



# TEST REPORT

**Test Report No. : UL-RPT-RP11867511-316B V2.0**

**Customer** : Kathrein Sachsen GmbH  
**Model No. / PMN** : ARU3560  
**HVIN** : 52010301  
**FCC ID** : WJ9-ARU3560  
**ISED Certification No.** : IC: 5530C-ARU3560  
**Technologies** : RFID (902 MHz to 928 MHz) &  
WLAN (5150 MHz to 5725 MHz)  
**Test Standard(s)** : FCC Parts 15.209(a) & 15.407  
ISED Canada RSS-247 6.2.1.2, 6.2.3.2 & RSS-Gen 6.13  
**Test Laboratory** : UL VS LTD, Basingstoke, Hampshire, RG24 8AH, United Kingdom

1. This test report shall not be reproduced in full or partial, without the written approval of UL VS LTD.
2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

**Date of Issue:** 27 March 2019

**Checked by:**

Ben Mercer  
Senior Test Engineer, Radio Laboratory

**Company Signatory:**

Sarah Williams  
Senior Test Engineer, Radio Laboratory  
UL VS LTD

This page has been left intentionally blank.

**Table of Contents**

<b>1 Customer Information.....</b>	<b>4</b>
<b>2 Summary of Testing.....</b>	<b>5</b>
2.1 General information	5
2.2 Summary Of Test Results	5
2.3 Methods and Procedures	5
2.4 Deviations from the Test Specification	5
<b>3 Equipment Under Test (EUT) .....</b>	<b>6</b>
3.1 Identification of Equipment Under Test (EUT)	6
3.2 Description of EUT	6
3.3 Modifications Incorporated in the EUT	6
3.4 Additional Information Related to Testing	6
3.5 Description of Available Antennas	7
3.6 Support Equipment	7
3.7 Description of Test Setup	8
<b>4 Operation and Monitoring of the EUT during Testing .....</b>	<b>9</b>
4.1 Operating Modes	9
4.2 Configuration and Peripherals	9
<b>5 Measurements, Examinations and Derived Results .....</b>	<b>10</b>
5.1 General Comments	10
5.2 Test Results	11
5.2.1 Transmitter Out of Band Radiated Emissions - RFID & 5 GHz WLAN bottom channel	11
5.2.2 Transmitter Out of Band Radiated Emissions - RFID & 5 GHz WLAN top channel	14
<b>6 Measurement Uncertainty .....</b>	<b>17</b>
<b>7 Report Revision History .....</b>	<b>18</b>

## **1. Customer Information**

<b>Company Name:</b>	Kathrein Saschen GmbH
<b>Address:</b>	Gewerbegebiet Muehlau, Lindenstrasse 3, Muehlau, 09241 Germany

## **2. Summary of Testing**

### **2.1. General information**

<b>Specification Reference:</b>	47CFR15.407
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) – Section 15.407
<b>Specification Reference:</b>	47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209
<b>Specification Reference:</b>	RSS-Gen Issue 5 April 2018
<b>Specification Title:</b>	General Requirements for Compliance of Radio Apparatus
<b>Specification Reference:</b>	RSS-247 Issue 2 February 2017
<b>Specification Title:</b>	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
<b>Site Registration:</b>	FCC: 621311; ISED Canada: 3245B-3 & 3245B-4
<b>Test Dates:</b>	16 March 2018 to 19 March 2018

### **2.2. Summary Of Test Results**

<b>FCC Reference (47CFR)</b>	<b>ISED Canada Reference</b>	<b>Measurement</b>	<b>Result</b>
15.209(a)/15.407(b)	RSS-247 6.2.1.2 & 6.2.3.2 / RSS-Gen 6.13	Transmitter Out of Band Radiated Emissions	Complied

### **2.3. Methods and Procedures**

<b>Reference:</b>	ANSI C63.10-2013
<b>Title:</b>	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
<b>Reference:</b>	KDB 789033 D02 General UNII Test Procedures New Rules v02r01 December 14, 2017
<b>Title:</b>	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E

### **2.4. Deviations from the Test Specification**

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

### **3. Equipment Under Test (EUT)**

#### **3.1. Identification of Equipment Under Test (EUT)**

<b>Brand Name:</b>	Kathrein RFID
<b>Model Number / PMN:</b>	ARU3560
<b>Test Sample Serial Number:</b>	G0K4485947
<b>Hardware Version:</b>	52010301
<b>Software Version:</b>	3.01.00
<b>FCC ID:</b>	WJ9-ARU3560
<b>ISED Certification Number:</b>	IC: 5530C-ARU3560

#### **3.2. Description of EUT**

The EUT was a UHF RFID Reader System incorporating *Bluetooth*, 2.4 GHz & 5 GHz WLAN technologies.

#### **3.3. Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

#### **3.4. Additional Information Related to Testing**

<b>Technology Tested:</b>	RFID
<b>Type of Unit:</b>	Transceiver
<b>Channel Spacing:</b>	500 kHz
<b>Transmit Frequency Range:</b>	902 MHz to 928 MHz
<b>Transmit Frequency Tested</b>	902.75 MHz

<b>Technology Tested:</b>	WLAN (IEEE 802.11a,n,ac) / U-NII / LE-LAN	
<b>Channel Spacing:</b>	20 MHz	
<b>Modulation:</b>	BPSK	
<b>Data Rate:</b>	802.11n HT20 (SISO)	
<b>Transmit Frequency Range:</b>	5150 MHz to 5725 MHz	
<b>Transmit Channels Tested:</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	36	5180
	140	5700

### **3.5. Description of Available Antennas**

The EUT utilizes integrated patch antennas for the RFID and WLAN band with the following maximum gains. The EUT also supports 3 external antennas which were not supplied.

<b>Antenna Port</b>	<b>Antenna Gain (dBi)</b>
RFID Antenna	6.0
5 GHz WLAN Antenna	4.5

### **3.6. Support Equipment**

The following support equipment was used to exercise the EUT during testing:

<b>Description:</b>	Laptop PC
<b>Brand Name:</b>	Lenovo
<b>Model Name or Number:</b>	E555
<b>Serial Number:</b>	N0599

<b>Description:</b>	Ethernet Cable. Length 5 metres
<b>Brand Name:</b>	Not marked or stated
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

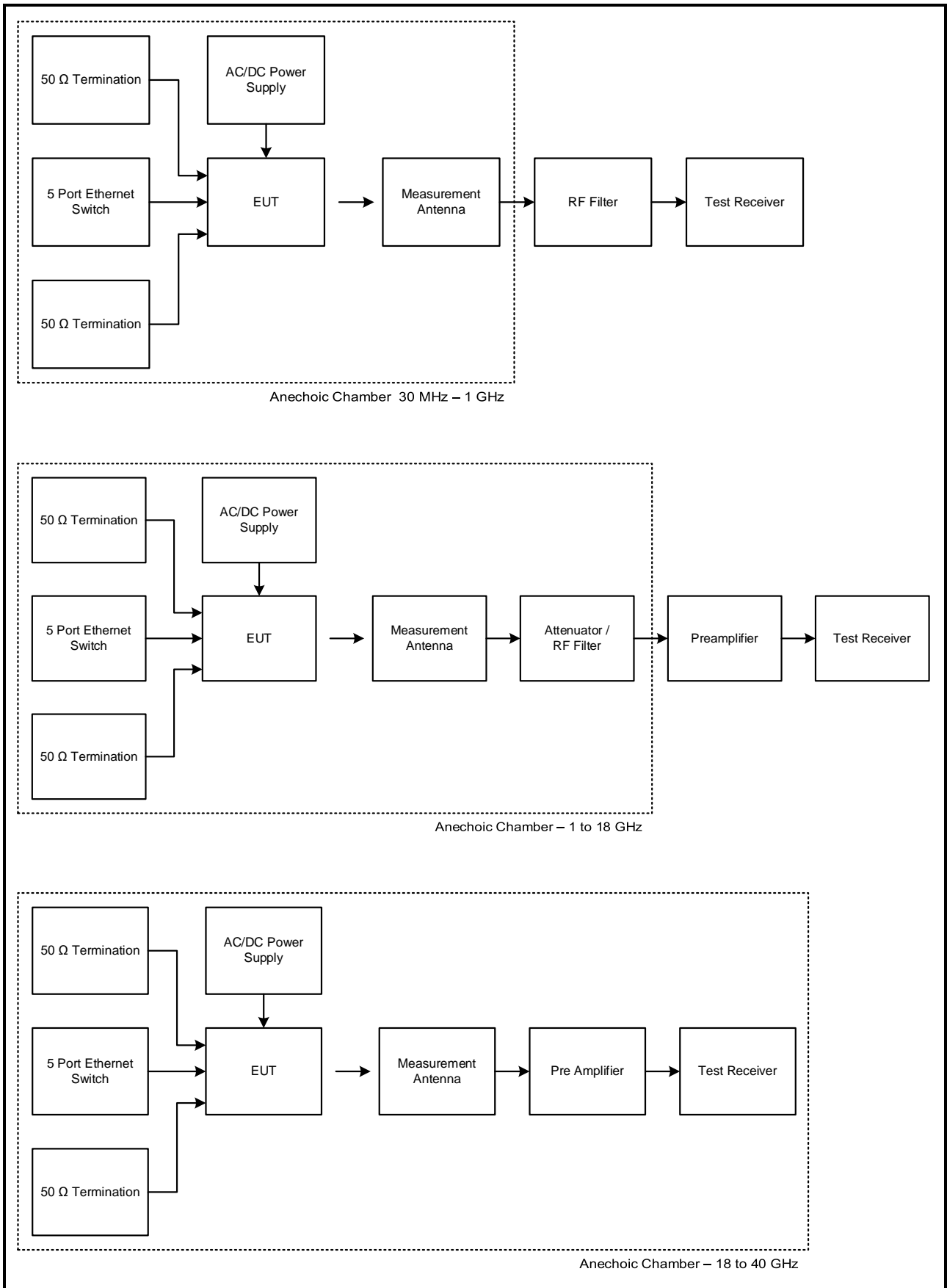
<b>Description:</b>	R-AC TNC-TNCR Antenna cable x2. Length 3 metres
<b>Brand Name:</b>	Not marked or stated
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	Power Supply. 120 VAC Input / 24 VDC output
<b>Brand Name:</b>	Meanwell
<b>Model Name or Number:</b>	GST90A24-P1M
<b>Serial Number:</b>	EB79F8S440

<b>Description:</b>	Ethernet 5 port Switch
<b>Brand Name:</b>	Netgear
<b>Model Name or Number:</b>	GS605
<b>Serial Number:</b>	1YG194390218E

### 3.7. Description of Test Setup

#### Test Setup for Transmitter Radiated Emissions





## **4. Operation and Monitoring of the EUT during Testing**

### **4.1. Operating Modes**

The EUT was tested in the following operating mode(s):

- Transmitting at maximum power on 902.75 MHz RFID and bottom and top channels of 5 GHz WLAN bands.
- The customer declared the worst case 5 GHz WLAN mode as 802.11n 6.5 Mbps 20 MHz channel.

### **4.2. Configuration and Peripherals**

The EUT was tested in the following configuration(s):

- Controlled using a bespoke application supplied by the customer and installed on a laptop PC. The application was used to enable a continuous transmission of both RFID and 5 GHz modes and to select the test channels as required. The customer supplied a document containing the setup instructions '\_\_\_\_RJ ARU Instructions READY". The laptop PC was connected to the EUT via an Ethernet connection.
- RFID and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power (RFID 902.75 MHz and 5 GHz WLAN on bottom channel).
- RFID and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power (RFID 902.75 MHz and 5 GHz WLAN on top channel).
- The EUT was powered via an AC/DC switch mode power supply.
- Two of the external antenna ports were terminated into 50 ohm using the customer supplied antenna cables.

## **5. Measurements, Examinations and Derived Results**

### **5.1. General Comments**

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 6. Measurement Uncertainty for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

## **5.2. Test Results**

### **5.2.1. Transmitter Out of Band Radiated Emissions - RFID & 5 GHz WLAN bottom channel**

#### **Test Summary:**

<b>Test Engineer:</b>	John Ferdinand	<b>Test Dates:</b>	16 March 2018 & 19 March 2018
<b>Test Sample Serial Number:</b>	G0K4485947		

<b>FCC Reference:</b>	Parts 15.209(a) / 15.407
<b>ISED Canada Reference:</b>	RSS-247 6.2.1.2 / RSS-Gen 6.13
<b>Test Method Used:</b>	KDB 789033 & ANSI C63.10 Sections 6.3, 6.5 and 6.6
<b>Frequency Range:</b>	30 MHz to 40 GHz
<b>Configuration:</b>	RFID and 5 GHz WLAN bottom channel

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	20 to 23
<b>Relative Humidity (%):</b>	28 to 31

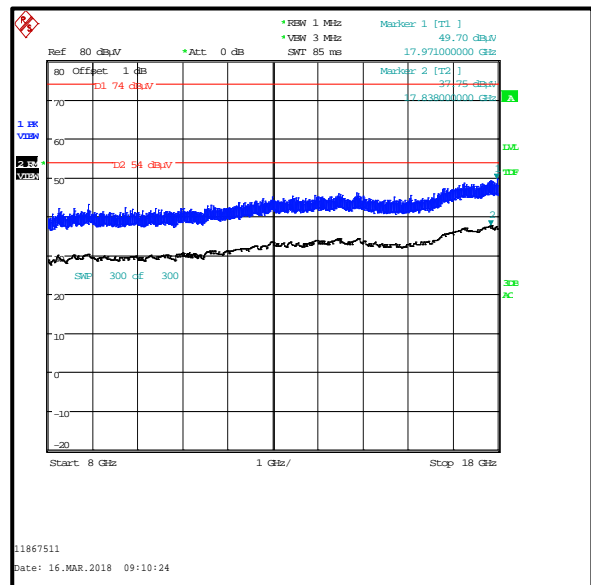
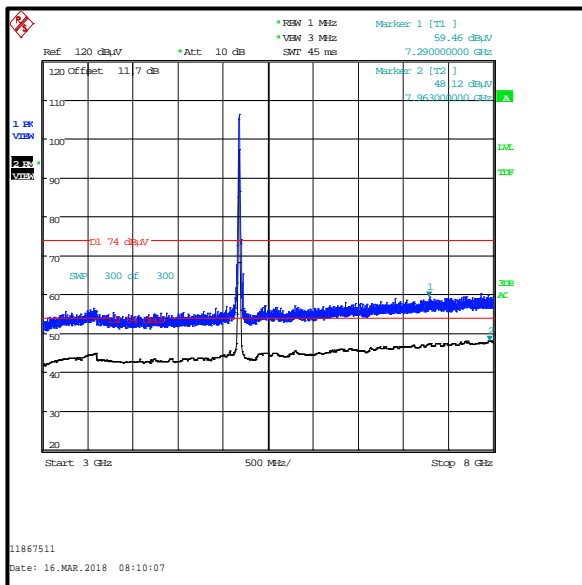
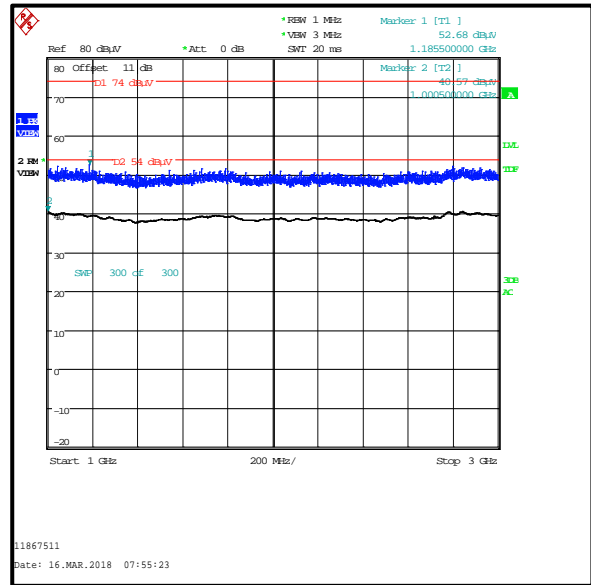
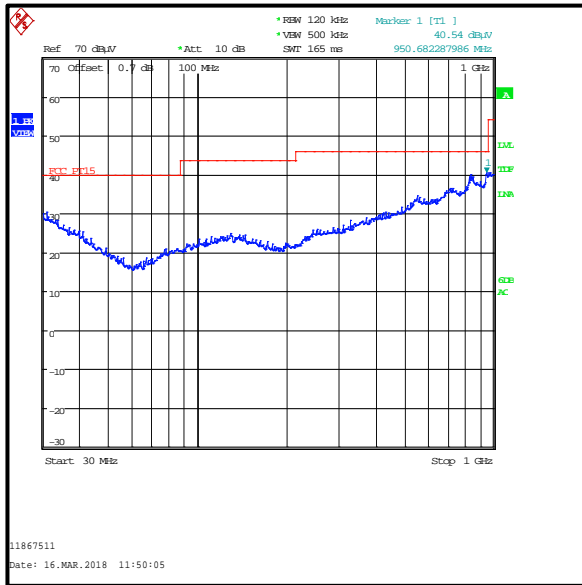
#### **Note(s):**

1. All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The RFID uplink is not shown in the 30 MHz to 1 GHz plots as a notch filter is used to prevent overload of test receiver.
3. The 5 GHz uplink is shown on the 3 GHz to 8 GHz plot.
4. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
5. The test receiver resolution bandwidth was set to 120 kHz and the video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and the video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable.
7. Pre-scans over range 1 GHz – 18 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
8. Pre-scans over range 18 GHz – 26.5 GHz were performed in a fully anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable.
9. Pre-scans over range 26.5 GHz – 40 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable.

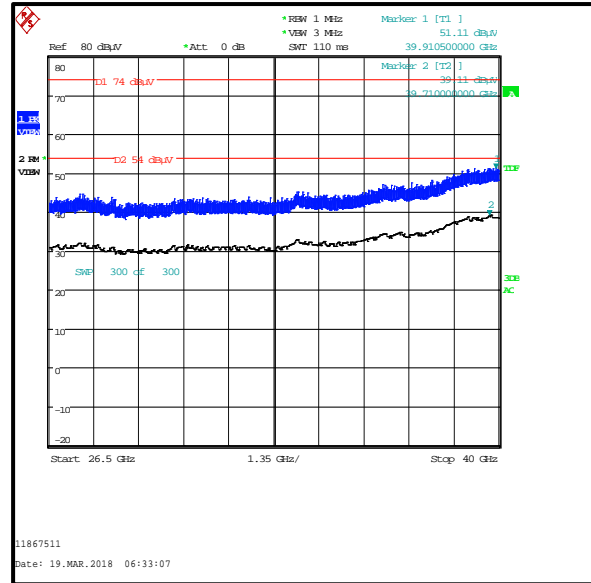
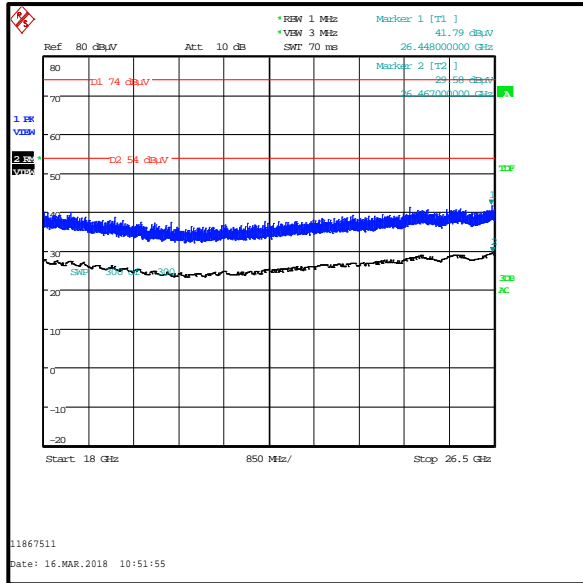
**Transmitter Out of Band Radiated Emissions - RFID & 5 GHz WLAN bottom channel (continued)**

**Results:**

Results: Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
See note 1					



**Transmitter Out of Band Radiated Emissions - RFID & 5 GHz WLAN bottom channel  
continued)**



**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	27 Feb 2019	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	14 Apr 2018	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	13 Apr 2018	12
A2893	Preamplifier	Schwarzbeck	BBV 9721	9721-021	11 Apr 2018	12
A2889	Antenna	Schwarzbeck	BBHA 9120B	BBHA 9120B653	11 Aug 2018	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	25 Apr 2018	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	11 Apr 2018	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	11 Apr 2018	12
A288	Antenna	Chase	CBL6111A	1589	21 Dec 2018	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	22 Feb 2019	12
A3035	Low Pass Filter	AtlanTecRF	AFL-02000	15062902847	23 Feb 2019	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	160190001	18 May 2018	12
A2915	Low Pass Filter	AtlanTecRF	AFL-0400	2156	22 Feb 2019	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	21 Feb 2019	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	28 Nov 2018	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	07 Feb 2019	12
A1551	Notch Filter	Wainright Instruments	WRCT902.6-0.3/40-8EE	2	Calibrated before use	-
M2016	Thermohygrometer	Testo	608-H1	45046428	26 Feb 2019	12

**5.2.2. Transmitter Out of Band Radiated Emissions - RFID & 5 GHz WLAN top channel****Test Summary:**

<b>Test Engineer:</b>	John Ferdinand	<b>Test Dates:</b>	16 March 2018 & 19 March 2018
<b>Test Sample Serial Number:</b>	G0K4485947		

<b>FCC Reference:</b>	Parts 15.209(a) / 15.407
<b>ISED Canada Reference:</b>	RSS-247 6.2.3.2 / RSS-Gen 6.13
<b>Test Method Used:</b>	KDB 789033 & ANSI C63.10 Sections 6.3, 6.5 and 6.6
<b>Frequency Range:</b>	30 MHz to 40 GHz
<b>Configuration:</b>	RFID and 5 GHz WLAN top channel

**Environmental Conditions:**

<b>Temperature (°C):</b>	20 to 23
<b>Relative Humidity (%):</b>	28 to 31

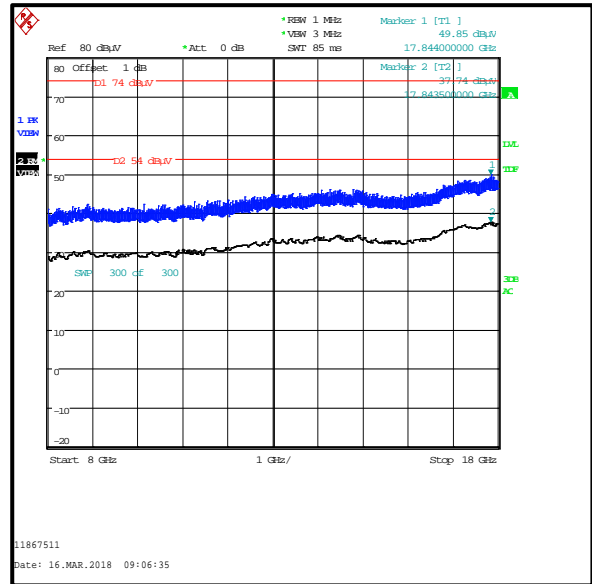
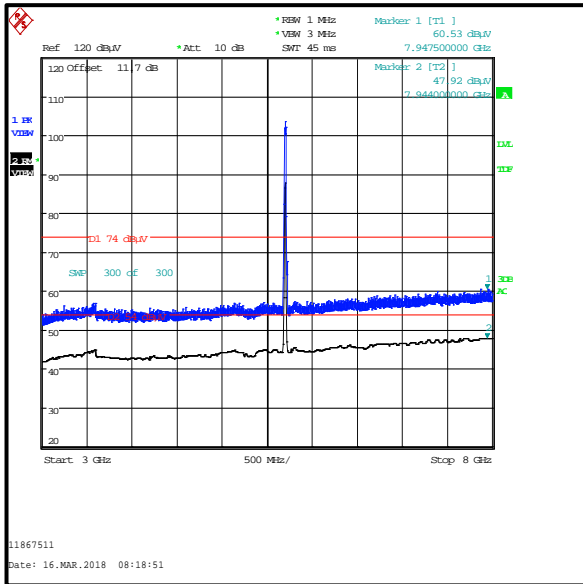
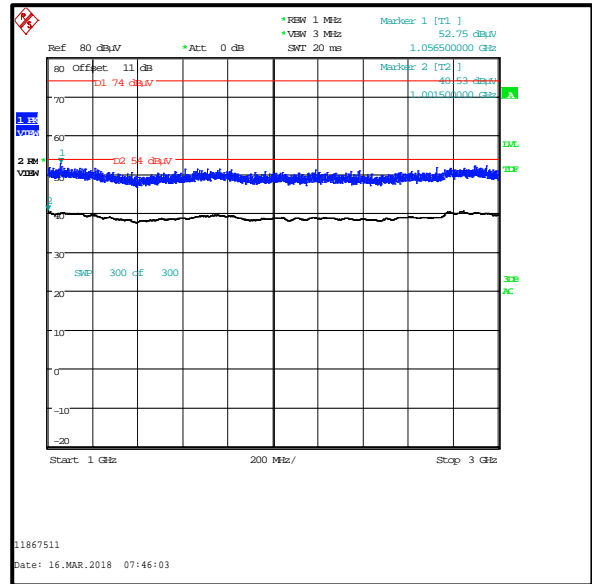
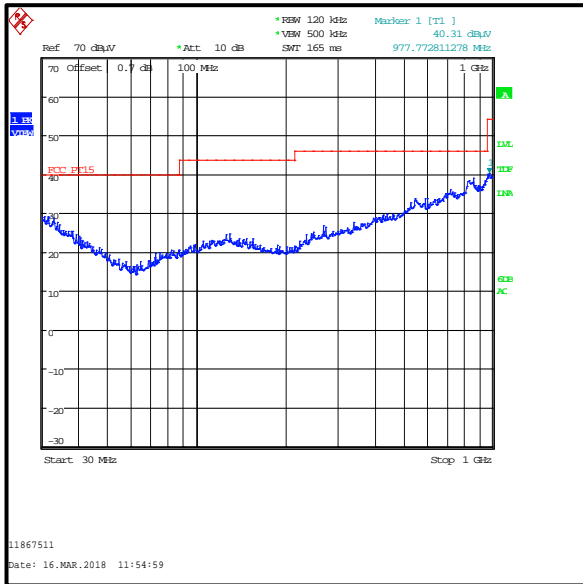
**Note(s):**

- All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
- The RFID uplink is not shown in the 30 MHz to 1 GHz plots as a notch filter is used to prevent overload of test receiver.
- The 5 GHz uplink is shown on the 3 GHz to 8 GHz plot.
- Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
- The test receiver resolution bandwidth was set to 120 kHz and the video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and the video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
- Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable.
- Pre-scans over range 1 GHz – 18 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
- Pre-scans over range 18 GHz – 26.5 GHz were performed in a fully anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable.
- Pre-scans over range 26.5 GHz – 40 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable.

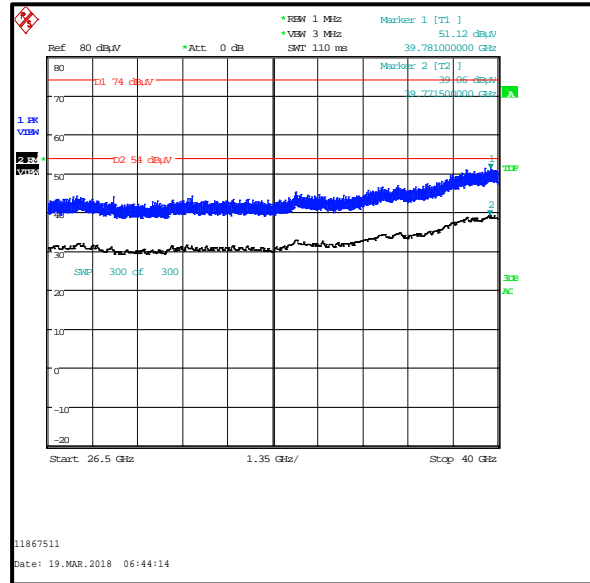
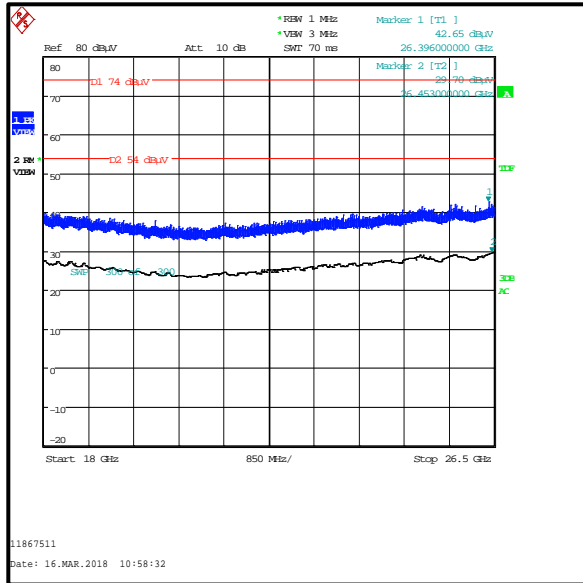
**Transmitter Out of Band Radiated Emissions - RFID & 5 GHz WLAN top channel (continued)**

**Results:**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
See note 1					



**Transmitter Out of Band Radiated Emissions - RFID & 5 GHz WLAN top channel (continued)**



**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	27 Feb 2019	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	14 Apr 2018	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	13 Apr 2018	12
A2893	Preamplifier	Schwarzbeck	BBV 9721	9721-021	11 Apr 2018	12
A2889	Antenna	Schwarzbeck	BBHA 9120B	BBHA 9120B653	11 Aug 2018	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	25 Apr 2018	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	11 Apr 2018	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	11 Apr 2018	12
A288	Antenna	Chase	CBL6111A	1589	21 Dec 2018	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	22 Feb 2019	12
A3035	Low Pass Filter	AtlanTecRF	AFL-02000	15062902847	23 Feb 2019	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	160190001	18 May 2018	12
A2915	Low Pass Filter	AtlanTecRF	AFL-0400	2156	22 Feb 2019	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	21 Feb 2019	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	28 Nov 2018	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	07 Feb 2019	12
A1551	Notch Filter	Wainright Instruments	WRCT902.6-0.3/40-8EE	2	Calibrated before use	-
M2016	Thermohygrometer	Testo	608-H1	45046428	26 Feb 2019	12



## **6. Measurement Uncertainty**

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

<b>Measurement Type</b>	<b>Range</b>	<b>Confidence Level (%)</b>	<b>Calculated Uncertainty</b>
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±3.00 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	±2.94 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

## **7. Report Revision History**

Version Number	Revision Details		
	Page No(s)	Clause	Details
-	-	-	Draft Version
1.0	-	-	Initial Version FCC site registration corrected. References to RSS-Gen updated to the latest version – no impact on test results.
2.0	7	3.5	Antenna gains corrected.

--- END OF REPORT ---