REPORT ON THE EMC TESTING OF A
IRIDIUM SATELLITE LLC
IRIDIUM 9560 WI-FI ACCESS POINT WITH SATELLITE TRANSCEIVER
WITH RESPECT TO THE UNINTENTIONAL RADIATOR
REQUIREMENTS OF
THE FCC RULES CFR 47: OCTOBER 2010
PART 15.107 AND 15.109 CLASS B LIMIT

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REPORT ON THE EMC TESTING OF A IRIDIUM SATELLITE LLC IRIDIUM 9560 WI-FI ACCESS POINT WITH SATELLITE TRANSCEIVER WITH RESPECT TO THE UNINTENTIONAL RADIATOR REQUIREMENTS OF THE FCC RULES CFR 47: OCTOBER 2010 PART 15.107 AND 15.109 CLASS B LIMIT

TEST DATE: 04th September - 10th October 2013

Report Compiled By: ……

Sean Walker

Digitally signed by Tony Lowry
DN: CN = Tony Lowry, C = GB, O = TRaC Global, OU = EMC
Reason: I am approving this document
Date: 2013.12.20 12:55:49 Z

Approved By: ……

Antony Lowry

Date: ……19th December 2013……

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SUMMARY

TEST REPORT NO:	TRA-015542-35-01C
TRaC WORKS ORDER:	TRA-015542-00
PURPOSE OF TEST:	Radio Frequency Interference Emissions Verification
TEST SPECIFICATION:	FCC RULES CFR 47: OCTOBER 2010 PART 15.107 AND 15.109 CLASS B LIMIT
EQUIPMENT UNDER TEST:	Iridium 9560 Wi-Fi Access Point with satellite transceiver
TEST RESULT:	Measured as Compliant, Class B Given the modifications (if any) described in Section 5 (Note uncertainty values in Appendix B)
CLIENT:	Iridium Satellite LLC
CLIENT CONTACT:	Mr Hermon Pon Tele: +1.703.287.7434 E-mail: Hermon.Pon@Iridium.com
ORDER NO:	62895
TESTED BY:	Sean walker
DATE OF TEST:	04th September - 30th September 2013

The results contained herein relate only to the items tested.

CONTENTS

1 INTRODUCTION

This report presents the results of EMC tests carried out on equipment type Iridium 9560 Wi-Fi Access Point with satellite transceiver, in accordance with the FCC Rules CFR 47: October 2010 Part 15.107 and 15.109 Class B Limit

The testing was carried out for Iridium Satellite LLC by TRaC Global Ltd, an independent test house, at their EMC test facility located at Skelmersdale, West Lancashire, England.

TRaC Global Ltd is appointed as a CAB & TCB for FCC part 15 testing.

The test site is FCC listed and is calibrated as recommended in Document ANSI C63.4: 2003

This report also details the configuration of the equipment under test, the test methods used and any relevant modifications where appropriate.

The equipment and peripherals were operated as specified in ANSI C63.4: 2003 Document.

2 SYSTEM UNDER TEST

2.1 Equipment Under Test (EUT)

Iridium 9560 Wi-Fi Access Point with satellite transceiver

Manufacturer:	Hermon.Pon@Iridium.com
Build Level:	Production
Serial No:	APM01035
Software Revision:	Ver. 22.37
Highest frequency generated or used in the EUT or on which the EUT operates or tunes:	2.4GHz

2.2 Support Equipment

1. A Laptop
2. An External aero antenna technology inc antenna.
   Model No: AT1621-142BW-TNCF-000-00-00-NM-K S/N: 53172

2.3 Modes of Operation of EUT During Testing

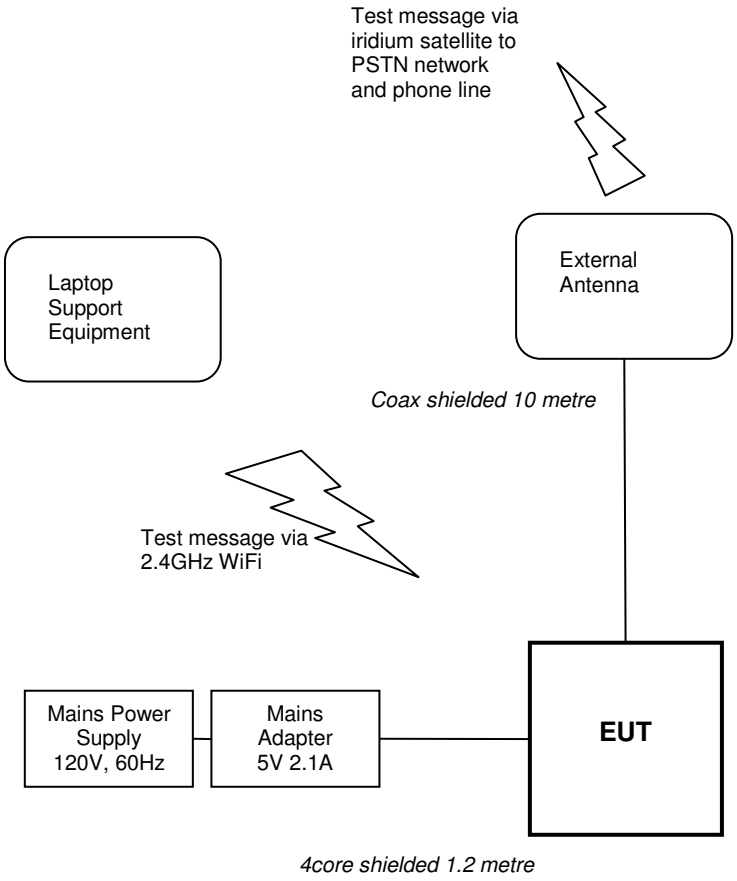
The EUT will operate in two modes:

- Active call and loud speaker via external antenna
- Charging mode

The call is made from the support laptop via 3XC sip client to the phone in the monitoring room, an audio file is on repeat through out the test and monitored for any signs of degradation.

The charging mode is monitored by the display icon and monitored via current draw on the AC side.

2.4 Block Diagram of EUT Configuration



NOTE: All cables unshielded unless otherwise stated.
Cable lengths are as shown in diagram.

3 TEST CONDITIONS

3.1 Conducted Emissions

3.1.1 General

This test measures conducted noise that may be present on an EUT's power supply cable. This test ensures the protection of broadcast and telecommunication services used in the vicinity of the EUT.

The test setup used complies with all the dimension requirements set out in ANSI C63.4: 2003.

3.1.2 Conducted Emission Test Parameters

Frequency Range	150kHz – 30MHz
Frequency Step Size	5kHz
Measurement Bandwidth	9kHz
Detectors	Peak (scan) Quasi-peak (final measurements) Average (scan & final measurements)
Quasi-peak Detector Dwell	Minimum 2s per frequency point
EUT Measurement Height	0.8m Insulated Table
Line Voltage	120V
Line Frequency	60Hz

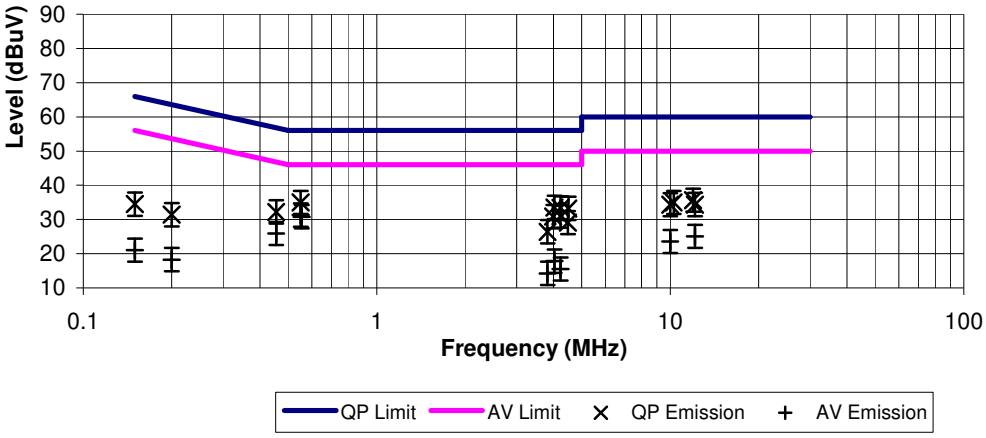
3.1.3 Test Equipment

The following test equipment was used:

Type of Equipment	***Maker/ Supplier***	***Model Number***	***Serial Number***	***TRaC Number***	***Actual Equipment Used***	***Calibration Due Date***
Receiver	Rhode & Schwarz	ESHS20	837960/003	237	☐	
Receiver	Rhode & Schwarz	ESHS10	844077/019	353	☐	
3-Phase LISN/AMN	Schwarzbeck	NSKL8128	8128151	207	☐	
LISN/AMN	Teseq	ISN T800	34437	UH446	☒	15/08/2014
Receiver	Rhode & Schwarz	ESHS10	830051/001	UH03	☒	08/05/2014
LISN/AMN	Rhode & Schwarz	ESH3-Z5	863906/018	UH05	☐	
N-Type Cable	TRaC	N/A	N/A	UH21	☒	10/08/2014
LISN/AMN	Schwarzbeck	NSLK8128	164	UH76	☐	
Receiver	Rhode & Schwarz	ESPC	843756/007	UH101	☐	
Receiver	Rhode & Schwarz	ESHS10	841429/012	UH187	☐	11/02/2014
LISN	Rhode & Schwarz	ESH3-Z5.831.5	8407 31/015	UH195	☐	
Transient Chamber	Rainford EMC	472-CH4-001-B	004	UH390	☐	
V Network LISN	Rohde & Schwarz	ENV216	101027	UH396	☒	30/04/2014
T8 ISN	Fisher custom communications	FCC-TLISN-T802	20469	HRFG485	☐	

3.1.4 EUT Test Results

Conducted Emissions - Class B



Frequency (MHz)	*Quasi Peak Level (dBµV)*	*Average Level (dBµV)*	*Quasi Peak Limit (dBµV)*	*Average Limit (dBµV)*	*Notes*
0.15	34.49	21.03	66	56	
0.2	31.39	18.25	63.61	53.61	
0.455	32.22	25.9	56.78	46.78	
0.55	34.99	31.31	56	46	
0.555		30.79		46	
3.82	26.39	14.24	56	46	

Mains power emissions with audio and video playing from USB with WI-FI comms active, with a continuous ping to google.com.

Error bars shown on the above graph represent measurement uncertainty for this test, for each frequency point, the EUT is said to either:

- Pass
- Pass within limits of uncertainty
- Fail within limits of uncertainty
- Fail

* In the notes section highlights a pass within limits of uncertainty

3.2 Radiated Emissions

3.2.1 General

This test measures radiated electromagnetic emissions that may emanate from EUT enclosures and cables. This test ensures the protection of broadcast and telecommunication services used in the vicinity of the EUT.

The test setup used complies with all the dimension requirements set out in ANSI C63.4:2009. The fully-anechoic chamber used meets the alternative site attenuation measurements required by ANSI C63.4:2009.

An initial scan is carried out in order to establish a frequency list that is attributable to the EUT. Any emissions measurements that fall within 20dBµV/m of the limit line are then maximised by rotating the equipment through 360° and raising/lowering the antenna through 1-4m height for each frequency of interest

3.2.2 Radiated Emission Test Parameters

Frequency Range	☒ 30MHz – 1GHz ☒ 1GHz – 2GHz ☐ N/A – Max EUT Freq Used <108MHz ☒ 2GHz – 5GHz ☐ N/A – Max EUT Freq Used <500MHz ☒ 5GHz – 13GHz ☐ N/A – Max EUT Freq Used <1GHz			
Measurement Bandwidth	☒ 120kHz (Measurements ≤1GHz) ☐ 1MHz (Measurements ≥1GHz)			
Video Bandwidth (measurements >1GHz)	☒ 3MHz (Peak Detector)			
Detectors	Peak (≤1GHz scan / ≥1GHz Final Measurements) Quasi-Peak (≤1GHz scan final measurements)			
Quasi-peak Detector Dwell	Minimum 2s per Frequency Point			
Frequency Step Size	50kHz (Measurements <1GHz)			
Antenna Height	1 – 4 Metres			
EUT to Antenna Distance	☐ 1m	☒ 3m	☐ 10m	☐ 30m
EUT Measurement Height	☒ 0.8m Insulated Table ☐ 0.1m Insulated Support/Pallet			

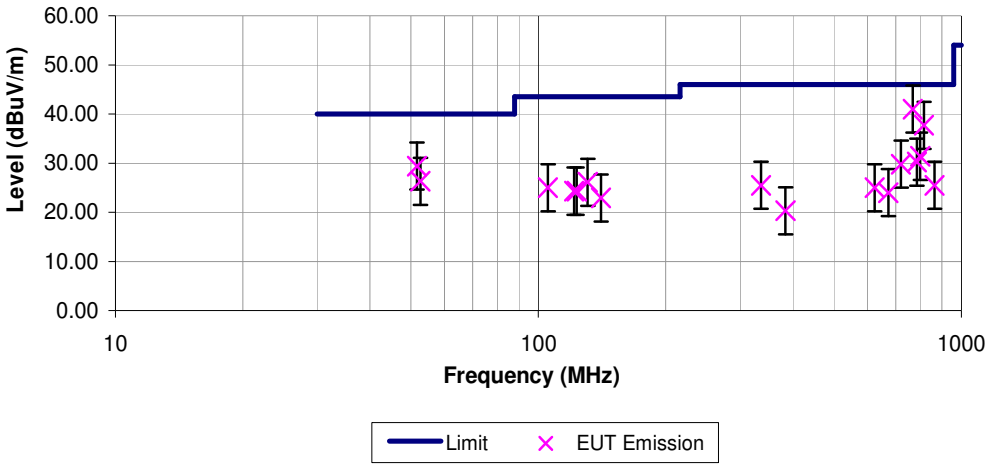
3.2.3 Test Equipment

The following test equipment was used:

Type of Equipment	*Maker/ Supplier*	*Model Number*	*Serial Number*	*TRaC Number*	*Actual Equipment Used*	*Calibration Due Date*
Bi-Log Antenna 30MHz - 2GHz	Chase	CBL6112	2098	L274	☐	
Bi-Log Antenna 30MHz - 1GHz	Chase	CBL6111	1945	L290	☐	
UHF Receiver 20 - 1000MHz	Rhode & Schwarz	ESVS10	837948/003	L317	☐	
RFS Chamber (MAC)	EMV	MAC 4	MAC4-1009	L323	☐	
UHF Receiver 20 - 1000MHz	Rhode & Schwarz	ESVS10	844594/003	L352	☐	
UHF Receiver 20 - 1000MHz	Rhode & Schwarz	ESVS20	838804/005	L415	☐	
Bi-Log Antenna 30MHz - 2GHz	Schaffner	CBL6112B	2761	L431	☐	
Pre-amplifier	Agilent	8449B	3008A01610	L572	☐	
RFS Chamber (Comm 1)	TRaC	-	-	L717	☐	
RFS Chamber (Comm 2)	TRaC	-	-	L718	☐	
UHF Receiver 20 - 1000MHz	Rhode & Schwarz	ESVS10	825892/006	UH04	☐	
2 Line V-network	Rhode & Schwarz	ESH3-Z5	863906/018	UH05	☐	
Log Periodic Antenna	Schwarzbeck	UHALP 9108	AC2404C/1	UH28	☐	
Clamp	Schwarzbeck	MDS21	932354	UH32	☐	
E-Field Pre-scan Cable	TRaC	None	None	UH72	☐	
Bi-Log Antenna 30MHz - 2GHz	Chase	CBL6112	2053	UH420	☒	16/07/2014
Temp/Humid/Barometer	RS Comp	None	None	UH110	☐	
UHF Receiver 20 - 1000MHz	Rhode & Schwarz	ESVS10	841431/014	UH186	☐	
Bi-Log Antenna	York	CBL611/A	1618	UH191	☐	
LISN	Rhode & Schwarz	ESH3-Z5.831.5	8407 31/015	UH195	☐	
Spectrum Analyser 20Hz – 40GHz	Rhode & Schwarz	FSU	200034	UH281	☐	
Receiver / Analyser	Rhode & Schwarz	ESU 26	100081	UH377	☐	
Log Periodic Antenna 0.85 – 26.5GHz	Rhode & Schwarz	HL050	100457	UH385	☒	16/07/2014
RF Chamber 1	Rainford EMC	31241	472-CH1-001	UH387	☐	
RF Chamber 2	Rainford EMC	31144	472-CH2-001	UH388	☒	05/09/2014
Temp/Humid/Barometer	Innovative	888R05	None	UH391	☐	
9kHz-7GHz EMI Test Receiver	Rohde & Schwarz	ESCI7	100850	UH403	☒	12/08/2014
Pre-Amp	Agilent	8449B		TRL527	☒	12/12/2013

3.2.4 EUT Test Results 30MHz – 1GHz

Radiated Emissions - Class B 3m measuring distance



Frequency (MHz)	*Level (dBµV/m)*	*Limit*	*Antenna Polarisation*	*Angle (°)*	*Notes*	*Margin (dB)*
51.60	29.4	40.0	Vertical	180		10.6
52.60	26.3	40.0	Vertical	202		13.7
105.45	25.0	43.5	Vertical	205		18.5
121.45	24.3	43.5	Vertical	1		19.2
123.25	24.3	43.5	Vertical	87		19.2
130.85	26.1	43.5	Vertical	1		17.4
140.65	22.9	43.5	Vertical	126		20.6
336.05	25.5	46.0	Vertical	143		20.5
384.10	20.3	46.0	Horizontal	322		25.7
624.10	25.0	46.0	Horizontal	290		21.0

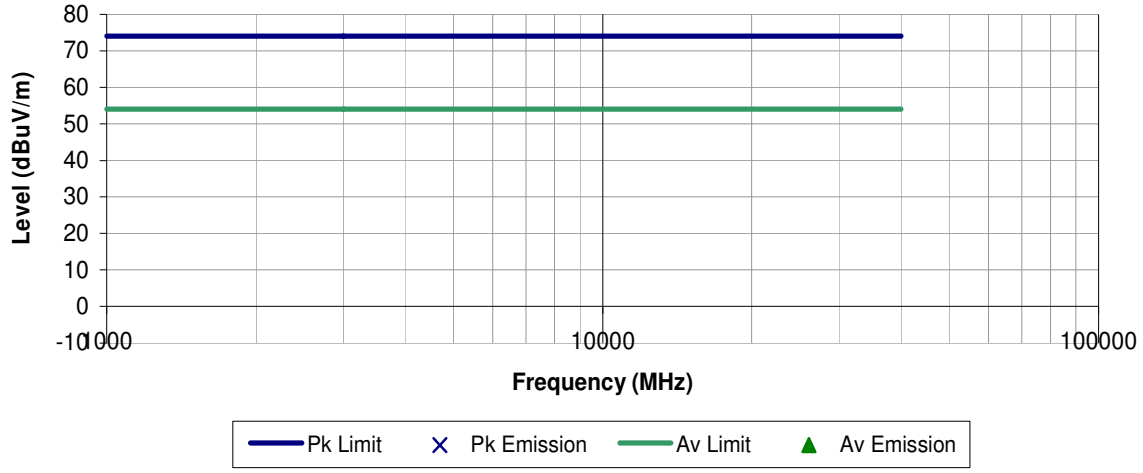
Error bars shown on the above graph represent measurement uncertainty for this test, for each frequency point, the EUT is said to either:

- Pass
- Pass within limits of uncertainty
- Fail within limits of uncertainty
- Fail

* In the notes section highlights a pass within limits of uncertainty

3.2.5 EUT Test Results 1GHz – 13GHz

Radiated Emissions
Class B 3m measuring distance



Frequency (MHz)	*Av Level (dBµV/m)*	*Av Limit*	*Pk Level (dBµV/m)*	*Pk Limit*	*Antenna Polarisation*	*Angle (°)*	*Notes*	*AV Margin (dB)*	*Pk Margin (dB)*

No emissons were detected within 10dB of the limit

Error bars shown on the above graph represent measurement uncertainty for this test, for each frequency point, the EUT is said to either:

- Pass
- Pass within limits of uncertainty
- Fail within limits of uncertainty
- Fail

* In the notes section highlights a pass within limits of uncertainty

\+ In the notes section highlights an Average Measurement pass within limits of uncertainty.

3.2.6 Sample Calculation

The radiated emission levels used in the report are calculated thus:

FREQUENCY (MHz)	*MEASURED VALUE (dBµV)*	*ANTENNA FACTOR (dB/m)*	*CABLE FACTOR (dB)*	*EMISSION LEVEL (dBµV/m)*
49.5	-0.9	7.70	0.3	7.1
151.05	8.2	10	0.6	18.80
200	1.1	8.70	0.7	10.5
247.4	1.3	12.10	0.7	14.1
720	8.3	19.30	1.3	28.9

4 LIST OF MODIFICATIONS

The following modifications were incorporated in the equipment during testing:

1. A 74271132 ferrite with one turn on the usb cable between the charger and EUT

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5 CONCLUSIONS

5.1 Result of Testing

The Iridium Satellite LLC, Iridium 9560 Wi-Fi Access Point with satellite transceiver Unit meets the requirements of the FCC RULES CFR 47: OCTOBER 2010 PART 15.107 and 15.109 CLASS A LIMIT in the configuration tested defined in Section 2 of this report and incorporating any modifications detailed in Section 4 of this report.

Note should be taken of modifications (if any) as described in Section 4 of this report.

5.2 Conformity in Production

TRaC Global Ltd has based this test report on results from the equipment sample(s) provided.

The manufacturer is advised that they may have an obligation to demonstrate that production samples are in conformity with the Standards noted.

The EMC performance reported above was achieved after incorporation of any modifications as detailed in Section 5 of this report.

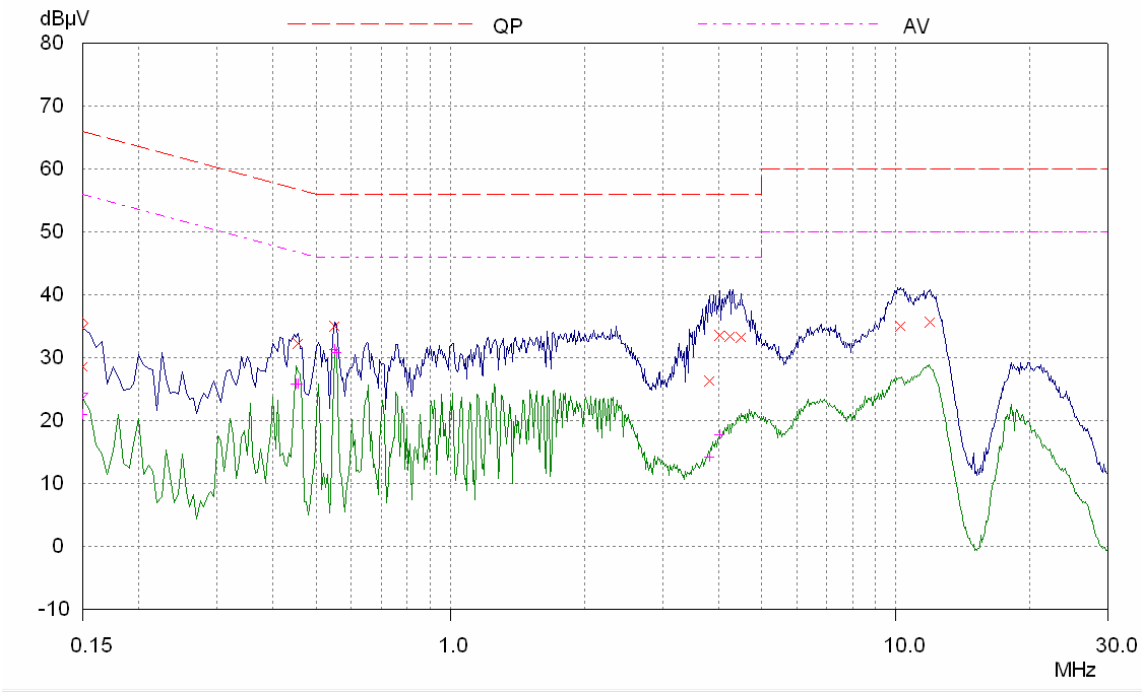
APPENDIX A

SCAN DATA GRAPHS

TRaC Global LTD

Powerline Conduction 150kHz - 30MHz

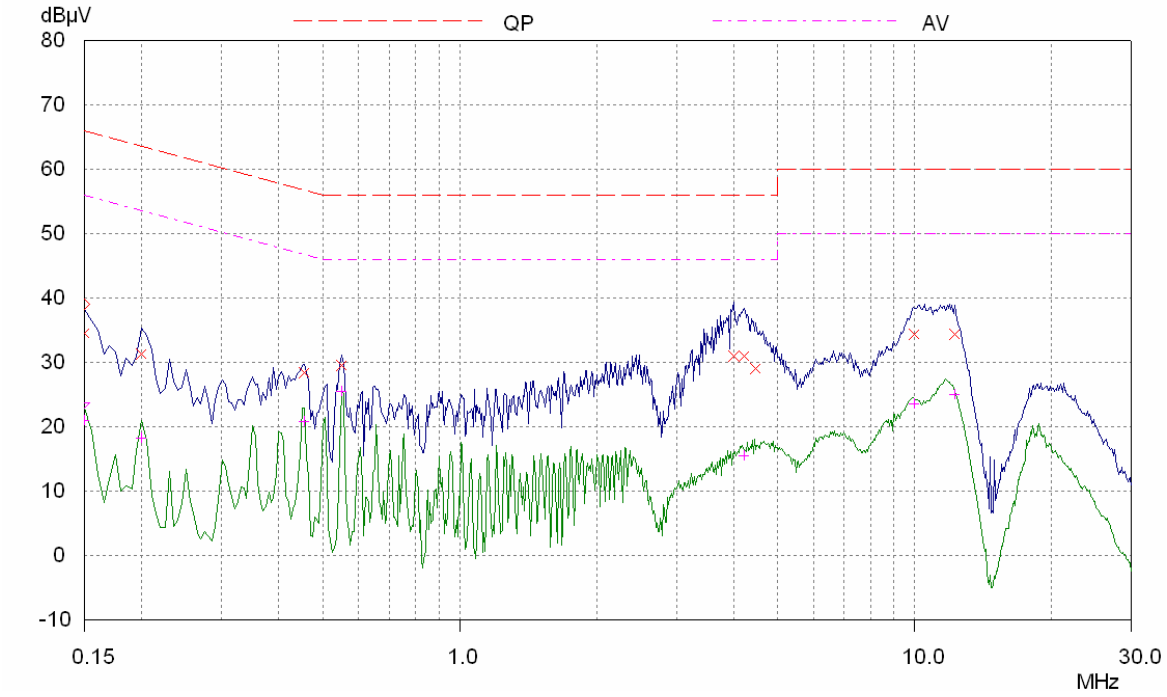
EUT:	Iridium 9560 Wi-Fi Access Point with satellite transceiver
Manufacturer:	Iridium Satellite LLC
Operating Conditions:	EUT charging during active call with loudspeaker active.
Operator:	SW
Test Specification:	CFR47 FCC part 15.107 Class B
Comments:	Live Line, 120V, 60Hz



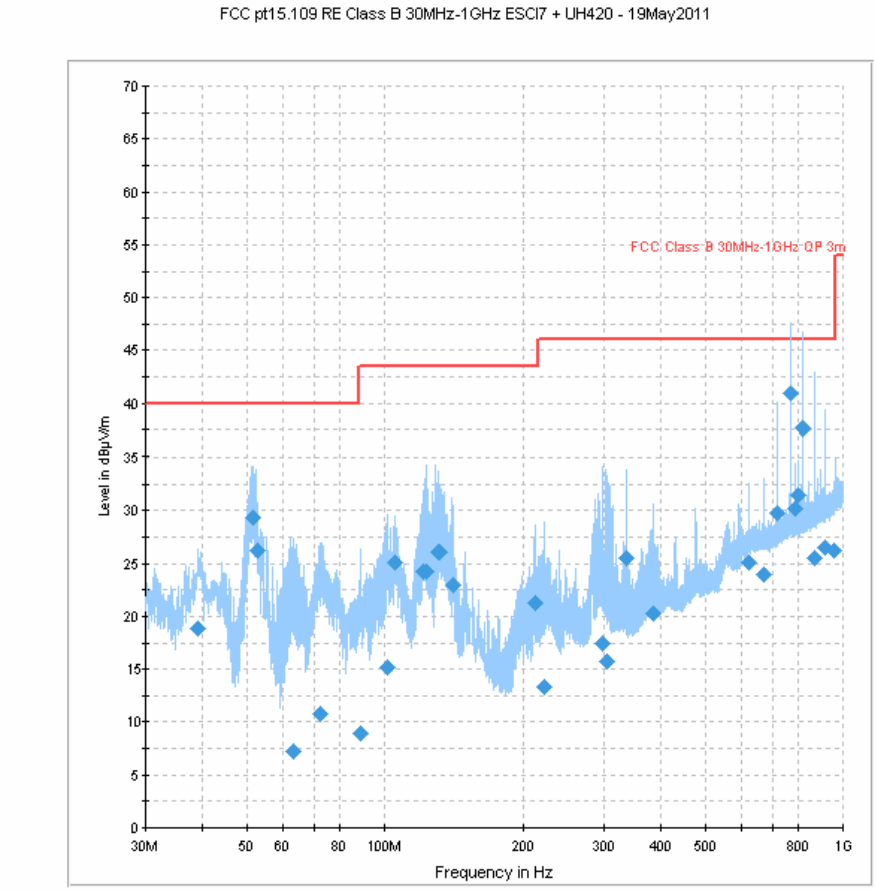
TRaC Global LTD

Powerline Conduction 150kHz - 30MHz

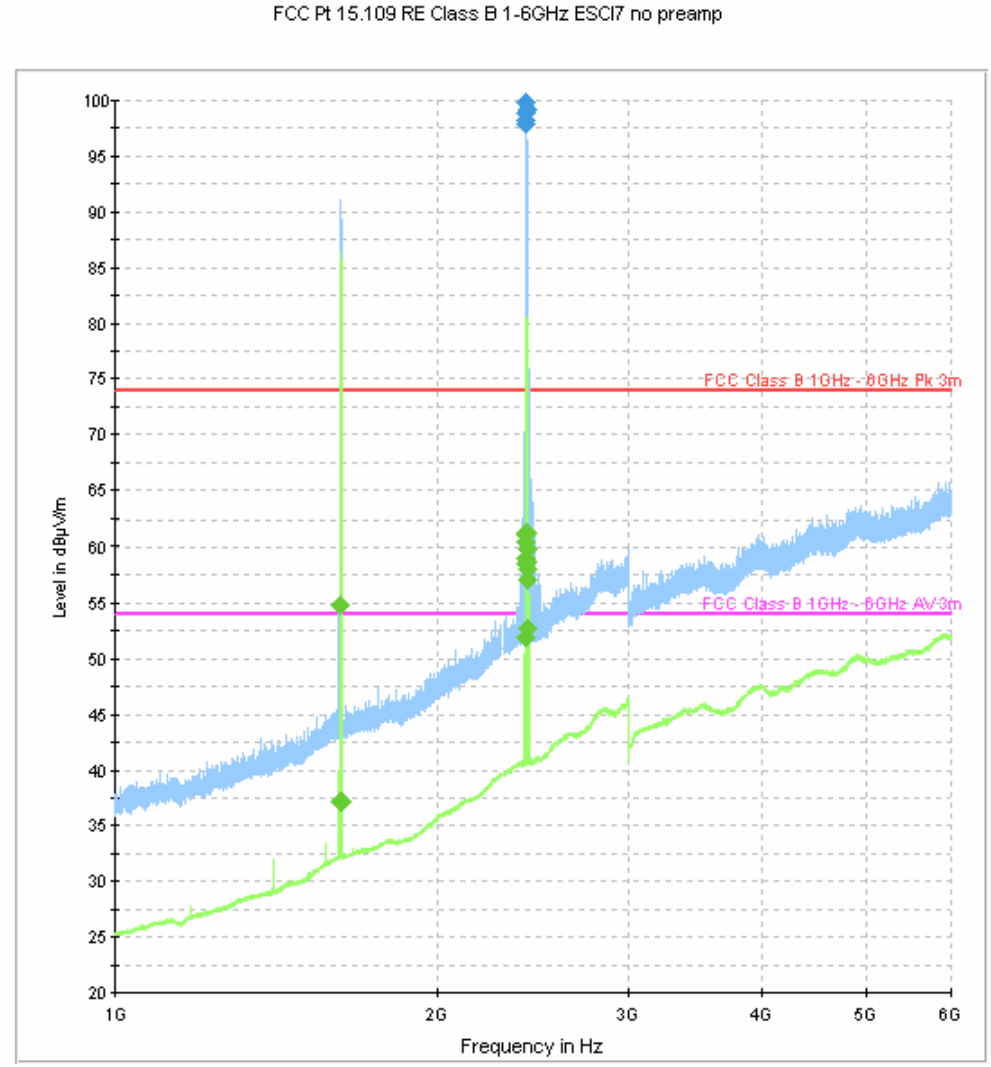
EUT:	Iridium 9560 Wi-Fi Access Point with satellite transceiver
Manufacturer:	Iridium Satellite LLC
Operating Conditions:	EUT charging during active call with loudspeaker active.
Operator:	SW
Test Specification:	CFR47 FCC part 15.107 Class B
Comments:	Neutral Line, 120V, 60Hz



RADIATED E-FIELD EMISSIONS

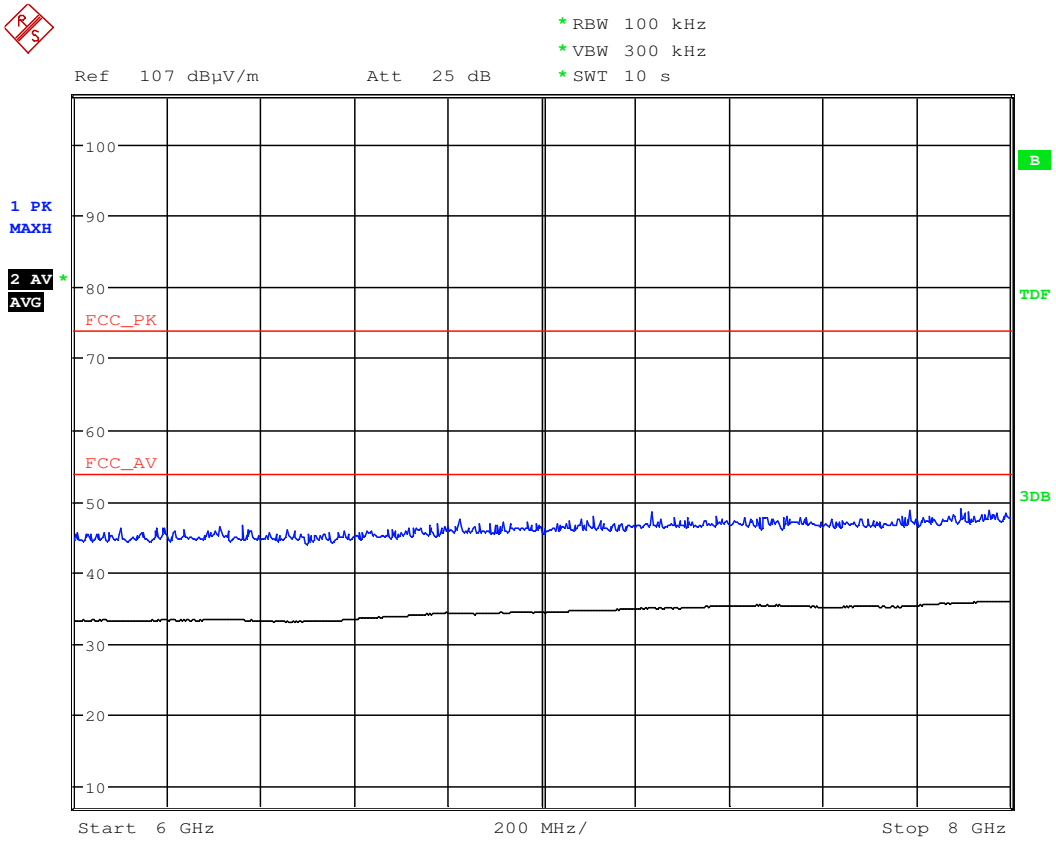


Horizontal & Vertical polarisation 1GHz – 6GHz

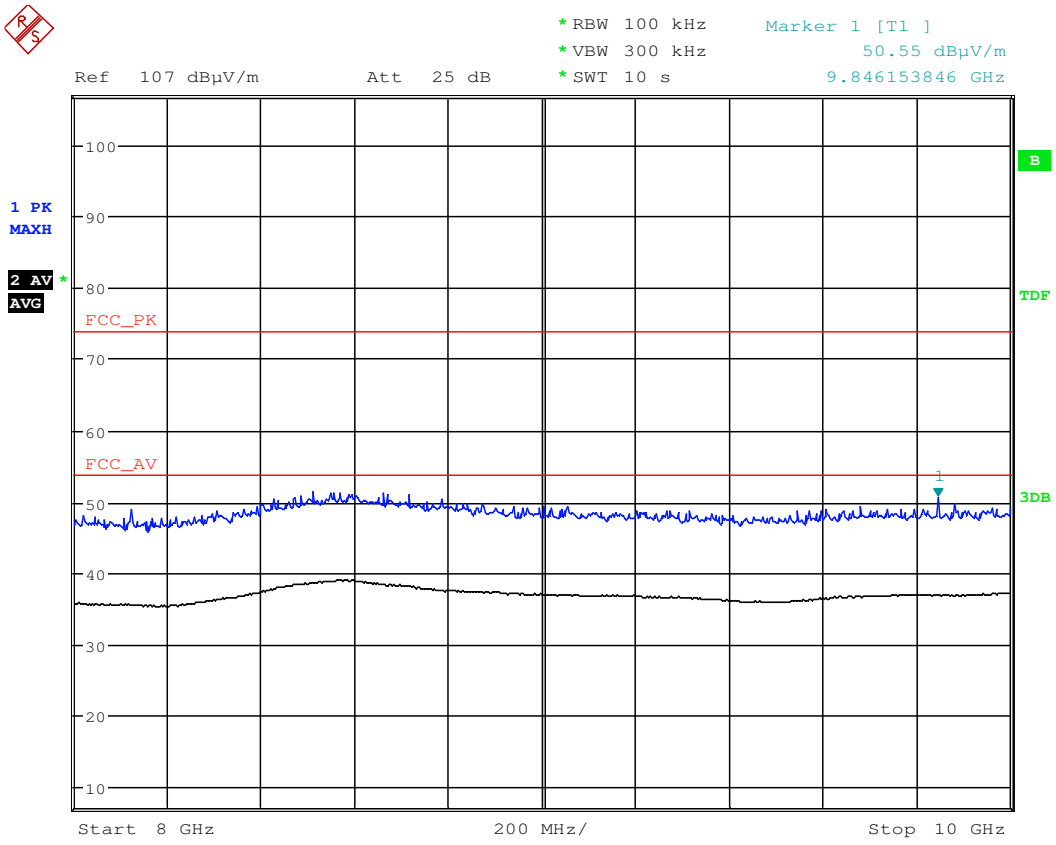


- *Note that the emission observed at 1.61 GHz and the 2.4GHz is the intentional transmission of the wifi module and the iridium network and therefore falls under radio approval and are not covered under the scope of this EMC test report.*

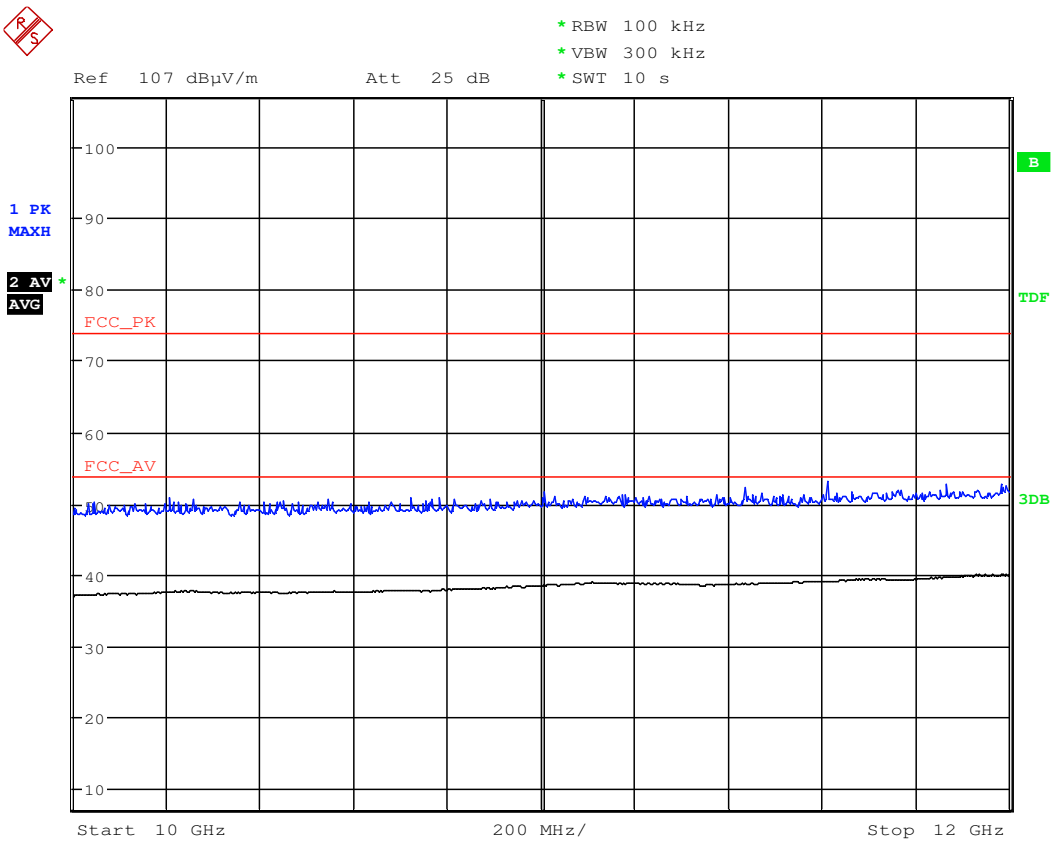
Vertical polarisation 6GHz – 8GHz



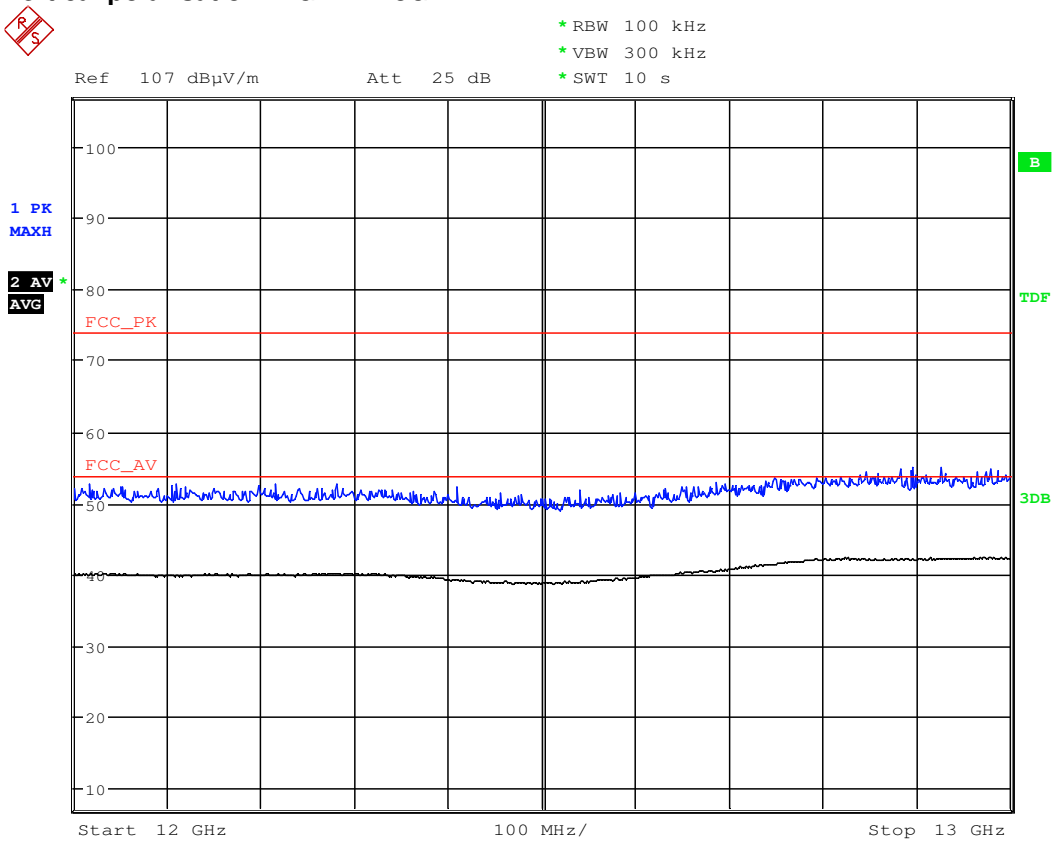
Vertical polarisation 8GHz – 10GHz



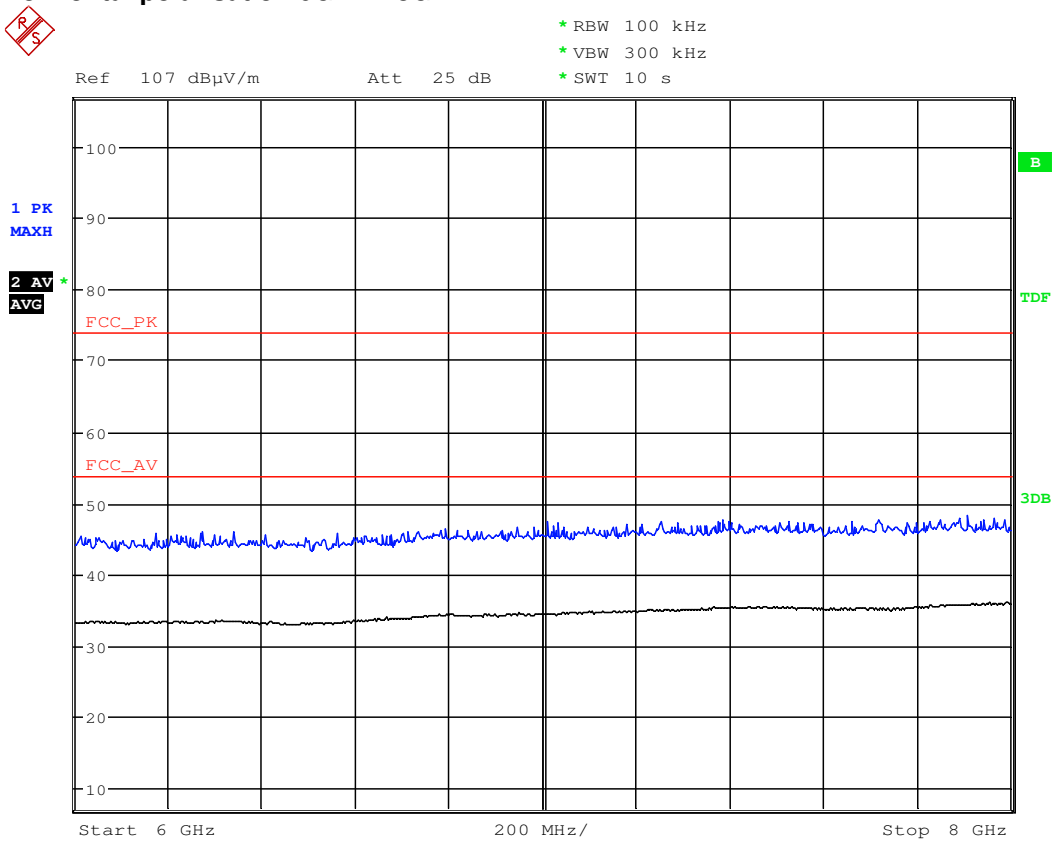
Vertical polarisation 10GHz – 12GHz



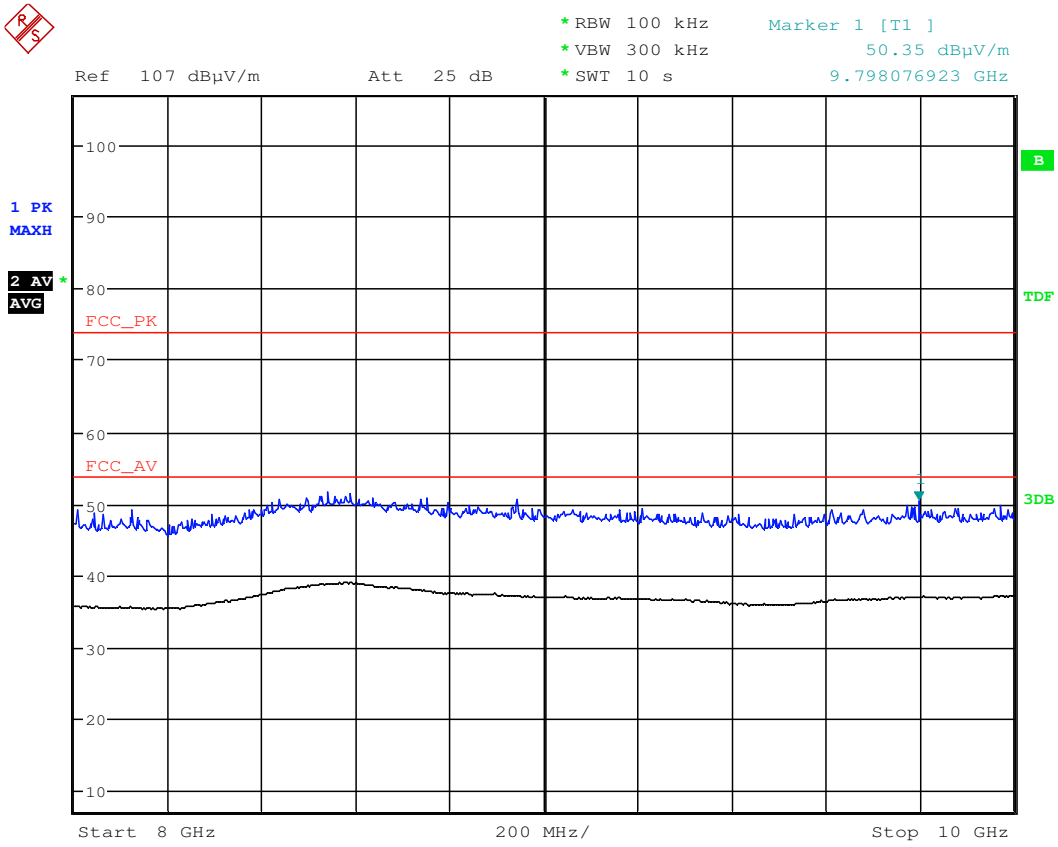
Vertical polarisation 12GHz – 13GHz



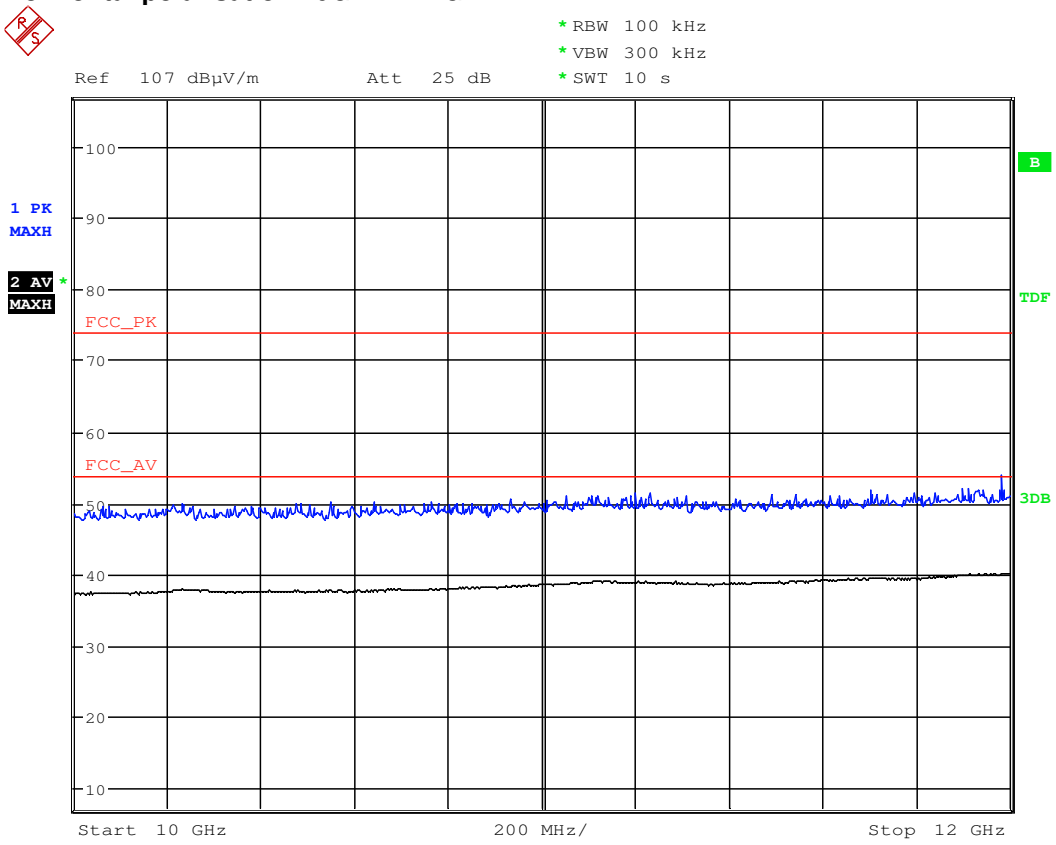
Horizontal polarisation 6GHz – 8GHz



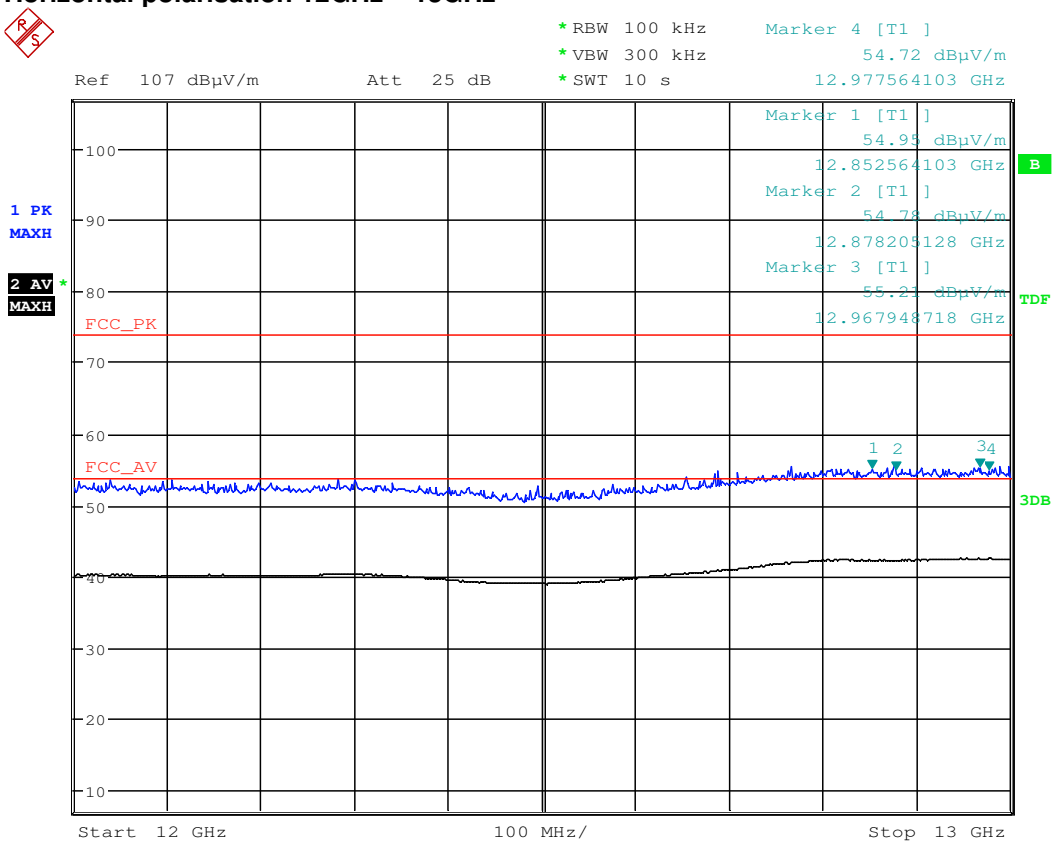
Horizontal polarisation 8GHz – 10GHz



Horizontal polarisation 10GHz – 12GHz



Horizontal polarisation 12GHz – 13GHz



APPENDIX B

EMC TEST MEASUREMENT UNCERTAINTY

Measurement Uncertainty

SCHEDULE A – EMC MEASUREMENT UNCERTAINTY (LAB BASED)

Static Discharge

Tolerance Parameter	UH01	UH85	L697	L327	RESD1	RFG639	Tolerance
Negative Discharge Current at 2kV	13.40%	11.18%	24.95%	14.98%	11.31%	17.35%	**30%**
Negative Discharge Current at 8kV	28.10%	11.96%	24.03%	14.06%	6.85%	11.93%	**30%**
Negative Discharge Voltage	3.76%	2.95%	5.97%	3.33%	3.20%	5.73%	**10%**
Negative Rise Time at 2kV	7.24%	1.58%	9.69%	4.52%	4.12%	2.17%	**17.7%**
Negative Rise Time at 8kV	6.06%	2.17%	3.81%	1.34%	3.18%	5.46%	**17.7%**
Positive Discharge Current at 2kV	19.70%	11.18%	13.55%	10.70%	10.09%	14.74%	**30%**
Positive Discharge Current at 8kV	28.10%	11.96%	20.09%	15.24%	6.97%	18.13%	**30%**
Positive Discharge Voltage	4.35%	2.95%	6.28%	3.71%	2.52%	7.26%	**10%**
Positive Rise Time at 2kV	3.72%	5.81%	5.58%	11.57%	1.51%	4.52%	**17.7%**
Positive Rise Time at 8kV	6.06%	5.81%	12.40%	12.04%	1.07%	2.75%	**17.7%**

Voltage Surge (1.2/50µs)

Tolerance Parameter	UH42	L449	U159	RBEST1	RFG639	TRL429	Tolerance
Positive Voltage	5.78%	10.37%	7.99%	6.13%	4.07%	6.88%	**10%**
Negative Voltage	6.43%	7.33%	8.42%	5.34%	5.68%	6.88%	**10%**
Positive Duration	14.50%	12.86%	3.54%	19.22%	19.43%	6.29%	**20%**
Negative Duration	12.45%	-16.66µs	3.73%	19.02%	9.71%	5.88%	**20% / +10,-25µs**
Positive Front Time	19.83%	16.97%	19.21%	10.67%	28.47%	25.80%	**30%**
Negative Front Time	18.96%	18.57%	18.50%	12.14%	28.47%	27.50%	**30%**
Peak Current	9.10%	9.76%	9.76%	7.71%	8.61%	9.10%	**10%**
Duration (8/20µS)	13.47%	5.26%	14.67%	11.14%	16.74%	9.46%	**10%**
Front Time (8/20µS)	7.14%	10.00%	28.12%	8.59%	11.50%	9.67%	**10%**
Current Undershoot	Outside Tolerance	Inside Tolerance	Inside Tolerance	Inside Tolerance	Inside Tolerance	Outside Tolerance	**30% of Peak Current**

Transients (5/50ns)

Tolerance Parameter	L448	U161	L429	RFG639	RBEST1	UH9	Tolerance
Positive Voltage	3.31%	9.37%	7.25%	9.71%	7.71%	5.92%	**10%**
Negative Voltage	4.55%	7.03%	4.59%	6.02%	8.80%	5.26%	**10%**
Source impedance (positive waveform)	8.07%	7.67%	14.53%	17.77%	8.80%	6.45%	**20%**
Source impedance (negative waveform)	N/A	N/A	N/A	N/A	2.82%	N/A	**20%**
Pulse Parameters (positive waveform)	4.87%	13.82%	22.08%	17.77%	9.83%	19.51%	**30%**
Pulse Parameters (negative waveform)	4.06%	8.90%	12.19%	4.57%	8.07%	18.69%	**30%**
Burst Parameters	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	**10%**

Voltage Dips and Short Interruptions

Tolerance Parameter	TRLUH160	TRL450	RBEST1	RFG639	TRL429	Tolerance
Event Duration	1.00%	1.00%	1%	1.00%	1.00%	**10%**
Repetition Time	1.00%	1.00%	1%	1.00%	1.00%	**10%**
Supply Regulation	<5µs	<5µs	<5µs	<5 µs	<5µs	**<5µs**
Phase Delay	2.98%	2.98%	2.98	1.00%	2.98%	**10%**
Switching time at 90 degrees	3.9µs	2.95µs	2.45	1.9 µs	2.42µs	**1-5µs**
Switching time at 270 degrees	3.9µs	3.04µs	2.86	2.1 µs	2.12µs	**1-5us**

SCHEDULE A – EMC MEASUREMENT UNCERTAINTY (LAB BASED)

All uncertainties listed are standard uncertainties multiplied by a coverage factor K=2.00 for to give a 95% confidence level.

Conducted Emissions Including Discontinuous Emissions

[1] Conducted Emissions 9kHz to 150kHz = **3.7dB**
[2] Conducted Emissions 150kHz to 30MHz = **3.4dB**

Disturbance Power Emissions

[1] Disturbance Power 30MHz – 300MHz = **2.3dB**

Radiated Emissions

[1] Radiated Emissions 30MHz to 1GHz using Bilog CBL6112 Antenna = **4.6dB**
[2] Radiated Emissions 1GHz-6GHz using R&S Log Periodic Antenna = **5.5dB**

Conducted Immunity CDN Testing

[1] Re-establishment of pre-calibrated field = **1.6dB**
[2] Limiting of injected level using monitor coil = **2.1dB**

Conducted Immunity Clamp Testing

[1] Re-establishment of pre-calibrated field = **3.4dB**
[2] Limiting of injected level using monitor coil = **2.6dB**

Radiated Immunity 80MHz – 3GHz

[1] Re-establishment of pre-calibrated field level = **2.12dB**
[2] Dynamic feedback calibrated field level = **2.16dB**

Radiated Immunity 3GHz – 6GHz

[1] Re-establishment of pre-calibrated field level = **2.23dB**
[2] Dynamic feedback calibrated field level = **2.26dB**

Power Frequency magnetic Field

[1] Magnetic field immunity up to 1000A/m DC-400Hz = **1.7dB**

Spurious Emissions up to 18GHz

[1] Uncertainty in test result = **4.75dB**

Cable Calibrations

[1] Cable calibration up to 18GHz = **0.4dB**

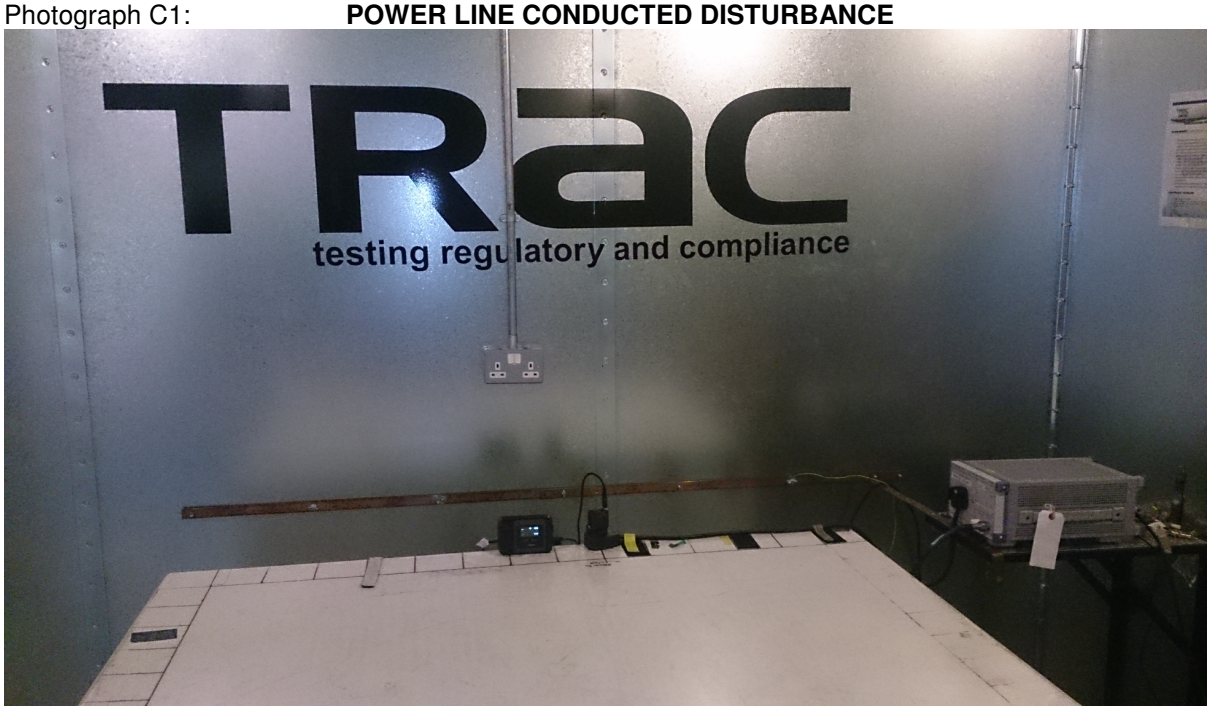
Mains Harmonics and Flicker

DMax = **3.4%**
Flicker (Psc, Dc, Dt) = **3.5%**
Harmonics = **1.54%**

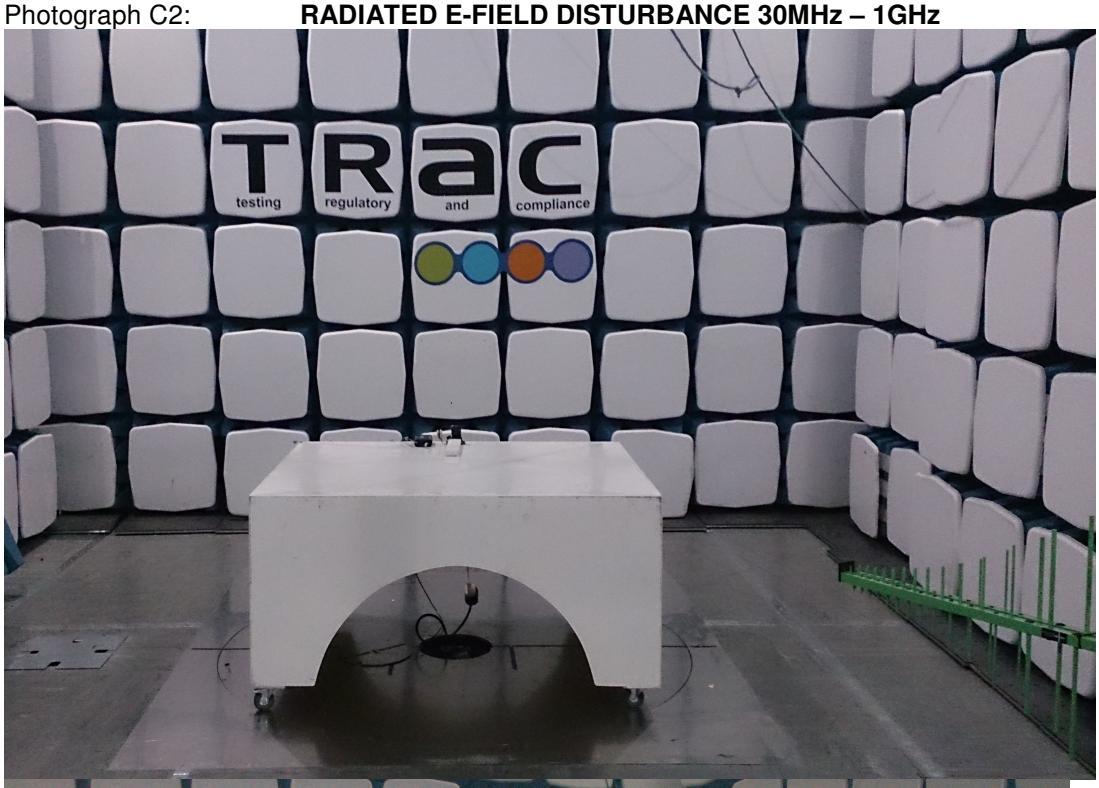
APPENDIX C

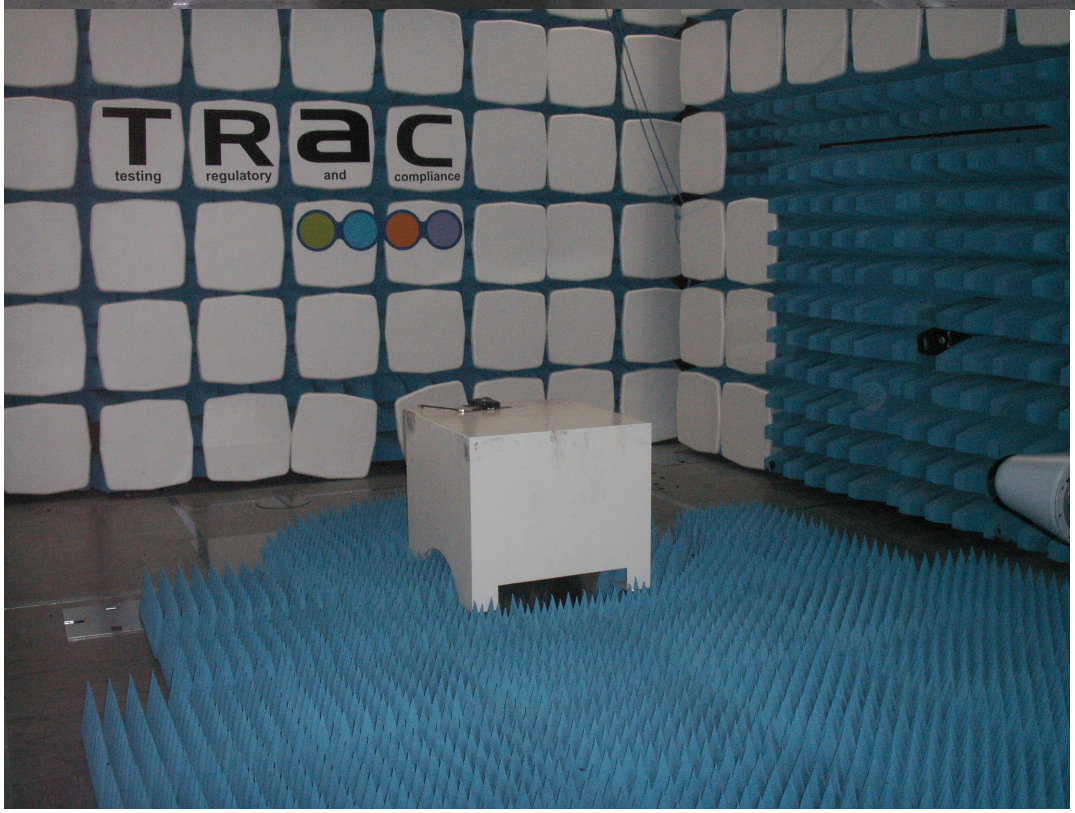
PHOTOGRAPHS

Photograph C1: **POWER LINE CONDUCTED DISTURBANCE**



Photograph C2: **RADIATED E-FIELD DISTURBANCE 30MHz – 1GHz**





APPENDIX D

ADDITIONAL INFORMATION

ADDITIONAL INFORMATION

NB: The contents of this page and the attached manufacturers/clients declaration are not covered by the scope of the laboratory's UKAS accreditation.

The following page(s) have been issued by the client following a change in EUT Model/Type number designation from that shown on the photographs contained within this report and as originally specified during the testing phase.