



TEST REPORT

Test Report No. : UL-RPT-RP11155823JD01A V2.0

Manufacturer : Sensative AB
Model No. : 1101012
FCC ID : 2AHIR-001
Test Standard(s) : FCC Parts 15.209(a) & 15.249

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: 06 June 2016

Checked by:

Ian Watch
Senior Engineer, Radio Laboratory

Company Signatory:

Steven White
Service Lead, Radio Laboratory,
UL VS LTD



This laboratory is accredited by UKAS.
The tests reported herein have been
performed in accordance with its terms
of accreditation.

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1. Customer Information

Company Name:	Sensitive AB
Address:	Mobilvägen 10 223 62 Lund Sweden

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.249
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.249
Specification Reference:	47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209
Site Registration:	209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	23 February 2016 to 24 March 2016

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.249(a)	Transmitter Fundamental Field Strength	
Part 2.1049	Transmitter 20 dB Bandwidth	
Part 15.249(a)(d)(e)/ 15.209(a)	Transmitter Radiated Emissions	
Part 15.249(d)/ 15.209(a)	Transmitter Band Edge Radiated Emissions	
Key to Results  = Complied  = Did not comply		

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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)

Brand Name:	Strips by Sensitive
Model Name or Number:	1101012
Test Sample Serial Number:	#00805 (<i>Radiated Sample</i>)
Hardware Version:	MCA 11 01 012/1 R1A
Software Version:	SWF 11 01 012/02.C.10.01 (<i>Software for micro controller</i>) SWG 11 01 012/02.F.10.01 (<i>Software for signalling</i>)
FCC ID:	2AHIR-001

Brand Name:	Strips by Sensitive
Model Name or Number:	1101012
Test Sample Serial Number:	#00807 (<i>Conducted Sample</i>)
Hardware Version:	MCA 11 01 012/1 R1A
Software Version:	SWF 11 01 012/02.C.10.01 (<i>Software for micro controller</i>) SWG 11 01 012/02.F.10.01 (<i>Software for signalling</i>)
FCC ID:	2AHIR-001

3.2. Description of EUT

The Equipment Under Test was a magnet-sensor containing a Z-Wave radio transceiver. It is powered from a 3 Volt battery.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Tested Technology:	Z-Wave	
Power Supply Requirement:	Nominal	3.0 VDC
Type of Unit:	Transceiver	
Modulation:	FSK	
Data Rates:	908.4 MHz, channel 1: 9.4 kbit/s & 40 kbit/s	
	916.0 MHz, channel 0: 100 kbit/s	
Transmit Frequency Range:	902 MHz to 928 MHz	
Transmit Channel Tested:	Channel ID	Channel Frequency (MHz)
	1	908.4
	0	916.0

3.5. Support Equipment

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

Description:	Laptop PC
Brand Name:	Lenovo
Model Name or Number:	L440
Serial Number:	R9019EA4

Description:	Development Board
Brand Name:	Sigma Designs Inc.
Model Name or Number:	ACC-DEVPLAT03A
Serial Number:	Not marked or stated

Description:	USB Type A to USB Type B Cable (length 1.85 m)
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	USB Type A to RS232 Cable (length 1.56 m)
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

3.6. Antenna

The table below shows the antenna that the manufacturer intends to use with this product when operating in the 902 to 928 MHz band:

Antenna Type	Stated Gain	Manufacturer	Part Number
SMD	+0.5 dBi	Rainsun	AN1603-868

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 with a modulated signal on channel 1 or 0 as required, using the supported data rates.

4.2. Configuration and Peripherals

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

- The EUT was controlled using Tera Term application on the laptop PC following operating instructions contained in the '*Sensitive Strips User guide for RF measurements*' document dated 17th February 2016. The application was used to enable continuous transmission and to select test channels, LO injection side and supported data rates as required.
- For conducted measurements, the EUT was powered via the UART cable, which was connected from the PCB to the test laptop.
- For radiated measurements, the EUT was powered by a 3.0 Volt battery. The battery was fully charged before testing commenced and monitored throughout testing.
- Radiated tests were performed with the USB port unterminated, as any connection to this port would place the EUT into a receive/idle mode.

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 Fundamental Field Strength

Test Summary:

Test Engineer:	David Doyle	Test Date:	24 February 2016
Test Sample Serial Number:	#00805		

FCC Reference:	Part 15.249(a)
Test Method Used:	ANSI C63.10 Section 6.5

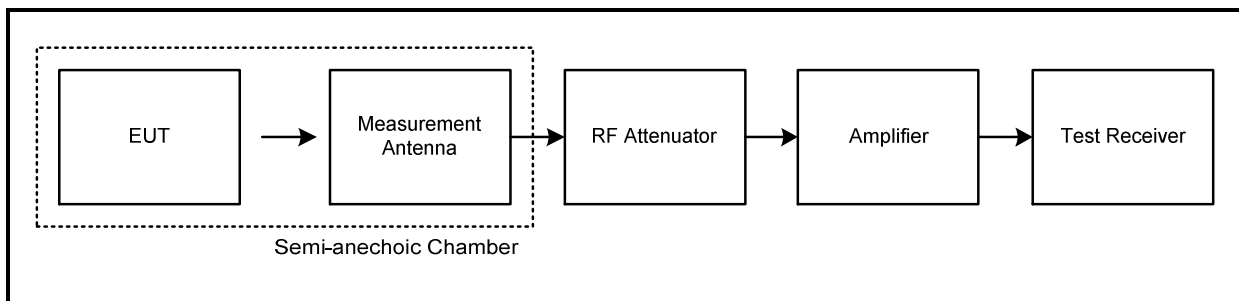
Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	32

Note(s):

1. The final measured value in the table below incorporates the calibrated antenna factor and cable loss.
2. Measurements were performed using a Quasi-Peak detector. The results were read directly from the test receiver and no result plots are shown.
3. Both data rates were tested at 908.4 MHz and the same fundamental field strength was measured with each. Therefore, only results for 908.4 MHz with a data rate of 40 kbit/s are included in the result table shown below.

Test Setup:



Results: Quasi-Peak / 908.4 MHz / 40 kbit/s

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
908.400	Horizontal	90.8	94.0	3.2	Complied

Results: Quasi-Peak / 916 MHz

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
916.000	Horizontal	88.7	94.0	5.3	Complied

Transmitter Fundamental Field Strength (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	21 Dec 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 May 2016	12
A288	Antenna	Chase	CBL6111A	1589	27 Aug 2016	12

5.2.2. Transmitter 20 dB Bandwidth**Test Summary:**

Test Engineer:	Kiren Mistry	Test Date:	24 March 2016
Test Sample Serial Number:	#00807		

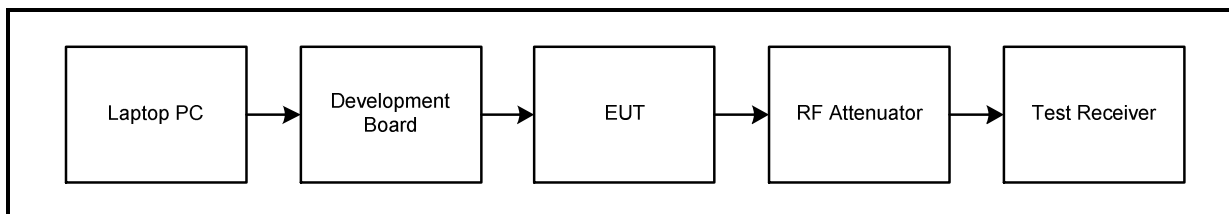
FCC Reference:	Part 2.1049
Test Method Used:	ANSI C63.10 Section 6.9.2

Environmental Conditions:

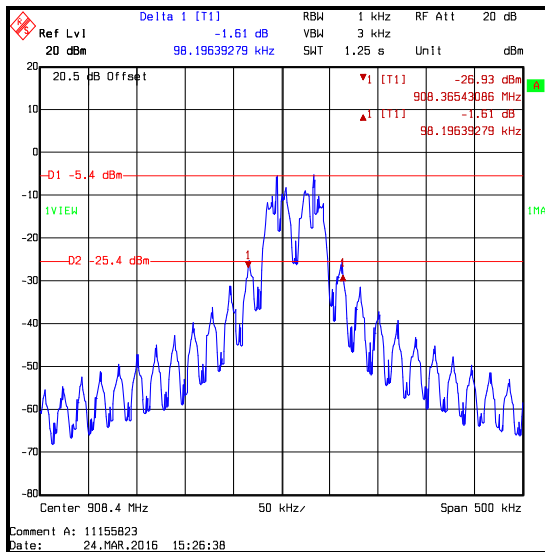
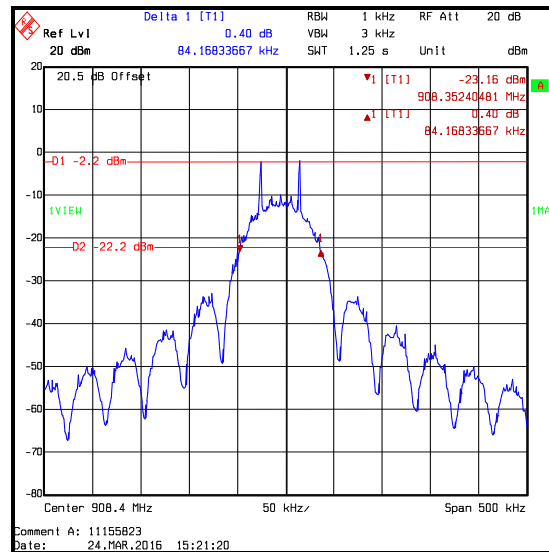
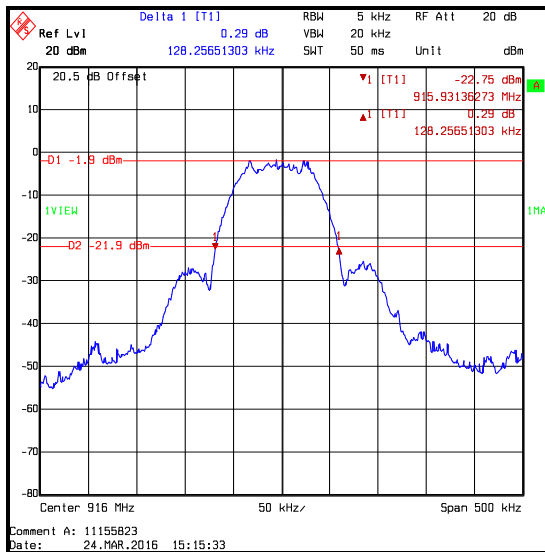
Temperature (°C):	27
Relative Humidity (%):	29

Note(s):

1. The test receiver resolution bandwidth was set to between 1% and 5% of the OBW as stated in ANSI C63.10 Section 6.9.2. and the VBW was set to as close to three times this value as the spectrum analyser allowed. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 500 kHz. Normal and delta markers were placed 20 dB down from the peak of the carrier. The markers on the 908.4 MHz / 9.6 kbit/s plot are positioned on vertical lines at the -20 dBc points. The marker levels are slightly below the -25.4 dBm line and the measured occupied bandwidth is correct. The occupied bandwidth results are recorded in the table below.

Test Setup:**Results:**

Transmitter Frequency (MHz)	Tx Data Rate (kbit/s)	20 dB Bandwidth (kHz)
908.4	9.6	98.196
908.4	40	84.168
916.0	100	128.257

Transmitter 20 dB Bandwidth (continued)**908.4 MHz Channel / 9.6 kbit/s****908.4 MHz Channel / 40 kbit/s****916 MHz Channel / 100 kbit/s****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
A2528	Attenuator	AtlanTecRF	AN18W5-20	832828#3	Calibrated before use	-
M127	Spectrum Analyser	Rohde & Schwarz	FSEB30	842659/016	11 Aug 2016	12
M1175	Power Sensor	Hewlett Packard	8485A	2942A10299	29 Jan 2017	12
M1009	Power Meter	Hewlett Packard	437B	3125U13706	09 Feb 2017	12
G085	Signal Generator	Hewlett Packard	83650L	3614A00104	11 Nov 2016	12

5.2.3. Transmitter Radiated Emissions**Test Summary:**

Test Engineer:	Kiren Mistry	Test Date:	24 February 2016
Test Sample Serial Number:	#00805		

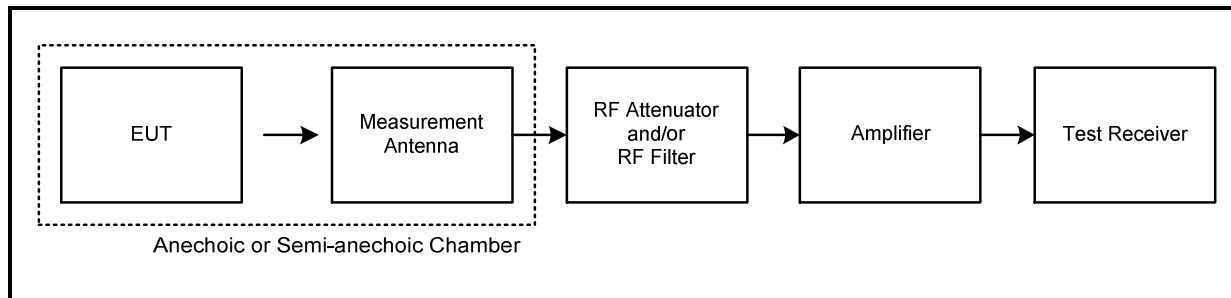
FCC Reference:	Parts 15.249(a)(d)(e) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.5
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	30

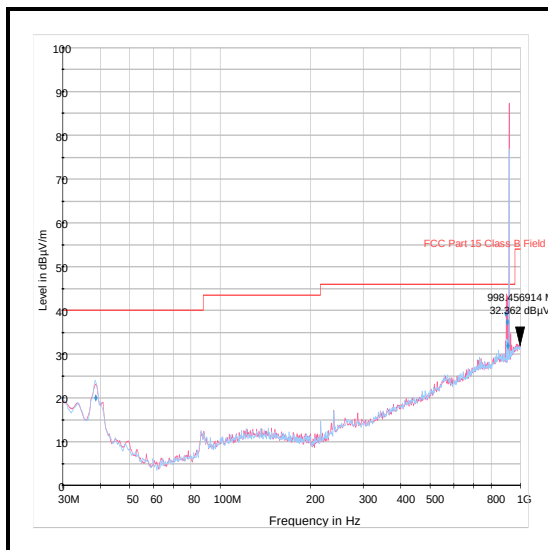
Note(s):

1. The emission at 916 MHz shown on the 30 MHz to 1 GHz plot is the EUT fundamental.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. All emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the table below
4. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
5. Pre-scans were performed on all three modes and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. The sweep time was set to auto. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
6. Final measurements were performed on the marker frequencies and the results entered into the table below. The test receiver resolution bandwidth was set to 120 kHz. A CISPR quasi-peak detector was used.

Test Setup:

Transmitter Radiated Emissions (continued)**Results: Quasi-Peak**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
998.457	Vertical	32.4	54.0	21.6	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1945	Thermohygrometer	JM Handelspunkt	30.5015.01	0112	23 Apr 2016	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	12 Jan 2017	12
G0543	Amplifier	Sonoma	310N	230801	29 May 2016	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	19 Mar 2016	12
A259	Antenna	Chase	CBL6111	1513	09 Apr 2016	12
A1834	Attenuator	Hewlett Packard	8491B	10444	05 Mar 2016	12

Transmitter Radiated Emissions (continued)**Test Summary:**

Test Engineer:	David Doyle	Test Date:	24 February 2016
Test Sample Serial Number:	#00805		

FCC Reference:	Parts 15.249(a)(d)(e) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.6
Frequency Range	1 GHz to 9.2 GHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	33

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. All other emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor.
3. In accordance with ANSI C63.10 Section 6.6.4.3, Note 1, where the peak detected amplitude was shown to comply with the average limit, an average measurement was not performed.
4. Pre-scans were performed on all three modes and markers placed on the highest measured levels. Only the pre-scan plots for 916 MHz 100 kbit/s, which produced the highest emissions, have been included in the report.
5. Pre-scans above 1 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 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.

Transmitter Radiated Emissions (continued)**Results: 908.4 MHz / 9.6 kbit/s**

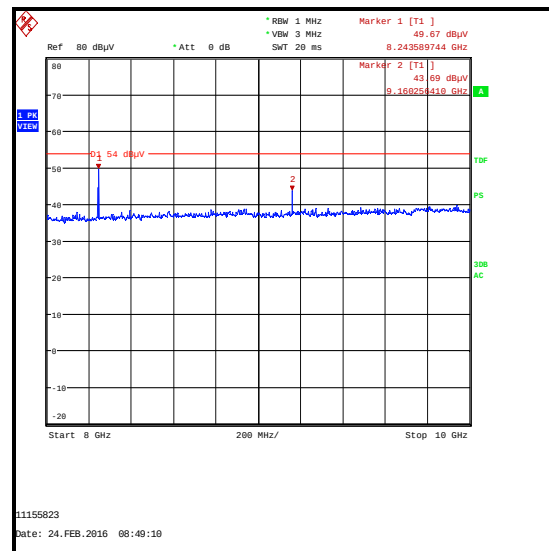
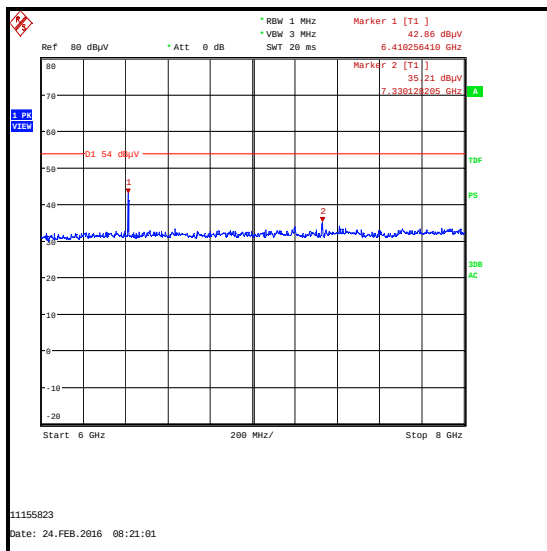
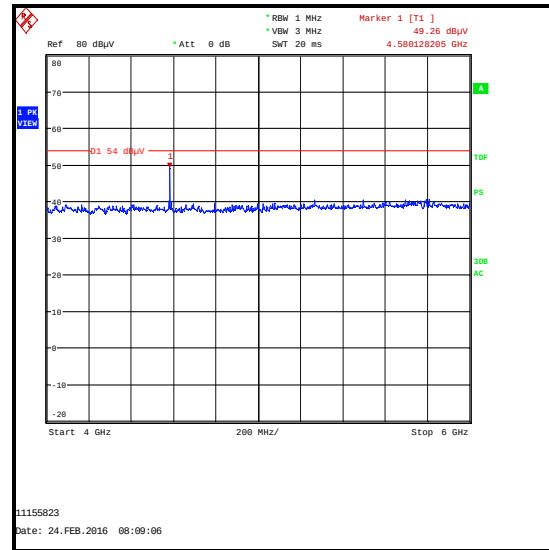
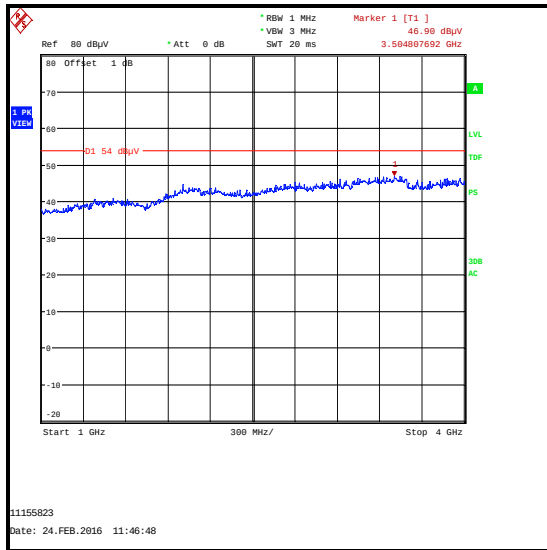
Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4542.147	Horizontal	46.7	54.0	7.3	Complied
8175.617	Horizontal	47.0	54.0	7.0	Complied
9083.948	Horizontal	48.2	54.0	5.8	Complied

Results: 908.4 MHz / 40 kbit/s

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4541.835	Horizontal	48.0	54.0	6.0	Complied
8173.076	Horizontal	47.9	54.0	6.1	Complied
9083.333	Horizontal	47.3	54.0	6.7	Complied

Results: 916 MHz / 100 kbit/s

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4579.856	Horizontal	49.7	54.0	4.3	Complied
8243.670	Horizontal	50.6	54.0	3.4	Complied
9159.767	Horizontal	45.6	54.0	8.4	Complied

Transmitter Radiated Emissions (continued)

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Radiated Emissions (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	21 Dec 2016	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 May 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 May 2016	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	19 Dec 2016	12
A1818	Antenna	EMCO	3115	00075692	17 Dec 2016	12
A253	Antenna	Flann	12240-20	128	17 Dec 2016	12
A254	Antenna	Flann	14240-20	139	17 Dec 2016	12
A255	Antenna	Flann	16240-20	519	17 Dec 2016	12
A2407	High Pass Filter	AtlanTecRF	AFH-02000	023357	17 Apr 2016	12
A148	High Pass Filter	Filtronic	SH036	32218	17 Apr 2017	24

5.2.4. Transmitter Band Edge Radiated Emissions**Test Summary:**

Test Engineer:	David Doyle	Test Date:	24 February 2016
Test Sample Serial Number:	#00805		

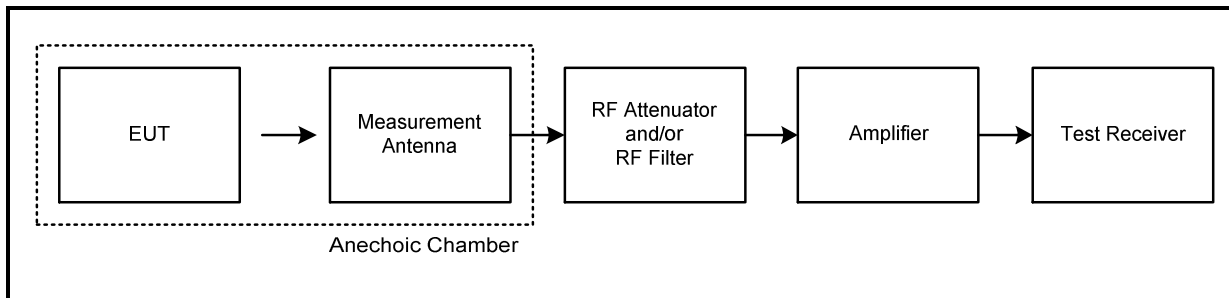
FCC Reference:	Parts 15.249(d) & 15.209
Test Method Used:	ANSI C63.10 Section 6.10

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	32

Note(s):

1. The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor and cable loss.

Test Setup:

Transmitter Band Edge Radiated Emissions (continued)**Results: 908.4 MHz / 9.6 kbit/s**

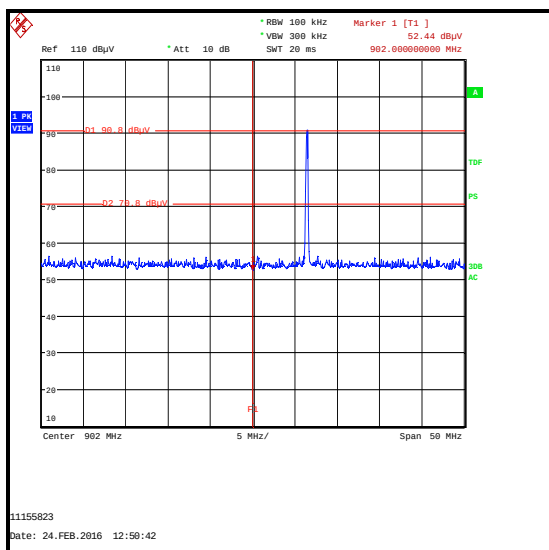
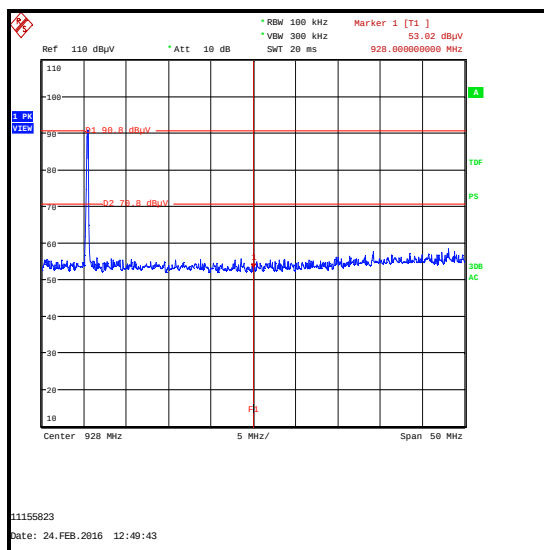
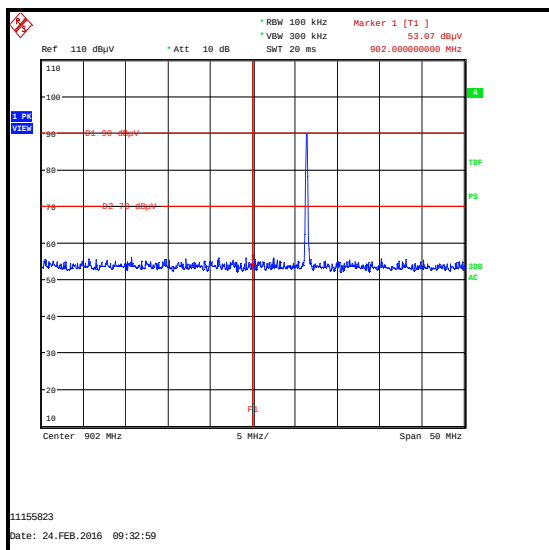
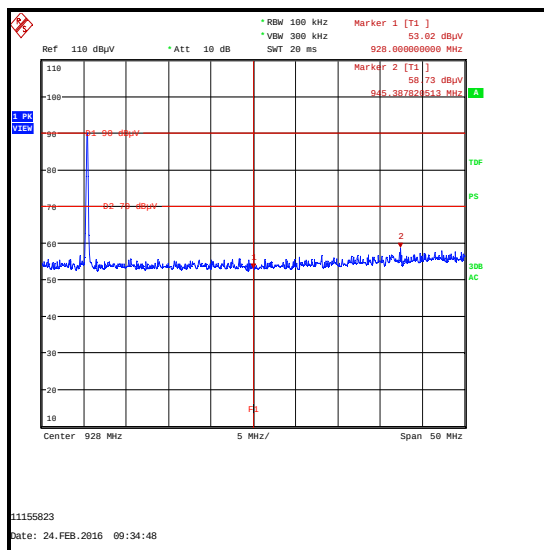
Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	-20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902	Horizontal	52.4	70.8	18.4	Complied
928	Horizontal	53.0	70.8	17.8	Complied

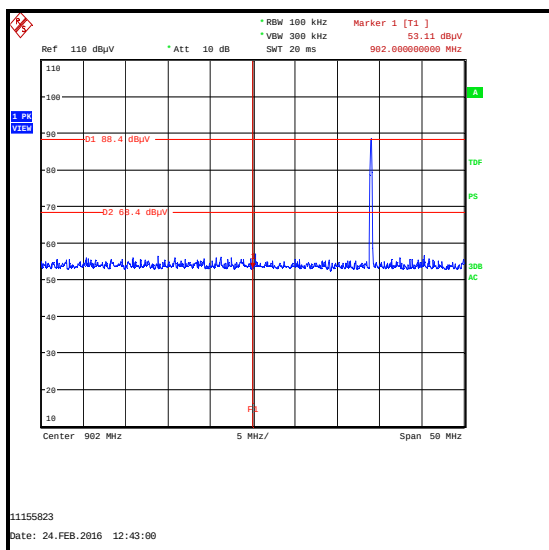
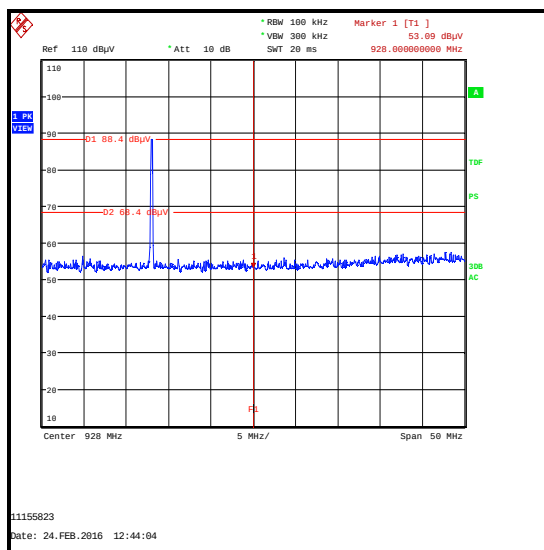
Results: 908.4 MHz / 40 kbit/s

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	-20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902	Horizontal	53.1	70.0	16.9	Complied
928	Horizontal	53.0	70.0	17.0	Complied
945.388	Horizontal	58.7	70.0	11.3	Complied

Results: 916 MHz / 100 kbit/s

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	-20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902	Horizontal	53.1	68.4	15.3	Complied
928	Horizontal	53.1	68.4	15.3	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: 908.4 MHz / 9.6 kbit/s****Lower Band Edge Peak Measurement****Upper Band Edge Peak Measurement****Results: 908.4 MHz / 40 kbit/s****Lower Band Edge Peak Measurement****Upper Band Edge Peak Measurement**

Transmitter Band Edge Radiated Emissions (continued)**Results: 916 MHz / 100 kbit/s****Lower Band Edge Peak Measurement****Upper Band Edge Peak Measurement****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	21 Dec 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 May 2016	12
A288	Antenna	Chase	CBL6111A	1589	27 Aug 2016	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".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Fundamental Field Strength	902 MHz to 928 MHz	95%	±5.65 dB
20 dB Bandwidth	902 MHz to 928 MHz	95%	±3.92 %
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 10 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
1.0	-	-	Initial Version
2.0	1 & 6	-	Changed Model No. '11 01 012 Rev: R1A' to '1101012' at the customer's request
	6	-	Added channel data rates to Section 3.4

---END OF REPORT---