-2016
Signal Generator: 10MHz to	Robde & Schwarz	SMR20	3475	12	18-Feb-2016
20GHz		01111120	0110		101 00 2010
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	27-Oct-2015
7m Armoured RF Cable	SSI Cable Corp	1501-13-13-7m	3600	-	TU
		WA(-)			
9m RF Cable (N Type)	Rhophase	NPS-2303-9000- NPS	3791	-	TU
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Suspended Substrate	Advance Power	11SH10-	4412	12	24-Mar-2016
Highpass Filter	Components	3000/X18000-O/O			
2m K-Type Cable (Rx)	Scott Cables	KPS-1501-2000- KPS	4527	-	TU
0.5m SMA Cable (Rx)	Scott Cables	SLSLL18-SMSM-	4528	6	19-Feb-2016
Section 2.6 Conducted Outp		00.00101			
Section 2.6 – Conducted Outp		75 MK3	155	12	10 Son 2016
Bower Supply Unit	Farpoll		4002	12	0/P Mon
Pubidium Standard	Pobdo & Schwarz	YSDM	1316	-	13 Ech 2016
Power Supply	Hewlett Packard	6104A	10/18	-	TII
Attopuator (30dR/50\V/)		47 30 34	3164	- 12	12 Doc 2015
Allendator (SodB/SovV)	Potronic	47-30-34	3220	12	10 Aug 2016
Function Concreter	Thurlby Thondor	TC2000	3220	12	19-Aug-2010
	Instruments	132000	3334	-	10
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016

#### **Product Service**

#### COMMERCIAL-IN-CONFIDENCE



#### **Product Service**

Instrument	Manufacturer	Type No.	TE No.	Calibration Period	Calibration Due		
				(months)			
Section 2.7 - Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Sat							
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016		
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016		
Power Supply	Hewlett Packard	6104A	1948	-	TU		
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2015		
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	16-Sep-2016		
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016		
Function Generator	Thurlby Thandar Instruments	TG2000	3334	-	TU		
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016		
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016		
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	13-Feb-2016		
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016		

TU – Traceability Unscheduled O/P MON – Output Monitored with Calibrated Equipment



#### 3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU
Occupied Bandwidth	± 16.74 kHz
Modulation Characteristics	-
Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service	± 3.08 dB
Frequency Tolerance	± 3.54 Hz
Spurious Emissions at Antenna Terminals	± 3.08 dB
Conducted Output Power	± 0.70 dB
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 17 GHz: ± 6.3 dB



**SECTION 4** 

# ACCREDITATION, DISCLAIMERS AND COPYRIGHT



## 4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

This report must not be reproduced, except in its entirety, without the written permission of TÜV SÜD Product Service

© 2015 TÜV SÜD Product Service