A RADIO TEST REPORT

FOR

Iridium Satellite LLC

ON

Iridium 9560 Wi-Fi Access Point with satellite transceiver

DOCUMENT NO. TRA-015542-03-47-00-D

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TRaC Wireless Test Report	**:** TRA-015542-03-47-00-D
Applicant	**:** Iridium Satellite LLC
Apparatus	: Iridium 9560 Wi-Fi Access Point with satellite transceiver
Specification	: FCC CFR47 Part 15(c) & Part 25
Purpose of Test	**:** Verification of emission profile
Authorised by	**:** 
	: Radio Product Manager
Issue Date	**:**
Authorised Copy Number	**:** *PDF*

Contents

Section 1: Introduction

1.1 General

This report contains an assessment of an apparatus based upon tests carried out on samples submitted to the Laboratory.

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1.2 Tests Requested By

This testing in this report was requested by:

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1.3 Manufacturer

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1.4 Apparatus Assessed

The following apparatus was assessed (i.e. tested for intermodulation products) between 9th November 2013 – 14th November 2013

Iridium 9560 Wi-Fi Access Point with satellite transceiver

The above device is a wireless access point that connects to the Iridium Satellite network to allow multiple users within WiFi range to the EUT to access a Wide Area Network for data and voice calls.

1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

Test Type	Regulations		Measurement standard	Result
Co-located Radiated Emissions <1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.247	Title 47 of the CFR: Part 25 Section 25.202 (f)	ANSI C63.10:2009	Pass
Co-located Radiated Emissions >1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.247	Title 47 of the CFR: Part 25 Section 25.202 (f)	ANSI C63.10:2009	Pass

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Abbreviations used in the above table:

CFR	: Code of Federal Regulations	ANSI	: American National Standards Institution
REFE	: Radiated Electric Field Emissions	PLCE	: Power Line Conducted Emissions

1.6 Notes Relating To the Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, “Pass” indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 15 to 23 °C
Humidity	: 63 to 73 %
Barometric Pressure	: 86 to 106 kPa

Note that temperature and humidity conditions can be found in the relevant test results appendix A.

All dates used in this report are in the format dd/mm/yy.

1.7 Deviations from Test Standards

No deviations were made from test standards

Section 2: Measurement Uncertainty

2.1 Measurement Uncertainty Values

For any test data recorded in accordance with note (iii) of Section 2.1 the following measurement uncertainty was calculated:

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Power Meter) = **1.08dB**
Uncertainty in test result (Spectrum Analyser) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,
Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,
Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result – Up to 8.1GHz = **3.31dB**
Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result – Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**,
Uncertainty in time measurement = **0.59%,**
Uncertainty in Amplitude measurement = **0.82%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

Uncertainty in test result = **2.59% (frequency)**
Uncertainty in test result = **1.32dB (amplitude)**

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector

ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation
CDN	: Coupling & decoupling network

A1 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric field emission test here applies only to Inter-modulation products. The EUT was set to transmit as required.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : [ ] 3m alternative test site : [X]

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details:	
Regulation	Part 15 Subpart (c) 15.247 / Part 25 Section 25.202 (f)
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 25 GHz
EUT sample number	S16
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	24.8
Photographs	Refer to Appendix E

The only emissions detected were the harmonics of fundamentals. No inter-modulation products were detected.

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10:2009: section 4.5, Table 1 For emissions below 30MHz the cable losses are assumed to be negligible.

2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.

3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.

4 For Frequencies below 1 GHz, RBW= 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW= 1MHz, VBW ≥ RBW
Average	RBW= 1MHz, VBW ≥ RBW

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15 Clause 15.33(a) and 15.33(a)(1).

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

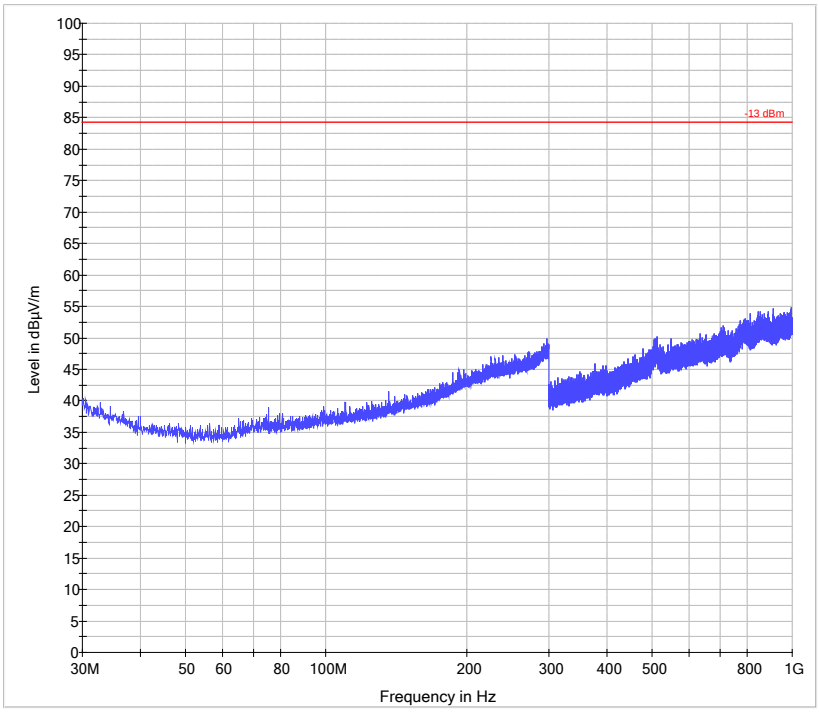
Notes:

(a) The time and date on the plots do not necessarily equate to the time of the test.

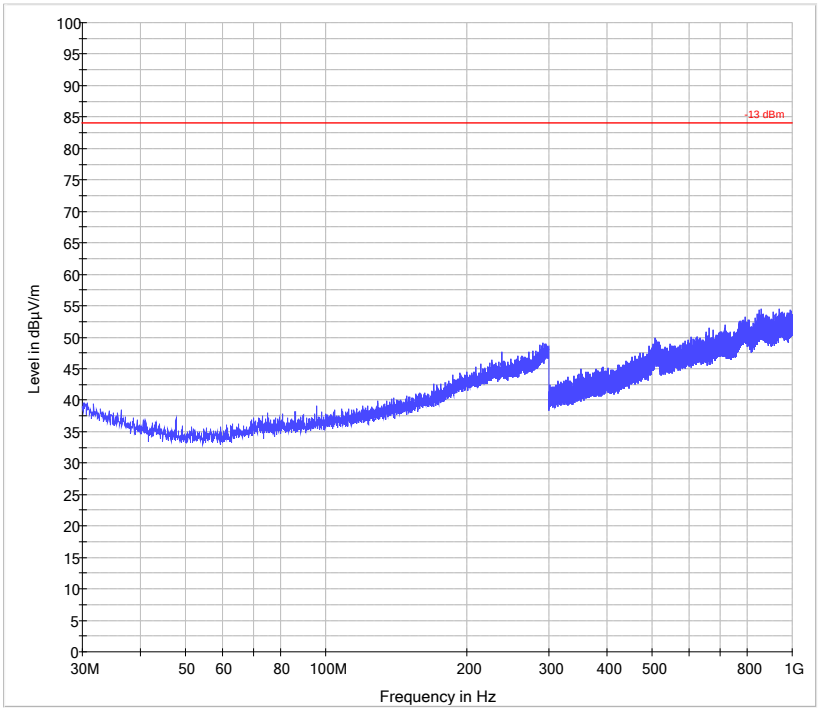
(b) Appendix D details the numbering system used to identify the sample and its modification state.

(c) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

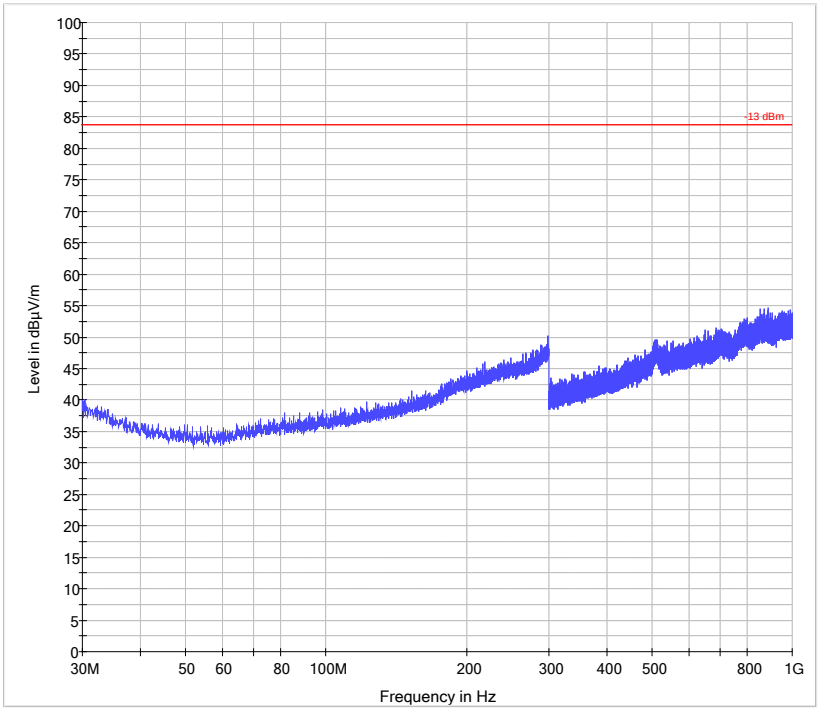
Iridium@Bottom Channel - Wifi@Bottom Channel 30 MHz – 1 GHz



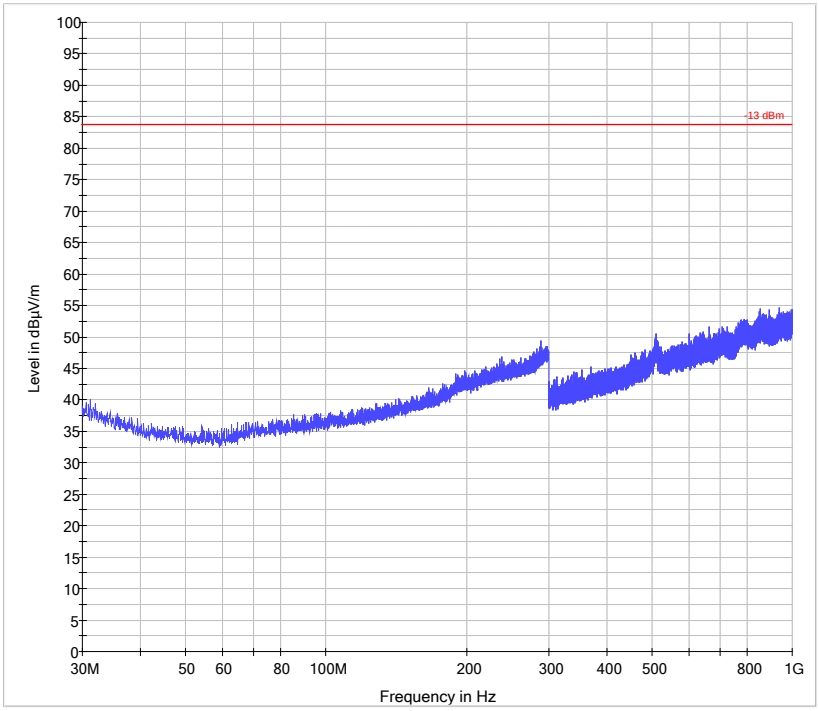
Iridium@Bottom Channel - Wifi@Medium Channel 30 MHz – 1 GHz



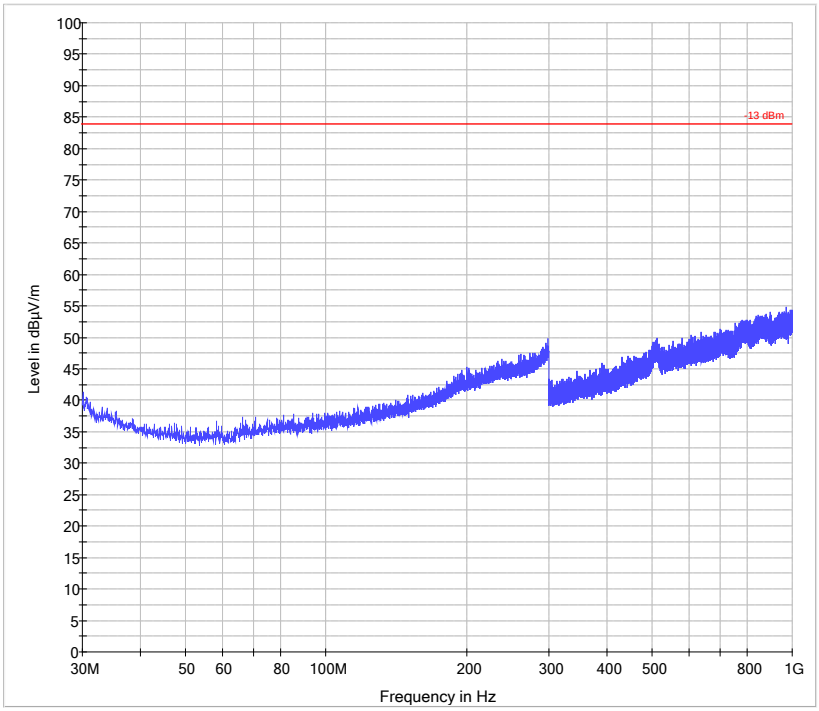
Iridium@Bottom Channel - Wifi@Top Channel 30 MHz – 1 GHz



Iridium@Top Channel - Wifi@Bottom Channel 30 MHz – 1 GHz 30



Iridium@Top Channel - Wifi@Medium Channel 30 MHz – 1 GHz



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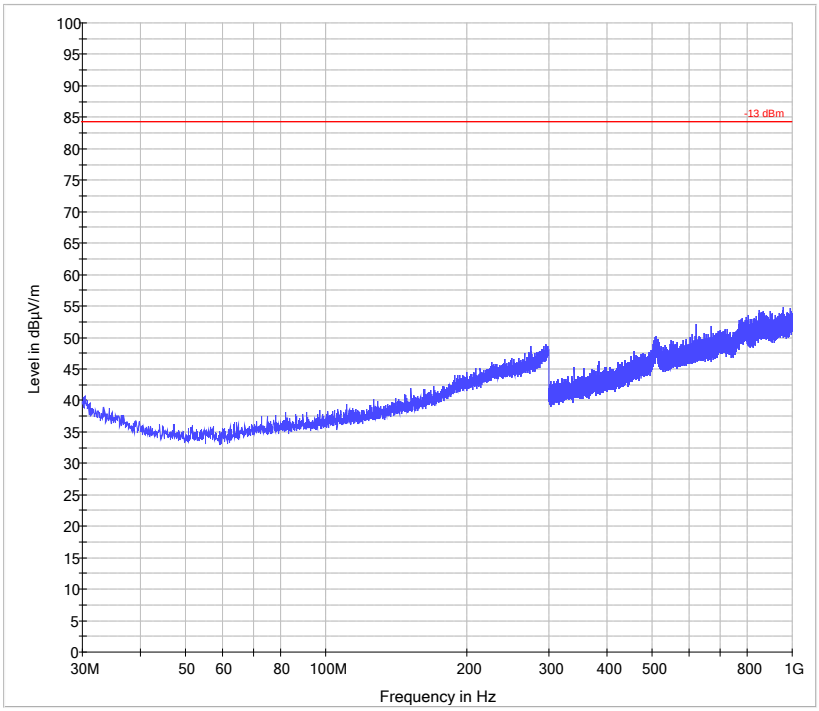
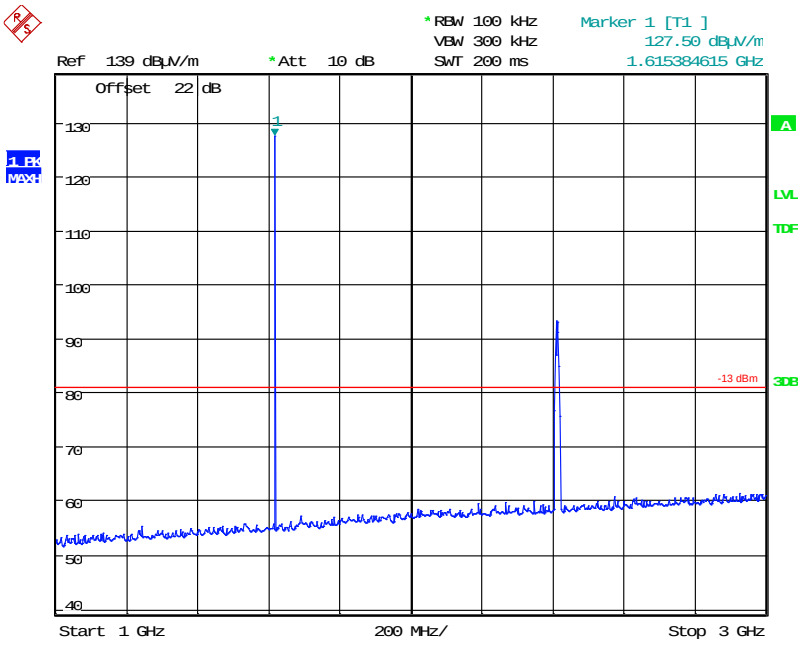


Iridium@Bottom Channel - Wifi@Bottom Channel 1 - 3 GHz



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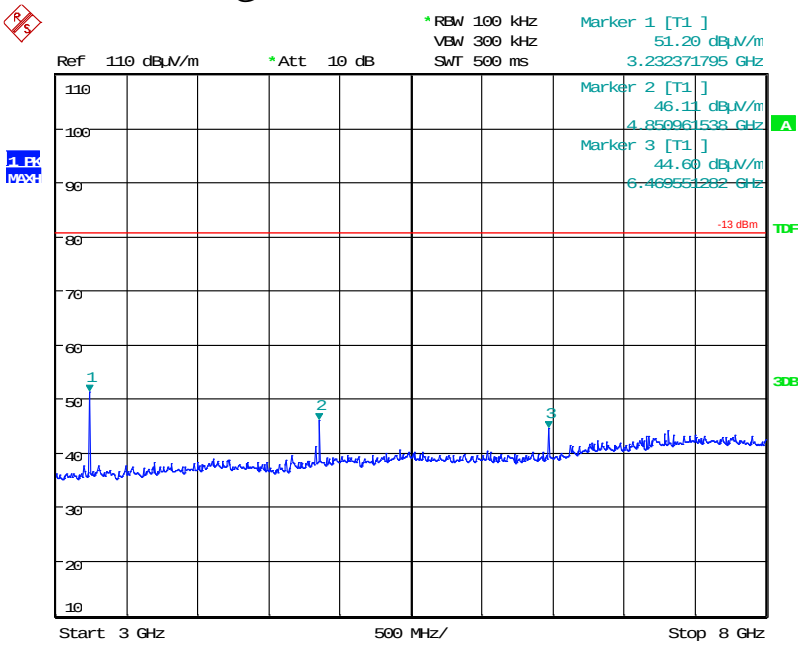
Iridium@Bottom Channel - Wifi@Bottom Channel 3 - 8 GHz



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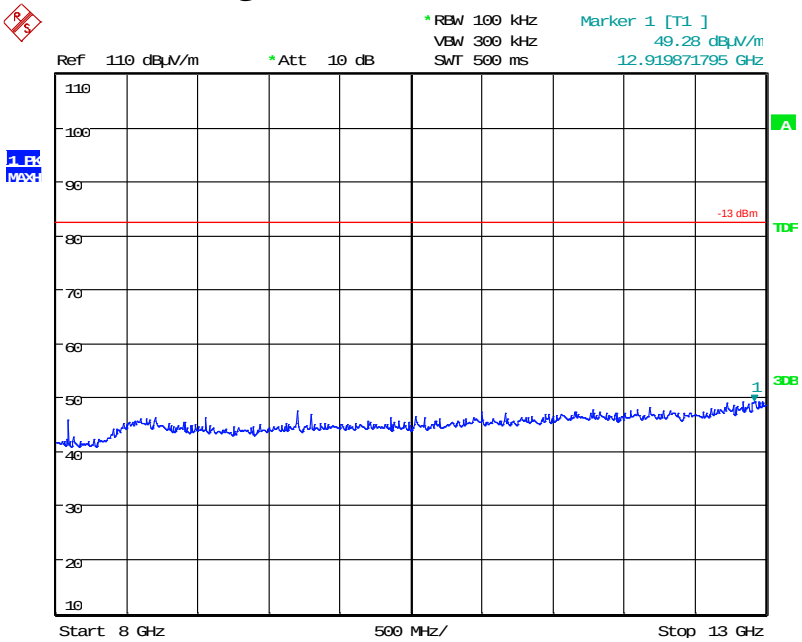

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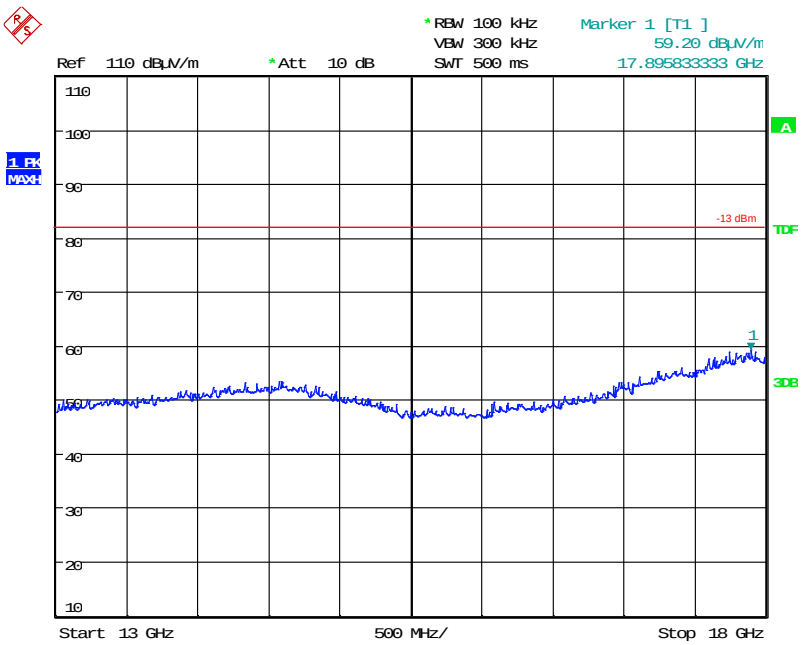

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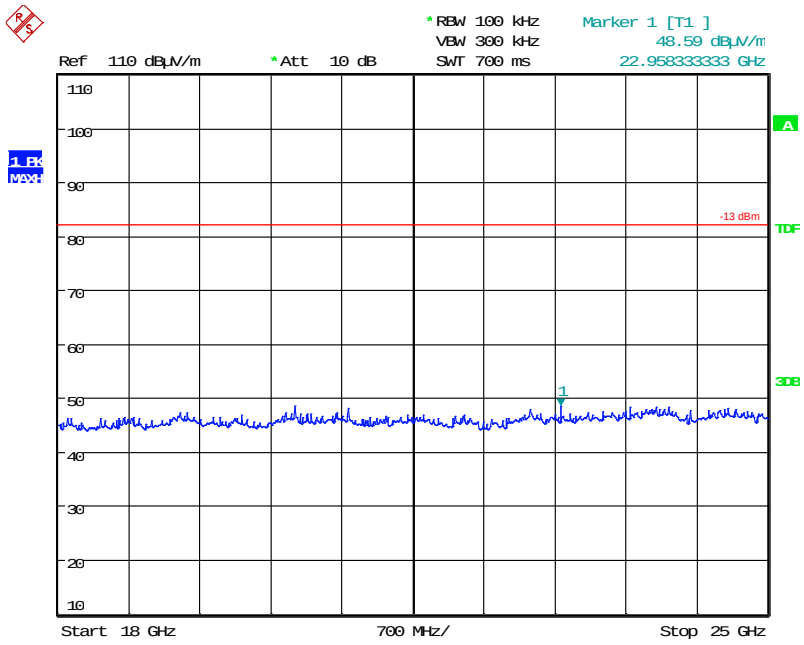

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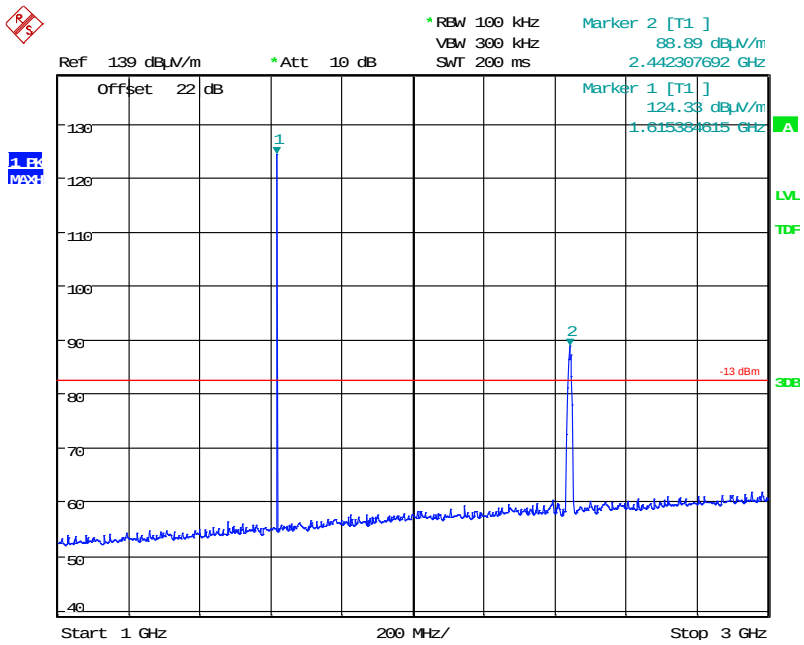
Iridium@Bottom Channel - Wifi@Medium Channel 1 - 3 GHz



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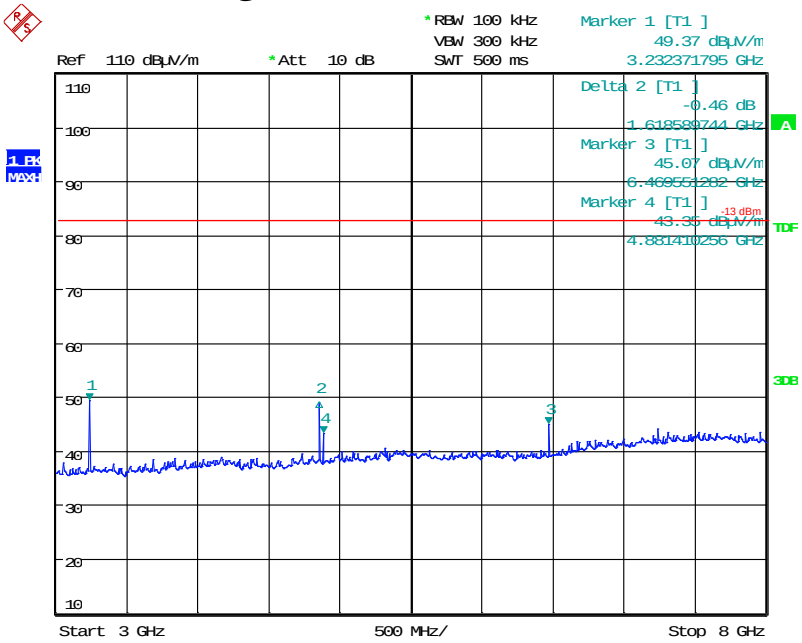

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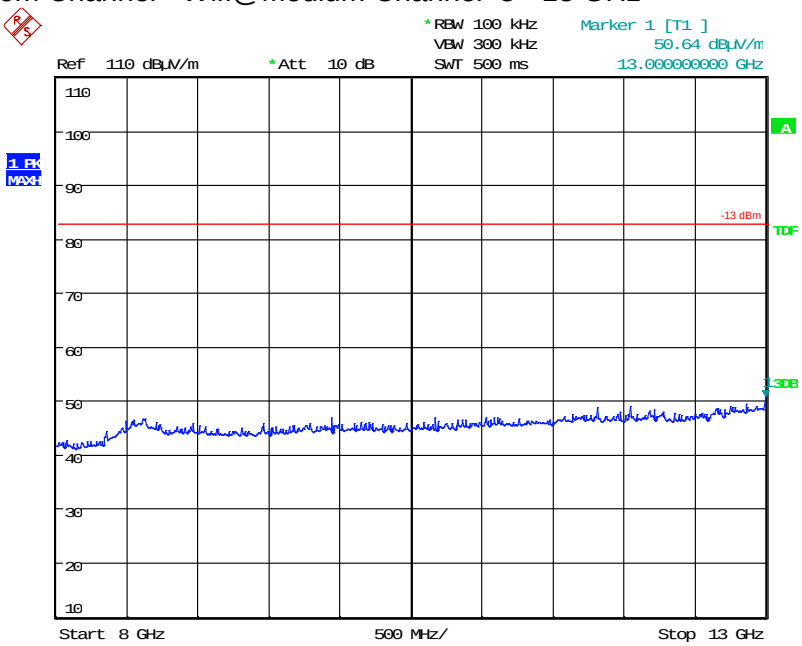

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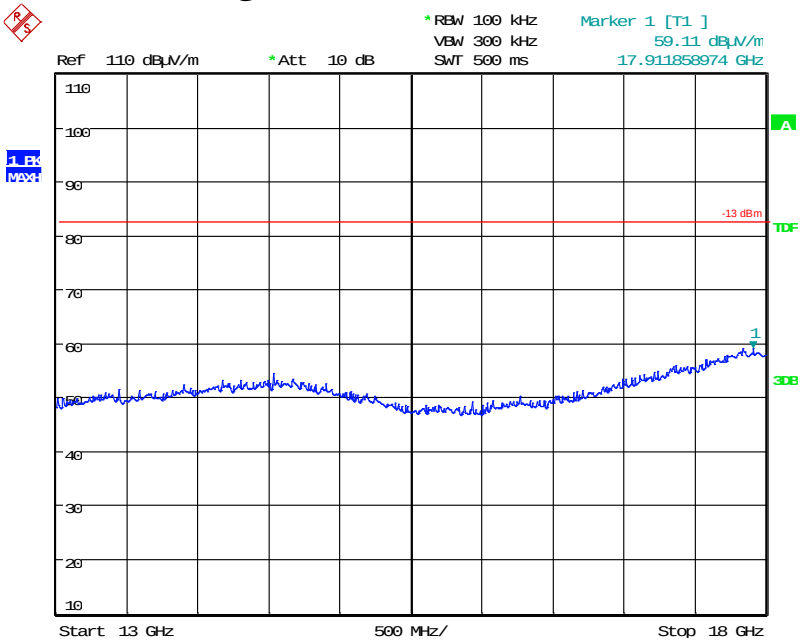

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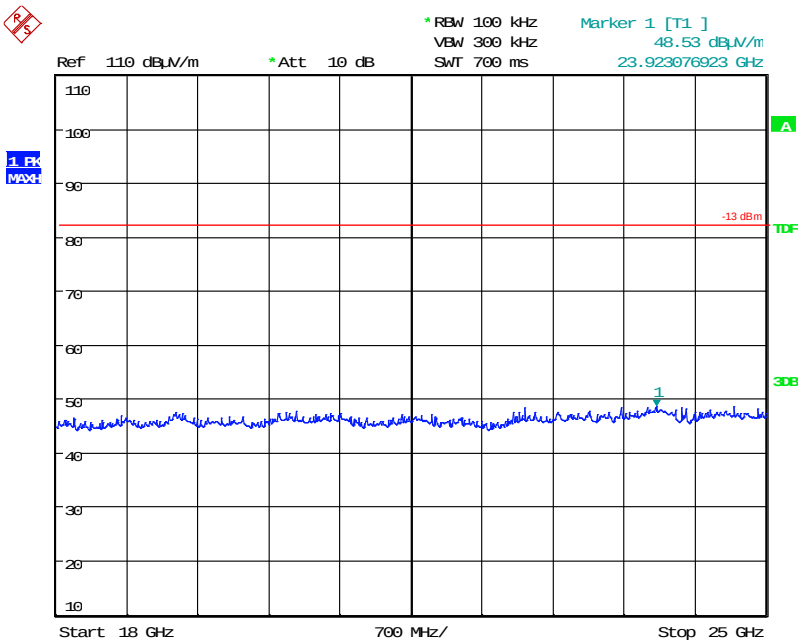
Iridium@Bottom Channel - Wifi@Medium Channel 18 - 25 GHz



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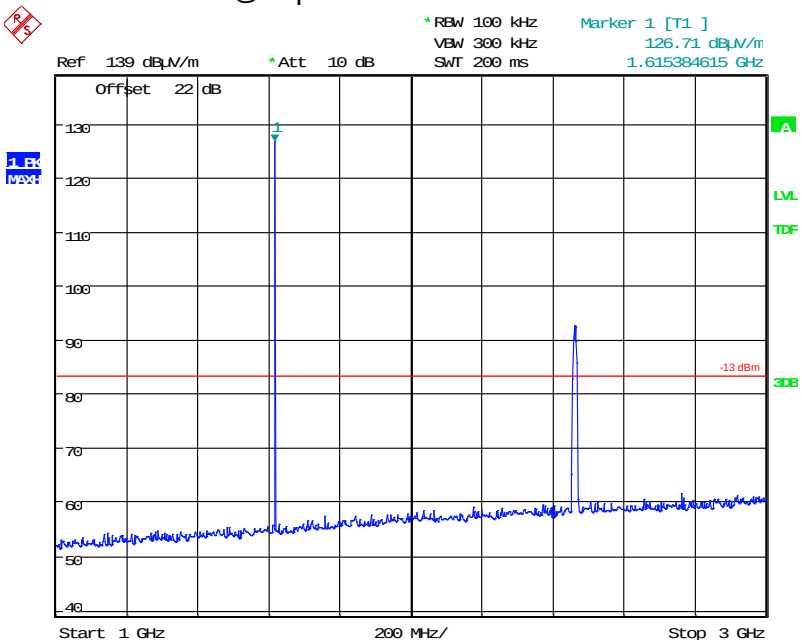

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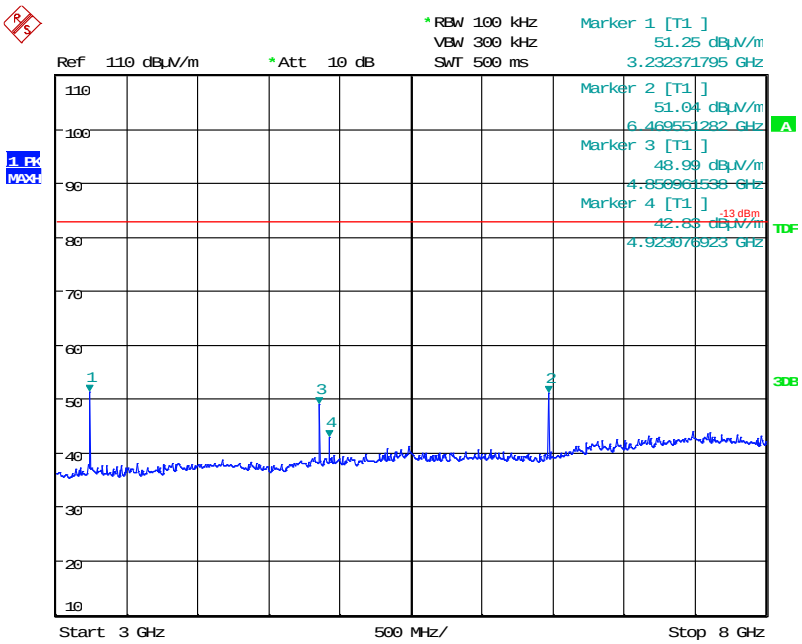

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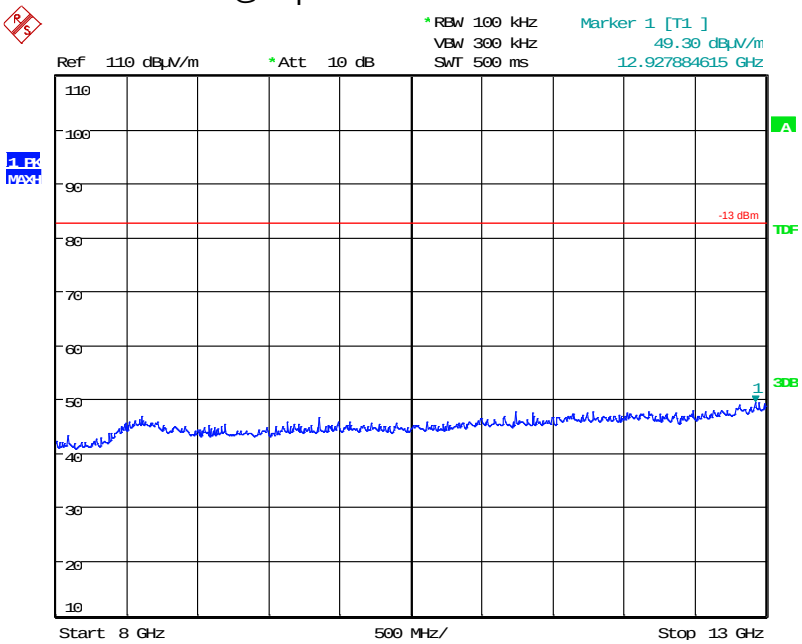

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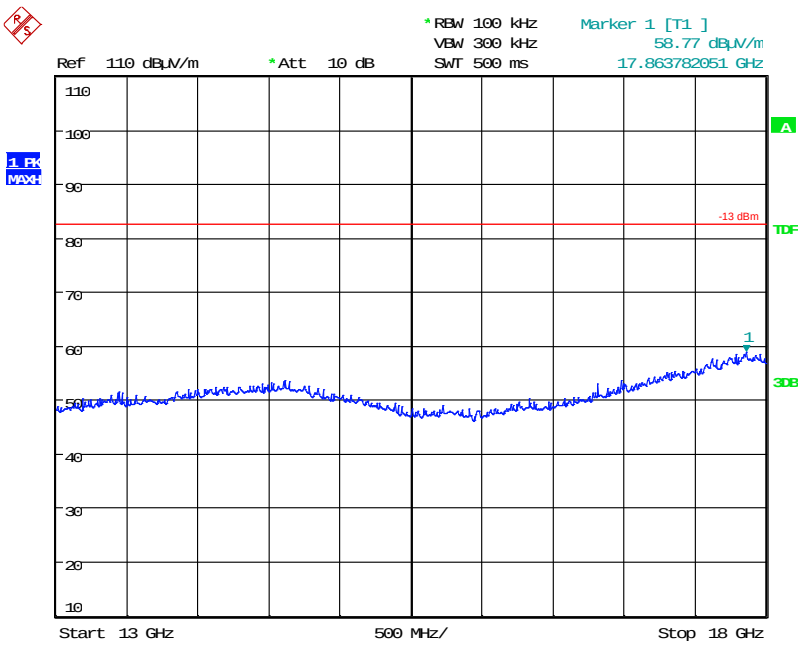
Iridium@Bottom Channel - Wifi@Top Channel 13 - 18 GHz



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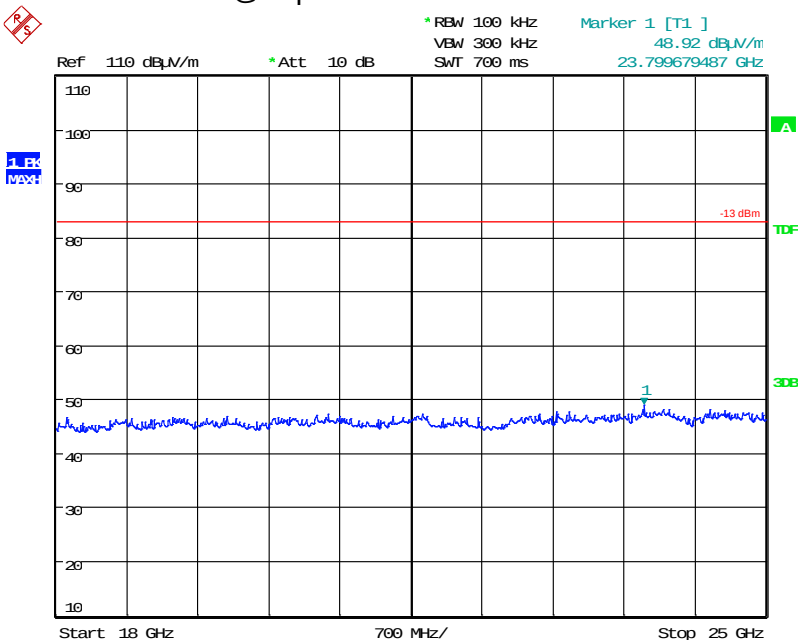
Iridium@Bottom Channel - Wifi@Top Channel 18 - 25 GHz



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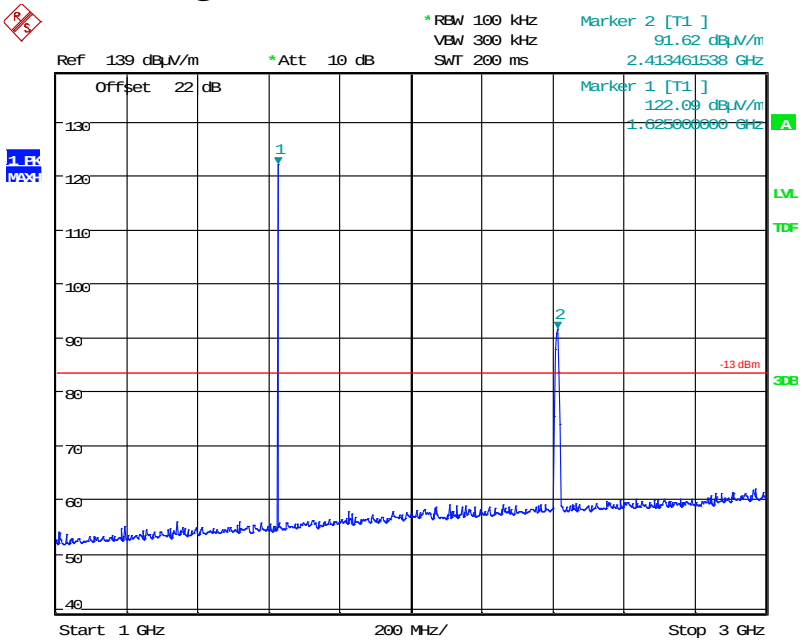

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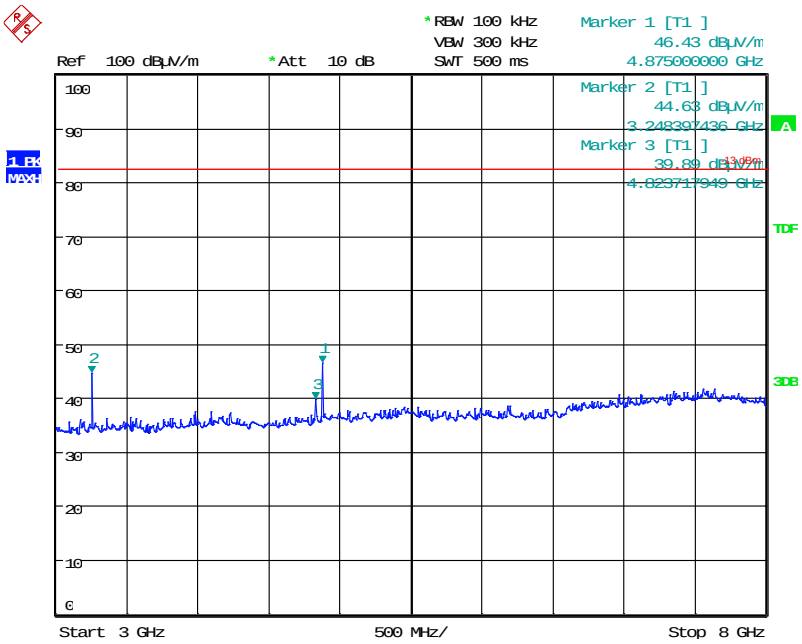
Iridium@Top Channel - Wifi@Bottom Channel 3 - 8 GHz



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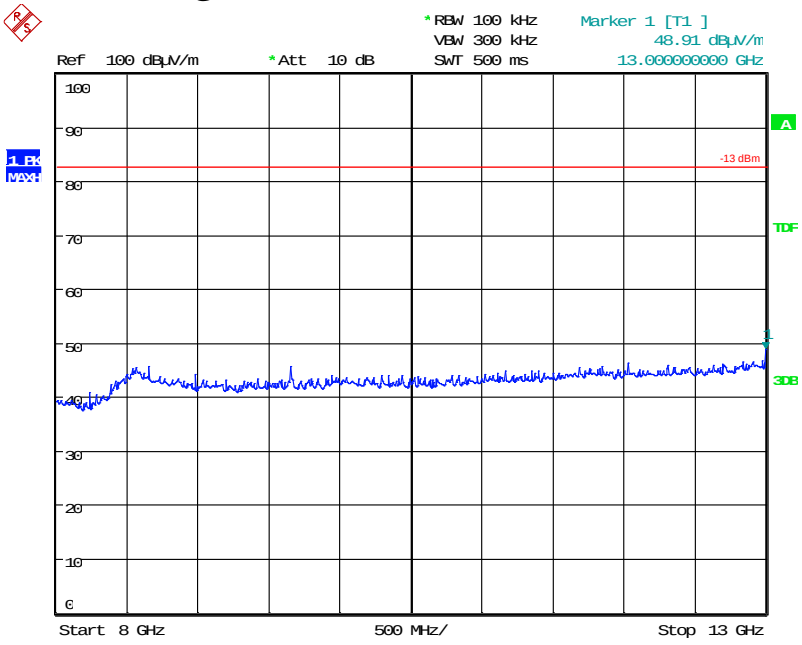
Iridium@Top Channel - Wifi@Bottom Channel 8 - 13 GHz



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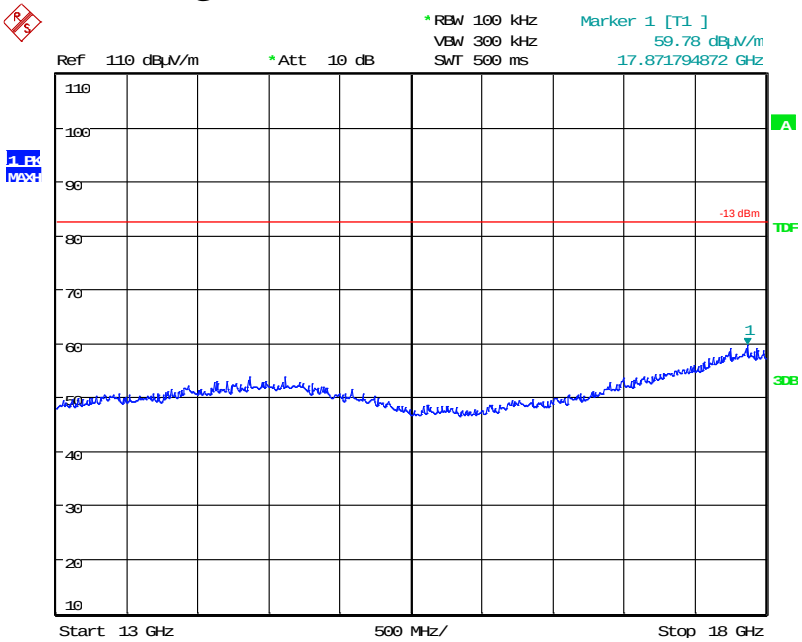

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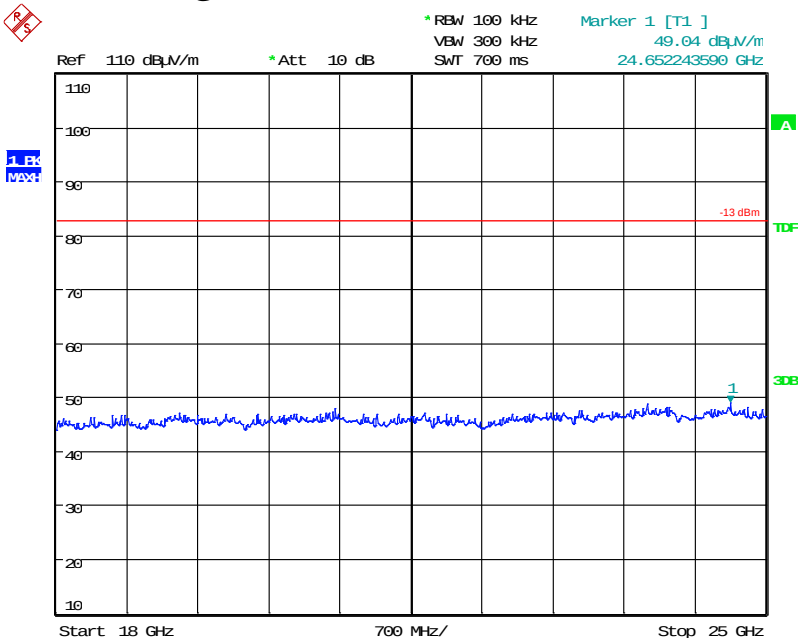
Iridium@Top Channel - Wifi@Bottom Channel 18 - 25 GHz



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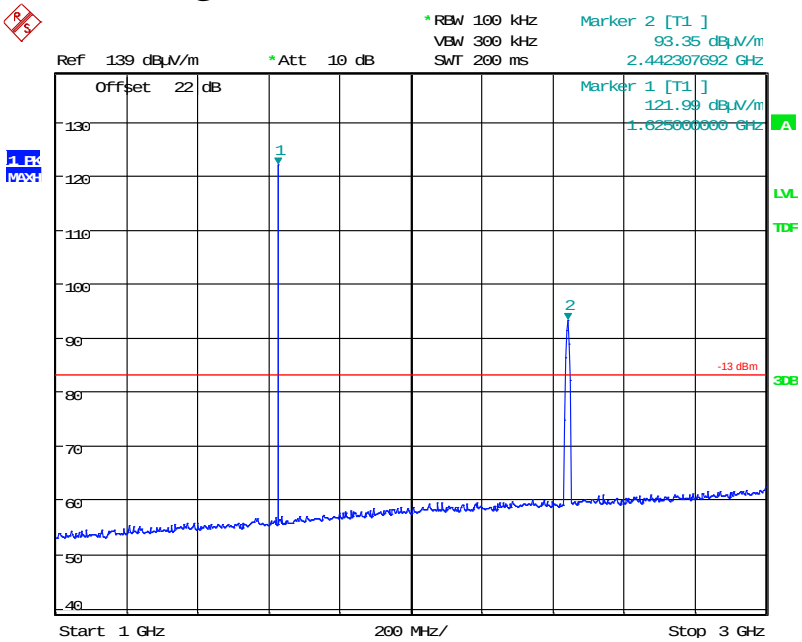

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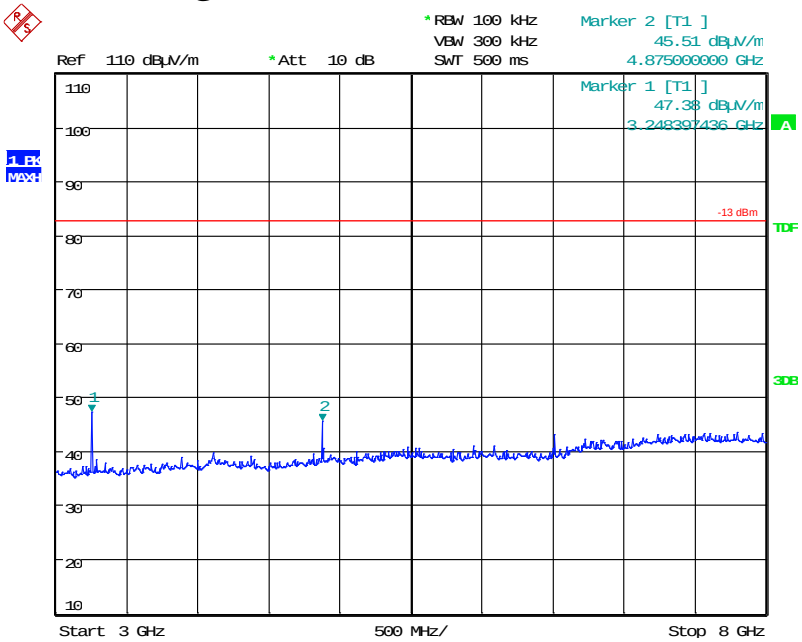

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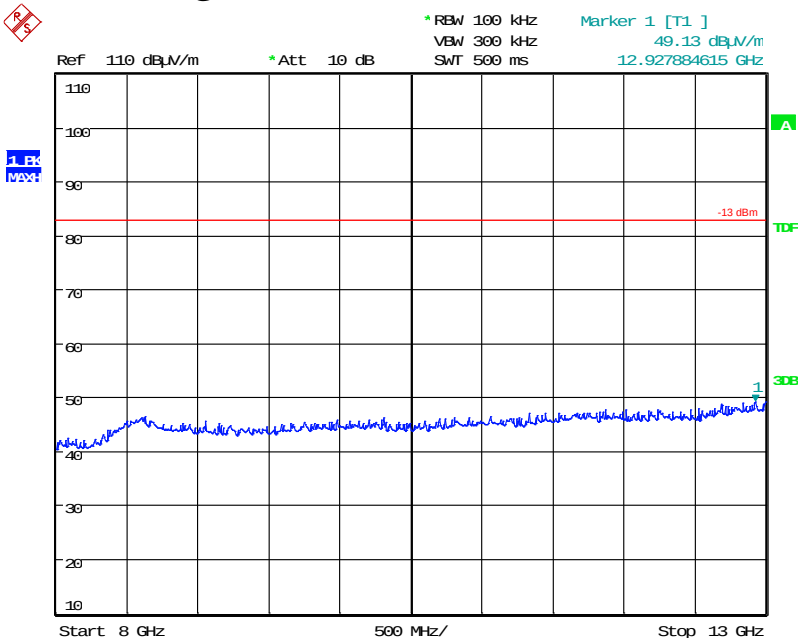
Iridium@Top Channel - Wifi@Medium Channel 8 - 13 GHz



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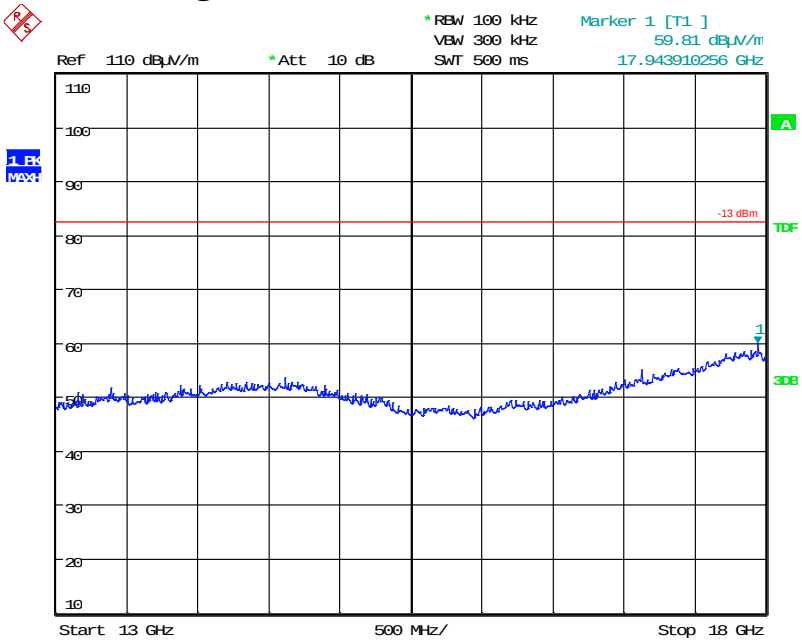

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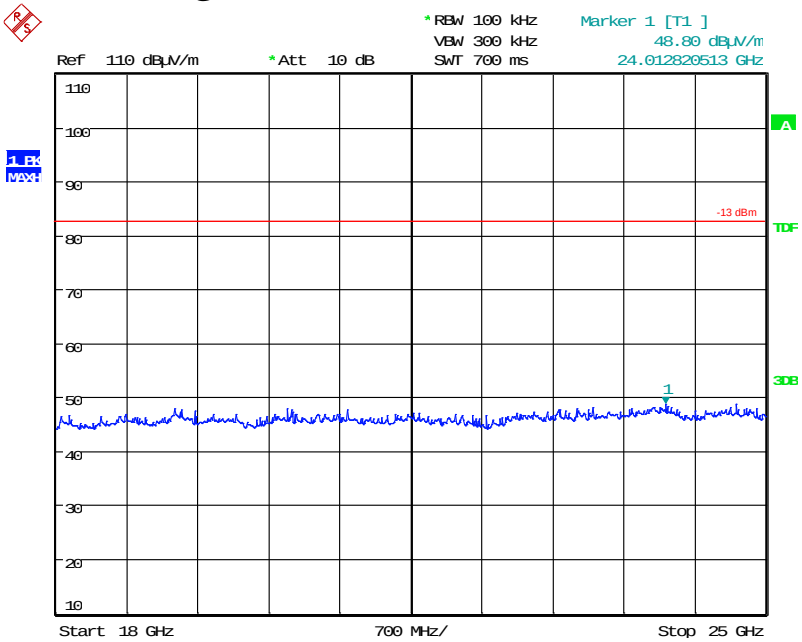

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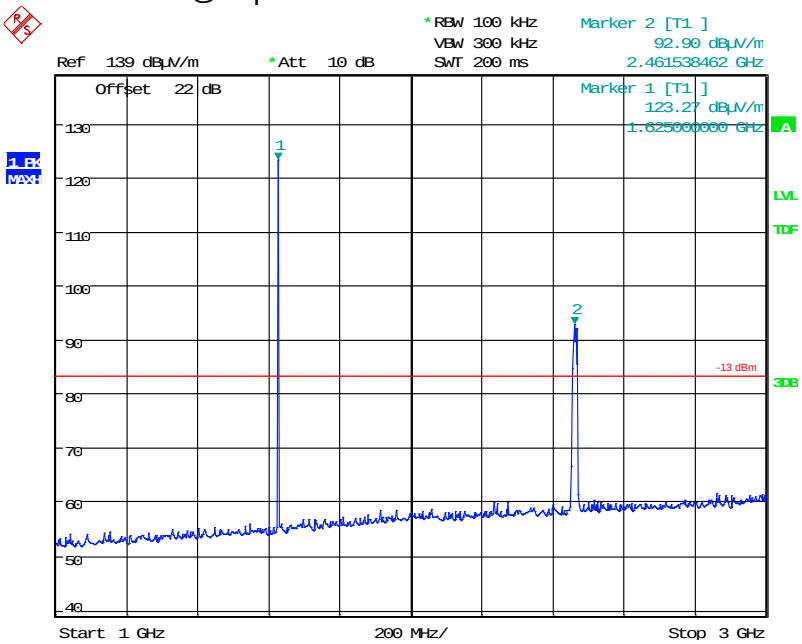

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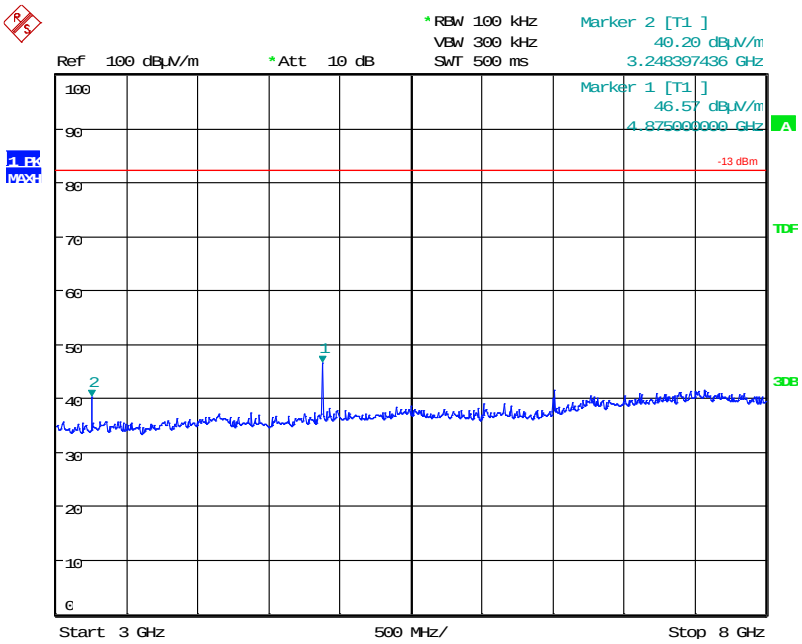
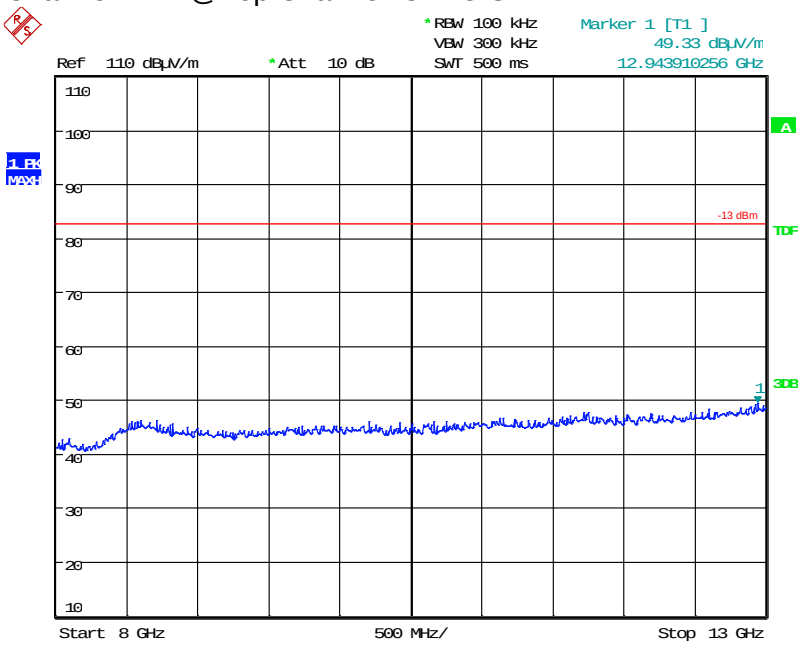


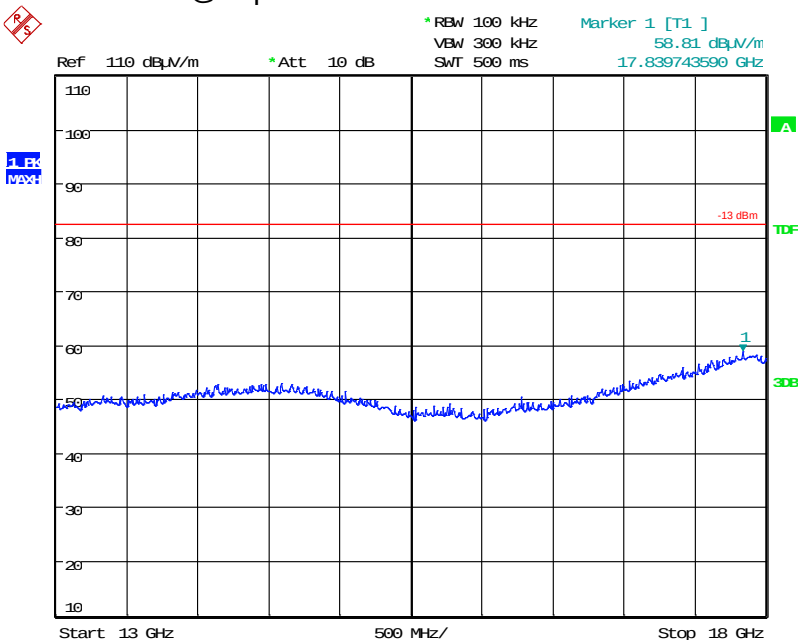
Date: 14.NOV.2013 17:52:29

Iridium@Top Channel - Wifi@Top Channel 8 - 13 GHz



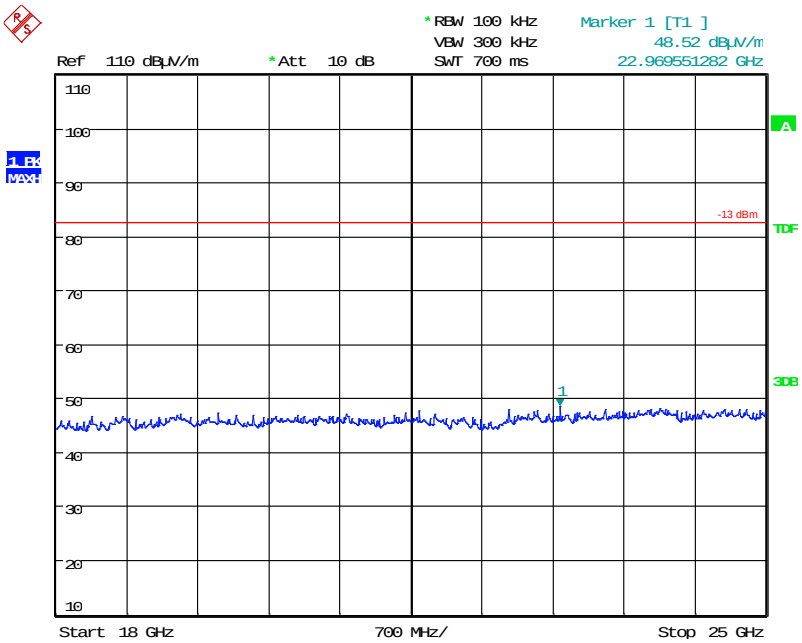
Date: 12.NOV.2013 17:47:39

Iridium@Top Channel - Wifi@Top Channel 13 - 18 GHz



Date: 12.NOV.2013 17:46:10

Iridium@Top Channel - Wifi@Top Channel 18 - 25 GHz



Date: 11.NOV.2013 12:16:36

Appendix C: Additional Test and Sample Details

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and it's modification state:

Sample No: Sxx Mod w

where:

xx = sample number eg. S01
w = modification number eg. Mod 2

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

Positioning of cards in a chassis.
Setting of any internal switches.
Circuit board jumper settings.
Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as “single possible configuration”.

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Global upon request.

C1) Test samples

The following samples of the apparatus were submitted by the client for testing:

Sample No.	Description	Identification
S16	Iridium 9560 Wi-Fi Access Point with satellite transceiver	None

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

Sample No.	Description	Identification
S15	Iridium 9560 Wi-Fi Access Point with satellite transceiver prototype - USB/SPI connection	None

The following samples of apparatus were supplied by TRaC Global as support or drive equipment (auxiliary equipment):

Identification	Description
None	Laptop

C2) EUT Operating Mode during Testing.

During testing, the EUT was exercised as described in the following table:

Test	Description of Operating Mode
Radiated Spurious Emissions	- TX mode - Iridium at Top and Bottom Channels - Wi-Fi at Top, Medium and Bottom Channels

C3) EUT Configuration Information.

The EUT was submitted for testing in one single possible configuration.

C5 Details of Equipment Used

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRL317	ESVS10	Receiver	Rhode & Schwarz	09/01/2013
TRL572	8449B	Pre Amp	Agilent	12/12/2012
TRL281	FSU46	Spectrum Analyser	Rhode & Schwarz	06/03/2013
TRL139	3115	Horn 1-18GHz	EMCO	20/09/2013
TRL300	20240-20	Horn 18-26GHz (&UH330)	Flann	17/11/2011
UH028	UHALP 9108	Log Periodic Ant	Schwarbeck	08/07/2013
TRL193	VHA 9103 balu	Bicone Antenna	Chase	19/06/2012

Appendix D: Additional Information

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Appendix E: Photographs and Figures

1: EUT close up 1

2: EUT close up 2

3: Test Setup for Below 1 GHz

4: Test Setup for Above 18 GHz

EUT close up 1:

EUT close up 2:

Test Setup for Below 1 GHz:

Test Setup for Above 18 GHz:

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