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Report On

FCC and Industry Canada Testing of the
Ultra Electronics Ltd Helix

In accordance with FCC 47 CFR Part 15C, Industry Canada RSS-210
and Industry Canada RSS-GEN

COMMERCIAL-IN-CONFIDENCE

FCC ID: XDW3663-0001

IC: Not Applicable

Document 75933746 Report 01 Issue 1

April 2016



Product Service

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Document 75933746 Report 01 Issue 1

April 2016

PREPARED FOR

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Authorised Signatory

DATED

04 April 2016

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 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

G Lawler

M Choudhury





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Product Service

SECTION 1

REPORT SUMMARY

FCC and Industry Canada Testing of the
Ultra Electronics Ltd Helix
In accordance with FCC 47 CFR Part 15C, Industry Canada RSS-210 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 Ultra Electronics Ltd Helix to the requirements of FCC 47 CFR Part 15C, Industry Canada RSS-210 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	Ultra Electronics Ltd
Model Number(s)	Helix
Serial Number(s)	Not serialised (75933746-TSR0001)
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C (2015) Industry Canada RSS-210 (Issue 8, 2010) Industry Canada RSS-GEN (Issue 4, 2014)
Incoming Release Date	Application Form 23 February 2016
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	3791-00 17 February 2016
Start of Test	8 March 2016
Finish of Test	15 March 2016
Name of Engineer(s)	G Lawler M Choudhury
Related Document(s)	ANSI C63.10: 2013 KDB 558074 D01 v03 r04



1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-210	RSS-GEN			
Transmit						
2.1	15.207	-	8.8	AC Line Conducted Emissions	Pass	
2.2	15.225 (a)(b)(c)(d)	A2.6	-	Field Strength of any Emission	Pass	
2.3	15.225 and 15.215 (c)	-	6.6	Occupied Bandwidth	Pass	
2.4	15.225 (e)	A2.6	-	Frequency Tolerance Under Temperature Variations	Pass	



1.3 APPLICATION FORM

EQUIPMENT DESCRIPTION	
Model Name/Number	Helix
Part Number	3663-xxxx-yy
Hardware Version	1.0
Software Version	1.45
FCC ID (if applicable)	XDW3663-0001
Industry Canada ID (if applicable)	
Technical Description (Please provide a brief description of the intended use of the equipment)	Printer for ID cards

POWER SOURCE	
<input checked="" type="checkbox"/> AC mains	State voltage 100 - 240VAC
AC supply frequency	50/60 (Hz)
100-240	VAC
2.2A	Max Current
50/60	Hz
<input checked="" type="checkbox"/> Single phase	<input type="checkbox"/> Three phase
And / Or	
<input type="checkbox"/> External DC supply	
Nominal voltage	V Max Current A
Extreme upper voltage	V
Extreme lower voltage	V
Battery	
<input type="checkbox"/> Nickel Cadmium	<input type="checkbox"/> Lead acid (Vehicle regulated)
<input type="checkbox"/> Alkaline	<input type="checkbox"/> Leclanche
<input type="checkbox"/> Lithium	<input type="checkbox"/> Other Details :
Volts nominal.	
End point voltage as quoted by equipment manufacturer	V



FREQUENCY INFORMATION			
Frequency Range	13.553 to 13.567	MHz	
Channel Spacing (where applicable)			
Receiver Frequency Range (if different)	13.09625 to 14.02375	MHz	
Channel Spacing (if different)			
Test Frequencies*	Bottom	MHz	Channel Number (if applicable)
	Middle	MHz	Channel Number (if applicable)
	Top	MHz	Channel Number (if applicable)
Intermediate Frequencies		MHz	
Highest Internally Generated Frequency :	200 MHz		

POWER CHARACTERISTICS			
Maximum TX power	0.1	W	
Minimum TX power		W (if variable)	
Is transmitter intended for :			
Continuous duty		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Intermittent duty		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
If intermittent state DUTY CYCLE			
Transmitter ON	<0.01 seconds		
Transmitter OFF	>1 seconds		

ANTENNA CHARACTERISTICS			
<input type="checkbox"/> Antenna connector		State impedance	Ohm
<input type="checkbox"/> Temporary antenna connector		State impedance	Ohm
<input checked="" type="checkbox"/> Integral antenna	Type Coil	State impedance	n/a dBi
<input type="checkbox"/> External antenna	Type	State impedance	dBi

MODULATION CHARACTERISTICS			
<input checked="" type="checkbox"/> Amplitude		<input type="checkbox"/> Frequency	
<input type="checkbox"/> Phase		<input type="checkbox"/> Other (please provide details):	
Can the transmitter operate un-modulated?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	

CLASS OF EMISSION USED	
ITU designation or Class of Emission:	
1 A1D	
(if applicable) 2	
(if applicable) 3	
If more than three classes of emission, list separately:	



Product Service

BATTERY POWER SUPPLY	
Model name/number	Identification/Part number
Manufacturer	Country of Origin

ANCILLARIES (If applicable)	
Model name/number	Identification/Part number
Manufacturer	Country of Origin

EXTREME CONDITIONS					
Extreme test voltages (Max)	126.5	V	Extreme test voltages (Mix)	93.5	V
Nominal DC Voltage	110	V	DC Maximum Current		A
Maximum temperature	+50	°C	Minimum temperature	-20	°C

I hereby declare that that the information supplied is correct and complete.

Name: Tim Last Position held: Design Engineer
 Date: 23/02/16



Product Service

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Ultra Electronics Ltd Helix. 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 an AC/DC Adapter containing a switch mode power supply, which was connected to a 110 V, 60 Hz supply. The EUT was powered using this configuration for all tests unless otherwise stated.

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.



Product Service

SECTION 2

TEST DETAILS

FCC and Industry Canada Testing of the
Ultra Electronics Ltd Helix
In accordance with FCC 47 CFR Part 15C, Industry Canada RSS-210
and Industry Canada RSS-GEN



Product Service

2.1 AC LINE CONDUCTED EMISSIONS

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.207
Industry Canada RSS-GEN, Clause 8.8

2.1.2 Equipment Under Test and Modification State

Helix S/N: Not serialised (75933746-TSR0001) - Modification State 0

2.1.3 Date of Test

9 March 2016

2.1.4 Test Equipment Used

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

2.1.5 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 6.2 and Industry Canada RSS-GEN, clause 8.8.

Remarks

A mains supply cable of 1 m length was used to supply mains power to the EUT from the LISN.

All final measurements were assessed against the emission limits in Clause 15.207 of FCC 47 CFR Part 15 Industry Canada RSS-GEN, clause 8.8.

2.1.6 Environmental Conditions

Ambient Temperature	20.4°C
Relative Humidity	31.0%

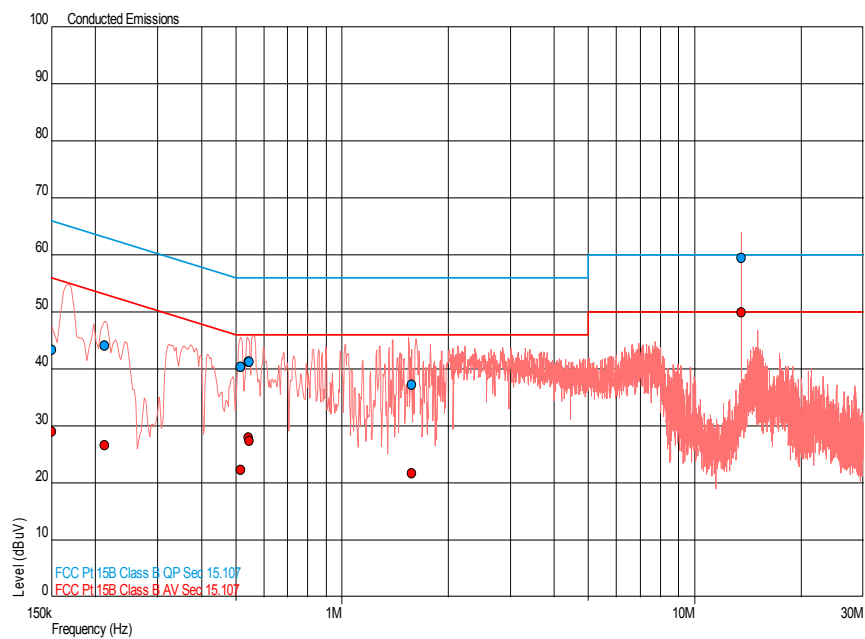


2.1.7 Test Results

Transmit, Live Line, AC Line Conducted Emissions Results

Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dBμV)	AV Level (dBμV)	AV Limit (dBμV)	AV Margin (dBμV)
0.150	43.3	66.0	-22.7	29.1	56.0	-26.9
0.212	44.1	63.1	-19.0	26.6	53.1	-26.5
0.517	40.4	56.0	-15.6	22.4	46.0	-23.6
0.542	41.3	56.0	-14.7	28.0	46.0	-18.0
0.546	41.2	56.0	-14.8	27.3	46.0	-18.7
1.579	37.2	56.0	-18.8	21.8	46.0	-24.2
13.560	59.5	60.0	-0.5	49.9	50.0	-0.1

Transmit, Live Line, AC Line Conducted Emissions Plot

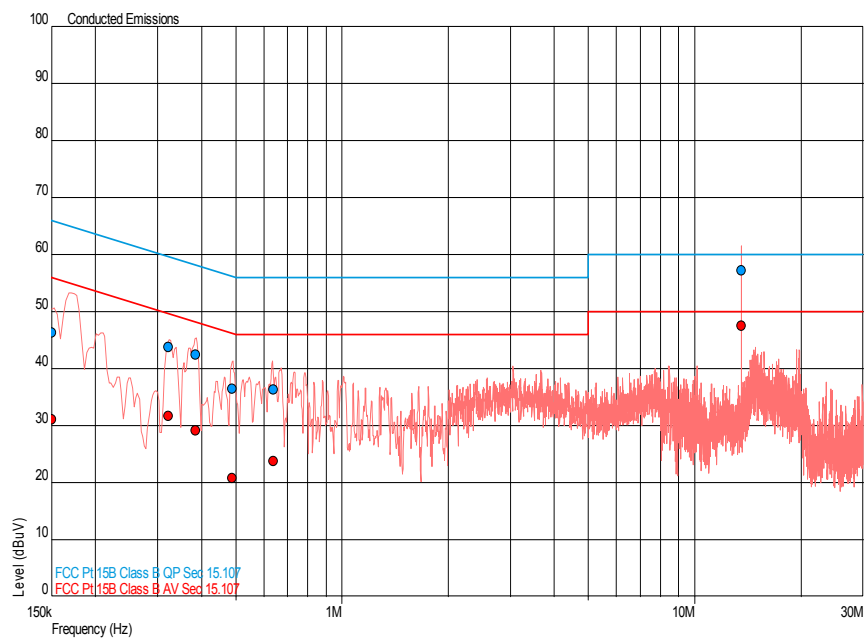




Transmit, Neutral Line, AC Line Conducted Emissions Results

Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dBμV)	AV Level (dBμV)	AV Limit (dBμV)	AV Margin (dBμV)
0.150	46.3	66.0	-19.7	31.1	56.0	-24.9
0.322	43.8	59.7	-15.9	31.7	49.7	-18.0
0.384	42.4	58.2	-15.8	29.2	48.2	-19.0
0.487	36.5	56.2	-19.7	20.8	46.2	-25.4
0.639	36.3	56.0	-19.7	23.8	46.0	-22.2
13.560	57.3	60.0	-2.7	47.6	50.0	-2.4

Transmit, Neutral Line, AC Line Conducted Emissions Plot



FCC 47 CFR Part 15, Limit Clause 15.207

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.



Product Service

Industry Canada RSS-210, Limit Clause 8.8

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average**
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.

** A linear average detector is required



Product Service

2.2 FIELD STRENGTH OF ANY EMISSION

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.225 (a)(b)(c)(d)
Industry Canada RSS-210, Clause A2.6

2.2.2 Equipment Under Test and Modification State

Helix S/N: Not serialised (75933746-TSR0001) - Modification State 0

2.2.3 Date of Test

8 March 2016

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 test was performed in accordance with ANSI C63.10, clause 6.3, 6.4 and 6.5 and Industry Canada RSS-GEN, clause 6.

2.2.6 Environmental Conditions

Ambient Temperature	20.1°C
Relative Humidity	25.0%



Product Service

2.2.7 Test Results

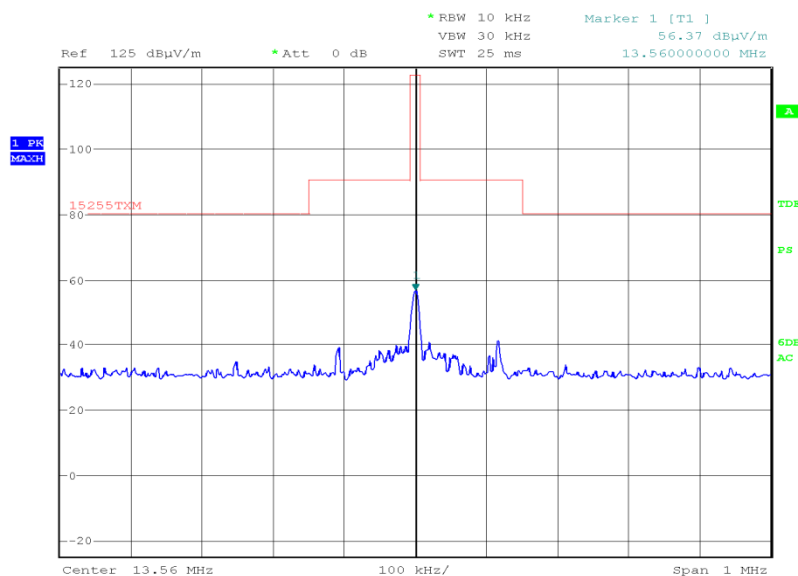
Transmit, Carrier Results

Frequency (MHz)	QP Level (dBμV/m) at 3m	QP Level (μV/m) at 30m	QP Limit (μV/m) at 30m	Angle (°)	Height (m)	Polarity
13.56	56.51	66.91	15848	0	1.5	Face On

*The level at 30m was calculated using the dBμV/m measurement at 3m and extrapolating this result to produce a level at 30m. This value was then converted to obtain the value in μV/m.

$$\begin{aligned}
 \text{'Distance Extrapolation}_{\frac{dB\mu V}{m}}' &= 20 \times \log_{10} \left(\frac{3m}{30m} \right) = -20 \frac{dB\mu V}{m} \\
 \text{'QP Level}_{\frac{\mu V}{m}} \text{ at } 30 \text{ m}' &= 10 \left(\frac{\text{'QP Level}_{\frac{dB\mu V}{m}} \text{ at } 3m' + \text{'Distance Extrapolation}_{\frac{dB\mu V}{m}}'}{20} \right)
 \end{aligned}$$

Transmit, Carrier Plot



Date: 8.MAR.2016 22:54:30



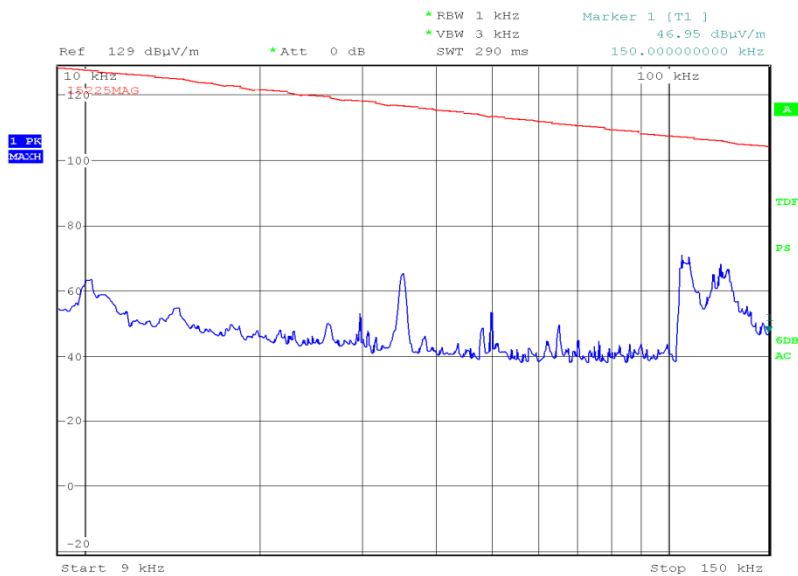
Product Service

Transmit, 9 kHz to 30 MHz, Field Strength of any Emission Results

Frequency (MHz)	QP Level (dBμV/m) at 3m	QP Level (μV/m) at 3m	QP Limit (dBμV/m) at 30m	QP Limit (μV/m) at 30m	Angle (°)	Height (m)	Polarity
*							

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

Transmit, 9 kHz to 150 kHz, Field Strength of any Emission Plot

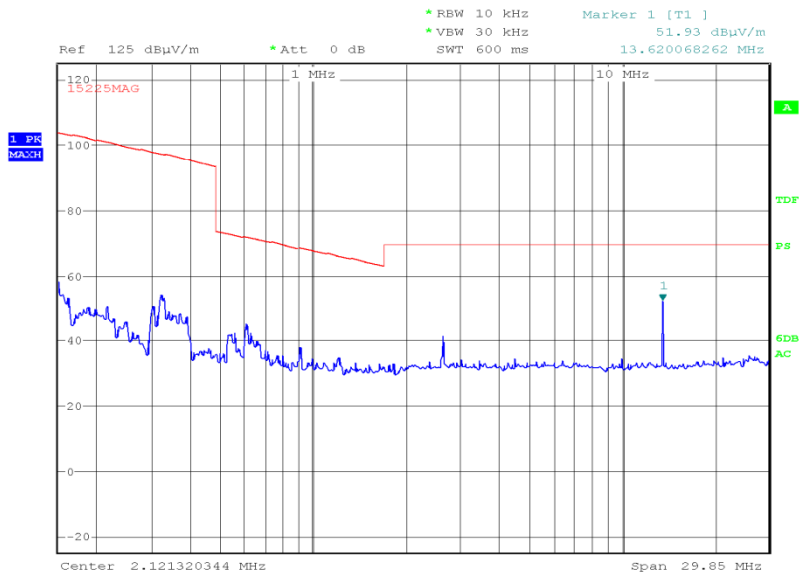


Date: 8.MAR.2016 23:11:14



Product Service

Transmit, 150 kHz to 30 MHz, Field Strength of any Emission Plot



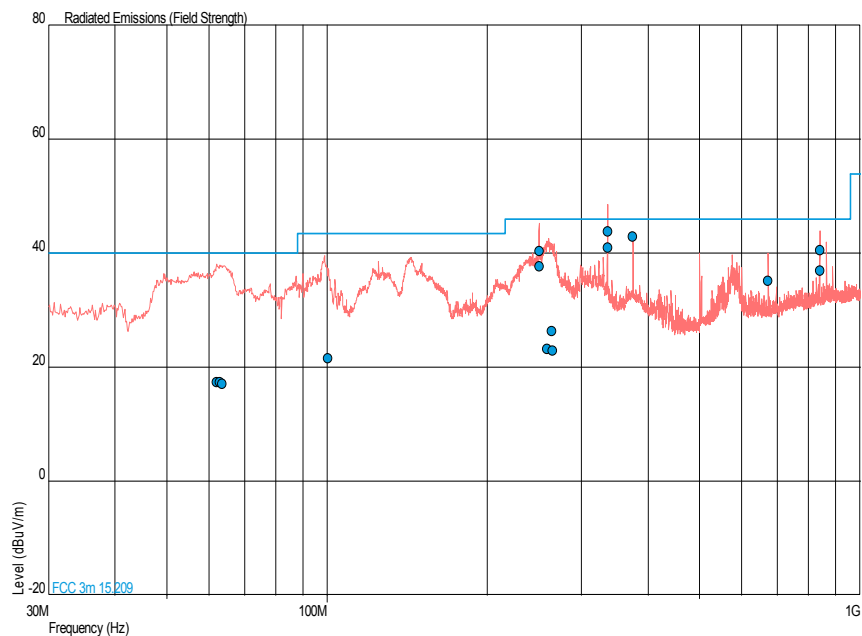
Date: 8.MAR.2016 23:04:30



Transmit, 30 MHz to 1 GHz, Field Strength of any Emission Results

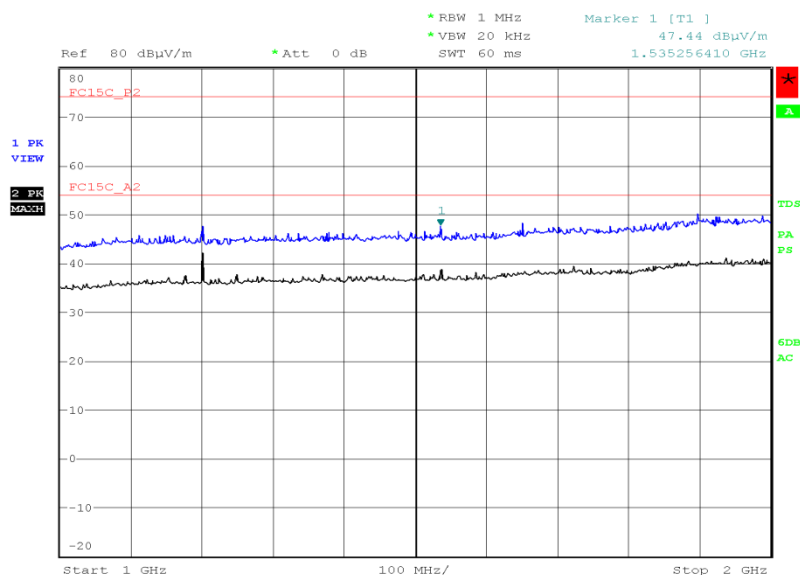
Frequency (MHz)	Quasi-Peak Level (dBμV/m)	Quasi-Peak Level (μV/m)	Quasi-Peak Margin (dBμV/m)	Quasi-Peak Margin (μV/m)	Angle (°)	Height (m)	Polarisation
62.056	17.3	7.3	-22.7	-92.7	31	1.00	Vertical
62.813	17.4	7.4	-22.6	-92.6	47	1.00	Vertical
63.563	17.1	7.2	-22.9	-92.8	26	1.00	Vertical
100.308	21.6	12.0	-21.9	-138.0	171	1.00	Vertical
249.988	40.4	104.7	-5.6	-95.3	335	1.00	Vertical
249.998	37.7	76.7	-8.3	-123.3	99	1.00	Horizontal
258.577	23.2	14.5	-22.8	-185.5	149	1.00	Horizontal
263.991	26.3	20.7	-19.7	-179.3	224	1.00	Horizontal
264.989	22.9	14.0	-23.1	-186.0	360	1.00	Horizontal
335.976	41.0	112.2	-5.0	-87.8	317	1.00	Vertical
335.997	43.8	154.9	-2.2	-45.1	335	1.00	Horizontal
374.989	42.9	139.6	-3.1	-60.4	208	1.00	Horizontal
671.964	35.2	57.5	-10.8	-142.5	7	1.00	Horizontal
839.958	36.9	70.0	-9.1	-130.0	48	1.00	Vertical
839.975	40.5	105.9	-5.5	-94.1	326	1.28	Horizontal

Transmit, 30 MHz to 1 GHz, Field Strength of any Emission Plot





Transmit, 1 GHz to 2 GHz, Field Strength of any Emission Plot



Date: 8.MAR.2016 22:26:32

FCC 47 CFR Part 15, Limit Clause 15.225 (a)(b)(c)(d)

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (m)
0.009 to 0.490	2400/F (kHz)	300
0.490 to 1.705	24000/F (kHz)	30
1705 to 30	30	30
30 to 88	100**	3
88 to 216	150**	3
216 to 960	200**	3
Above 960	500	5



Product Service

Industry Canada RSS-210, Limit Clause A2.6

Frequency Band	Limit
within the band 13.553-13.567 MHz	15.848 millivolts/m (84 dB μ V/m) at 30 m
within the bands 13.410-13.553 MHz and 13.567-13.710 MHz	334 microvolts/m (50.5 dB μ V/m) at 30 m
within the bands 13.110-13.410 MHz and 13.710-14.010 MHz	106 microvolts/m (40.5 dB μ V/m) at 30 m
outside the band 13.110-14.010 MHz	30 microvolts/m (29.5 dB μ V/m) at 30 m



Product Service

2.3 OCCUPIED BANDWIDTH

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.225 and 15.215 (c)
Industry Canada RSS-GEN, Clause 6.6

2.3.2 Equipment Under Test and Modification State

Helix S/N: Not serialised (75933746-TSR0001) - Modification State 0

2.3.3 Date of Test

15 March 2016

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 test was performed in accordance with ANSI C63.10, clause 6.9.1 and Industry Canada RSS-GEN, clause 6.6.

2.3.6 Environmental Conditions

Ambient Temperature	22.6°C
Relative Humidity	28.6%



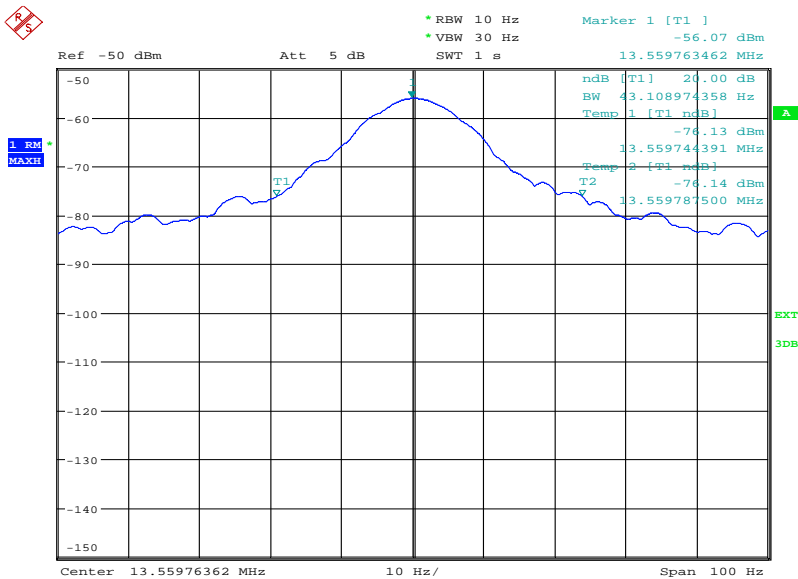
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2.3.7 Test Results

Transmit, Occupied Bandwidth Results

Frequency (MHz)	20 dB Bandwidth (Hz)
13.56	43.11

Transmit, Occupied Bandwidth Plot



Date: 15.MAR.2016 11:36:46

FCC 47 CFR Part 15C, Limit Clause 15.215 (c)

The 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Industry Canada RSS-210, Limit Clause

None specified



Product Service

2.4 FREQUENCY TOLERANCE UNDER TEMPERATURE VARIATIONS

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.225 (e)
Industry Canada RSS-210, Clause A2.6

2.4.2 Equipment Under Test and Modification State

Helix S/N: Not serialised (75933746-TSR0001) - Modification State 0

2.4.3 Date of Test

11 March 2016, 14 March 2016 & 15 March 2016

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

The test was performed in accordance with ANSI C63.10, clause 6.8 and Industry Canada RSS-GEN, clause 6.11.

2.4.6 Environmental Conditions

Ambient Temperature	22.6 - 25.5°C
Relative Humidity	13.9 - 28.6%



2.4.7 Test Results

Transmit, RFID, Frequency Tolerance Under Temperature Variations Results

Temperature Interval (°C)	Voltage	Fundamental Frequency (MHz)	Fundamental Frequency Deviation (%)
-20	110 V AC	13.559778846	0.0016
-10	110 V AC	13.559812500	0.0014
0	110 V AC	13.559822115	0.0013
+10	110 V AC	13.559793269	0.0015
+20	93.5 V AC	13.559762821	0.0017
+20	110 V AC	13.559762821	0.0017
+20	126.5 V AC	13.559762821	0.0017
+30	110 V AC	13.559754808	0.0018
+40	110 V AC	13.559721154	0.0021
+50	110 V AC	13.559697115	0.0022

FCC 47 CFR Part 15C, Limit Clause 15.225(e)

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency.

Industry Canada RSS-210, Limit Clause A.2.6

The carrier frequency stability shall be maintained to $\pm 0.01\%$ ($\pm 100\text{ppm}$).



Product Service

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 (months)	Calibration Due
Section 2.1 – AC Line Conducted Emissions					
LISN (1 Phase)	Chase	MN 2050	336	12	1-Apr-2016
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Transient Limiter	Hewlett Packard	11947A	2378	12	1-Jul-2016
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	2-Nov-2016
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
Section 2.2 - Field Strength of any Emission					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	27-Nov-2016
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Antenna (Active Loop, 9kHz-30MHz)	Rohde & Schwarz	HFH2-Z2	333	24	28-Nov-2016
Antenna (Dish/Tripod/Adaptor, 1GHz-18GHz)	Rohde & Schwarz	AC-008	334	-	TU
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	11-Jun-2017
Test Receiver	Rohde & Schwarz	ESIB40	2941	12	24-Feb-2017
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	2-Nov-2016
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	matur GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	matur GmbH	NCD	3917	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	-	TU
Section 2.3 - Occupied Bandwidth					
RF Coupler	TUV SUD Product Service	RFC1	414	-	TU
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	19-Aug-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	3-Sep-2016
2 metre N-Type Cable	IW Microwave	NPS-1806LC-788-NPS	4502	12	2-Mar-2017
Section 2.4 - Frequency Tolerance Under Temperature Variations					
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	18-Feb-2017
RF Coupler	TUV SUD Product Service	RFC1	414	-	TU
Programmable Power Supply	California Inst	2001RP	1898	-	TU
Montford F43	Montford	4FT CUBED	2126	12	17-Nov-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	19-Aug-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	3-Sep-2016
2 metre N-Type Cable	IW Microwave	NPS-1806LC-788-NPS	4502	12	2-Mar-2017

TU – Traceability Unscheduled



Product Service

3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU
AC Line Conducted Emissions	± 3.2 dB
Field Strength of any Emission	9 kHz to 30 MHz: ± 3.4 dB 30 MHz to 1 GHz: ± 5.1 dB
Occupied Bandwidth	± 3.28 Hz
Frequency Tolerance Under Temperature Variations	± 3.54 Hz



Product Service

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

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
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