



TEST REPORT

Test Report No. : UL-RPT-RP10952868JD02A V3.0

Manufacturer : Continental Automotive GmbH
Model No. : ALFA434
FCC ID : KR5ALFA434
Technology : SRD
Test Standard(s) : FCC Parts 15.209(a) & 15.231

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 3.0 supersedes all previous versions.

Date of Issue: 22 October 2015

Checked by:

Sarah Williams
Engineer, Radio Laboratory

Issued by :

pp

John Newell
Quality Manager,
UL VS LTD



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

UL VS LTD

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG, UK
Telephone: +44 (0)1256 312000
Facsimile: +44 (0)1256 312001

This page has been left intentionally blank.

Table of Contents

1. Customer Information.....	4
2. Summary of Testing.....	5
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
3. Equipment Under Test (EUT)	6
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. Support Equipment	6
4. Operation and Monitoring of the EUT during Testing	7
4.1. Operating Modes	7
4.2. Configuration and Peripherals	7
5. Measurements, Examinations and Derived Results.....	8
5.1. General Comments	8
5.2. Test Results	9
5.2.1. Transmitter Fundamental Field Strength	9
5.2.2. Transmitter 20 dB Bandwidth	11
5.2.3. Transmitter Timeout	14
5.2.4. Transmitter Duty Cycle	16
5.2.5. Transmitter Radiated Emissions	19
6. Measurement Uncertainty	24
7. Report Revision History	25

1. Customer Information

Company Name:	Continental Automotive GmbH
Address:	Siemensstrasse 12 Regensburg D-93055 Germany

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.231
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Radio Frequency Devices) - Section 15.231
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:	22 September 2015 to 21 October 2015

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.231(b)	Transmitter Fundamental Field Strength	
Part 15.231(c)	Transmitter 20 dB Bandwidth	
Part 15.231(a)(1)	Transmitter Timeout	
Part 15.35(c)	Transmitter Duty Cycle	
Part 15.231(b) / 15.209	Transmitter 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:	Continental
Model Name or Number:	ALFA434
Test Sample Serial Number:	UL Sample #2
Hardware Version:	ALFA434
Software Version:	ALFA434
FCC ID:	KR5ALFA434

Brand Name:	Continental
Model Name or Number:	ALFA434
Test Sample Serial Number:	UL Sample #5
Hardware Version:	ALFA434
Software Version:	ALFA434
FCC ID:	KR5ALFA434

3.2. Description of EUT

The equipment under test was a transmitter designed to provide remote keyless entry, passive entry, passive engine start and immobilization functionality to the Alfa Romeo platform.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Power Supply Requirement:	Nominal	3 VDC Li-ion battery
Type of Unit:	Transmitter	
Modulation:	ASK & FSK	
Data Rate:	ASK 2.4 kbps & FSK 9.6 kbps	
Transmit Frequency Range:	433.92 MHz	

3.5. Support Equipment

No support equipment was used to exercise the EUT during testing.

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating test modes, unless otherwise stated:

- Continuous transmitting maximum output power at the desired mode, on 433.92 MHz

4.2. Configuration and Peripherals

The EUT was tested in the following configuration:

- The EUT was powered by a new 3.0 VDC internal battery and the voltage was monitored throughout testing.
- Before each transmitter test, the EUT was placed into the required mode. This was performed by pressing a sequence of buttons on the front panel of the EUT, as instructed by the customer.
- The EUT had two main modes: RKE protocol (remote key functionality, ASK modulation) and PASE protocol (passive key functionality, FSK modulation).
- The transmitter fundamental field strength test was carried out on both modes and the highest value measured has been recorded in the test report.
- Transmitter emissions tests were performed with the EUT transmitting in Continuous wave ASK mode, as this mode was found to transmit the highest power.
- UL Sample #5 had normal functionality software fitted and was used for Transmitter timeout test.
- UL Sample #2 had the test software fitted and was used for all other tests.

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:	15 October 2015
Test Sample Serial Number:	UL Sample #2		

FCC Reference:	Part 15.231(b)
Test Method Used:	ANSI C63.10 Section 7.6.1 and Sections 6.3 & 6.5 (see note below)

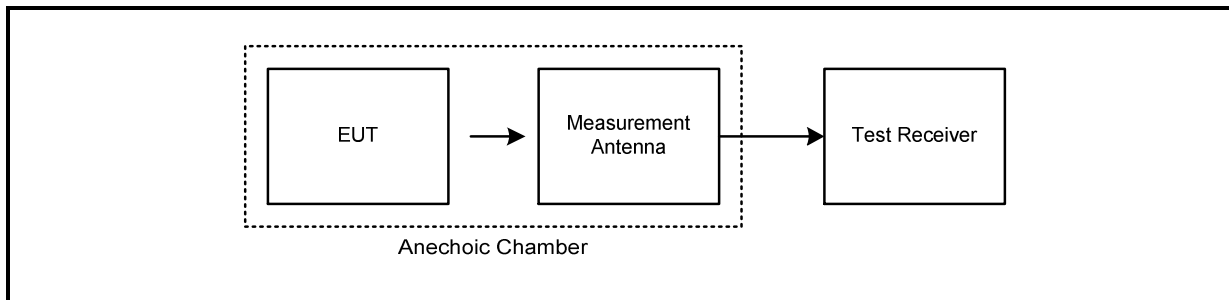
Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	36

Note(s):

1. The average level was determined by subtracting the duty cycle correction factor. The duty cycle correction factor of 6.6 dB was calculated using the formula $20 \log (\text{On Time}/100\text{ms})$ as stated in FCC Part 15.35(c). For further detail see section 5.2.4.
2. Measurements were made on both modes, with the test antenna in the horizontal and vertical planes and the EUT in the X, Y and Z planes. The highest level (ASK) is recorded in the below table.

Test setup:



Transmitter Fundamental Field Strength (continued)**Results: ASK / Average Level**

Frequency (MHz)	Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
433.92	77.0	80.8	3.8	Complied

Results: ASK / Peak Level

Frequency (MHz)	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
433.92	83.6	100.8	17.2	Complied

Results: FSK / Average Level

Frequency (MHz)	Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
433.92	76.3	80.8	4.5	Complied

Results: FSK / Peak Level

Frequency (MHz)	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
433.92	82.9	100.8	17.9	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	23 Apr 2016	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 May 2016	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12
A259	Antenna	Chase	CBL6111	1513	09 Apr 2016	12

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

Test Engineer:	David Doyle	Test Date:	15 October 2015
Test Sample Serial Number:	UL Sample #2		

FCC Reference:	Part 15.231(c)
Test Method Used:	ANSI C63.10 Section 6.9.2

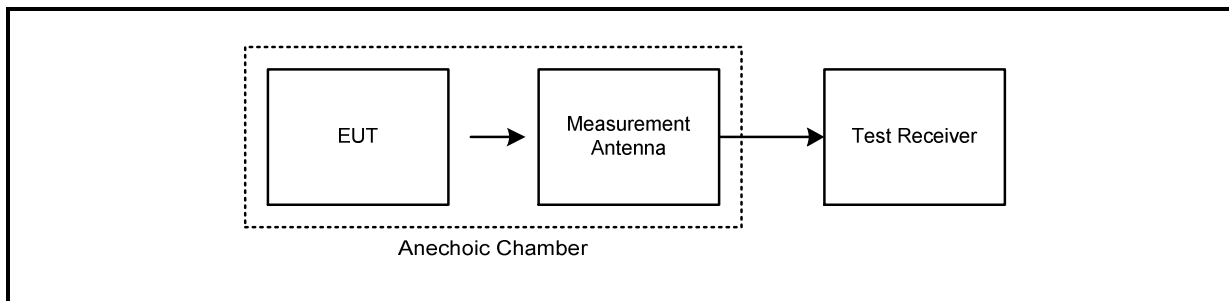
Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	37

Note(s):

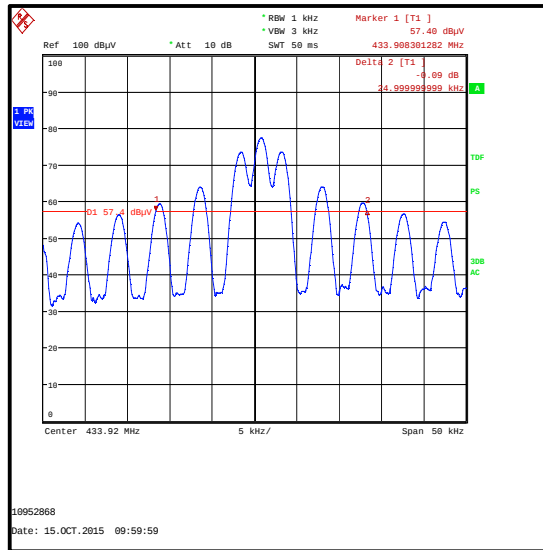
1. The 20 dB bandwidth of the emission shall be no wider than 0.25% of the centre frequency of the EUT.
2. The limit has been calculated as:

$$0.0025 * 433.92 \text{ MHz} = 1.0848 \text{ MHz}$$

Test setup:

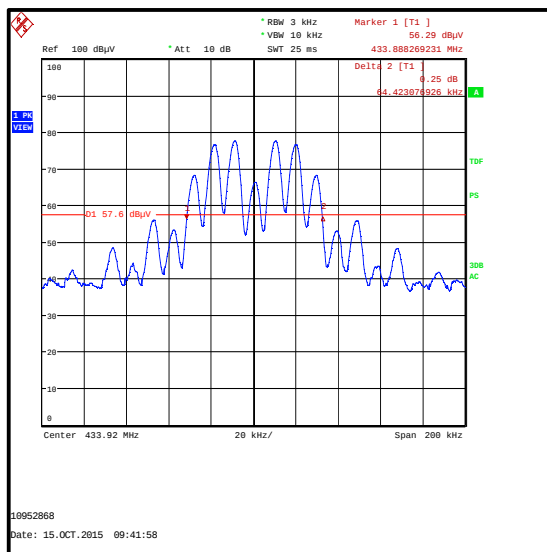
Transmitter 20 dB Bandwidth (continued)**Results: ASK Modulation**

Transmitter 20 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
0.0250	1.0848	1.0598	Complied



Transmitter 20 dB Bandwidth (continued)**Results: FSK Modulation**

Transmitter 20 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
0.064423	1.084800	1.020377	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	23 Apr 2016	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 May 2016	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12
A259	Antenna	Chase	CBL6111	1513	09 Apr 2016	12

5.2.3. Transmitter Timeout**Test Summary:**

Test Engineer:	David Doyle	Test Date:	21 October 2015
Test Sample Serial Number:	UL ID #5		

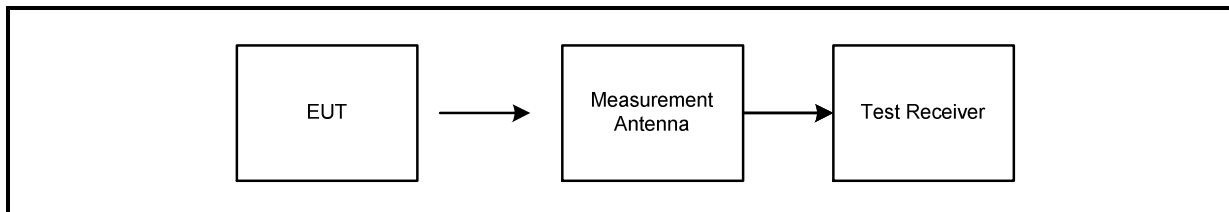
FCC Reference:	Part 15.231(a)(1)
Test Method Used:	The EUT transmitter was activated and monitored using a spectrum analyser for a period not exceeding 7 seconds.

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	39

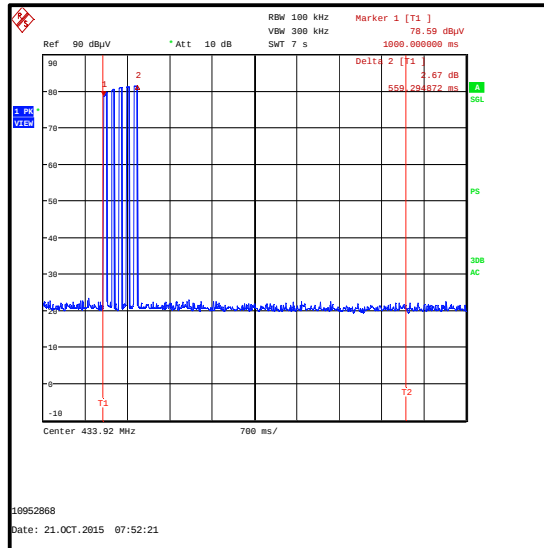
Note(s):

1. The button on the EUT was momentarily pressed at time T1 as shown on the plot. The plot shows that the transmitter stopped transmitting after 0.559 seconds.
2. Both modes on the EUT were tested and gave identical results.

Test setup:

Transmitter Timeout (continued)**Results:**

Deactivation Time (seconds)	Limit (seconds)	Margin (seconds)	Result
0.559	5.000	4.441	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	23 Apr 2016	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12

5.2.4. Transmitter Duty Cycle

Test Summary:

Test Engineer:	David Doyle	Test Date:	15 October 2015
Test Sample Serial Number:	UL Sample #2		

FCC Reference:	Part 15.35(c)
Test Method Used:	ANSI C63.10 Section 7.5

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	37

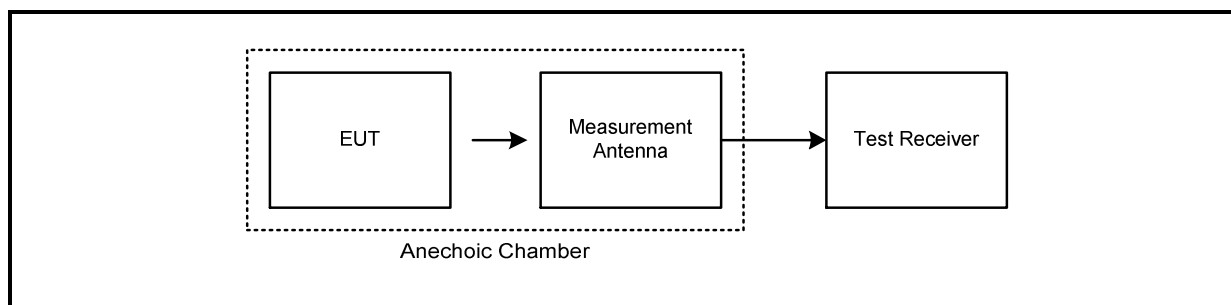
Note(s):

1. In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by $20 \log(\text{On Time} / [\text{Period or } 100 \text{ ms whichever is the lesser}])$.
2. For FSK modulation, the transmission of the EUT is continuously modulated.
3. The EUT transmits in ASK for a period of 46.795 milliseconds within the specified 100 ms period.

$$20 \log (1 / (\text{On Time} / [\text{Period or } 100 \text{ ms whichever is the lesser}]))).$$

$$20 \log (1 / (46.795/100)) = 6.6 \text{ dB}$$

Test setup:

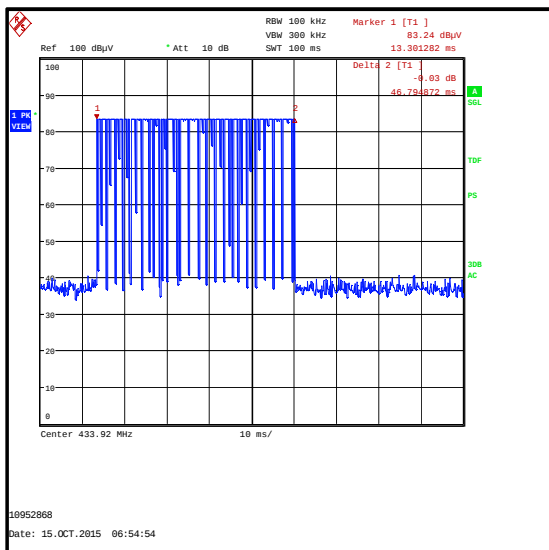


Transmitter Duty Cycle (continued)

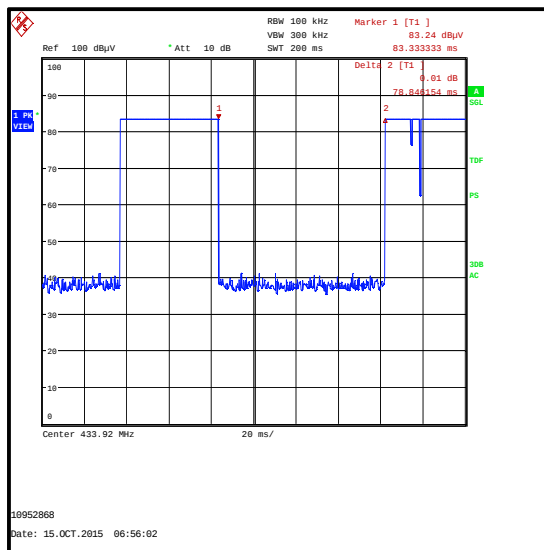
Results:

Pulse Duration (ms)	Duty Cycle (dB)
46.795	6.6

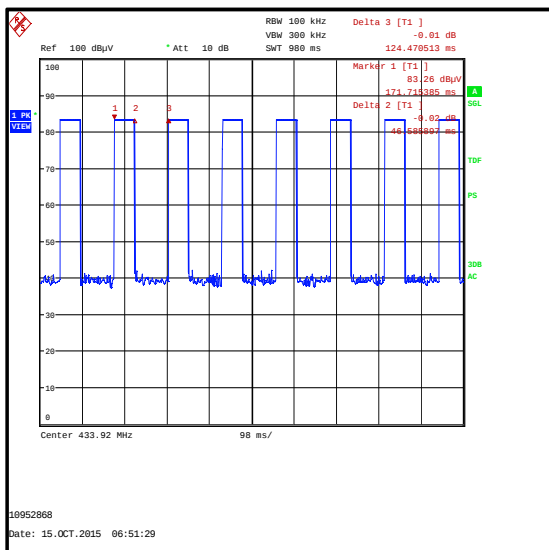
Silent Period (ms)
78.846



Time On



Time Off



Full Sequence

Transmitter Duty Cycle (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	Not stated	23 Apr 2016	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 May 2016	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12
A259	Antenna	Chase	CBL6111	1513	09 Apr 2016	12

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

Test Engineer:	David Doyle	Test Date:	07 October 2015
Test Sample Serial Number:	UL Sample #2		

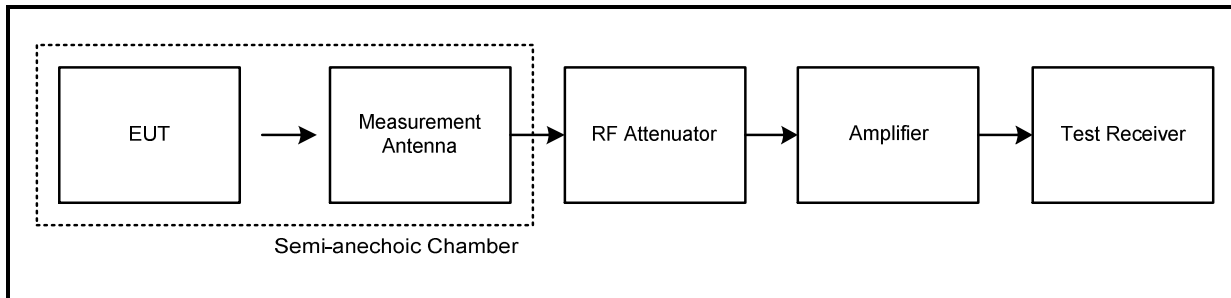
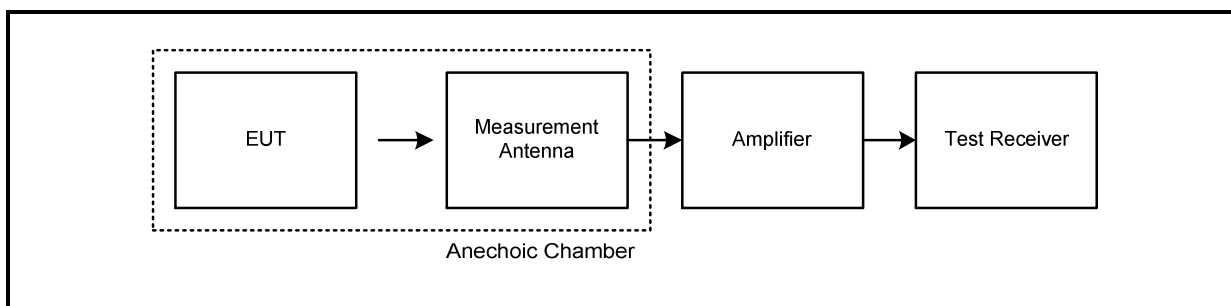
FCC Reference:	Parts 15.231(b) / 15.209
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.5
Frequency Range	30 MHz to 1 GHz

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	42

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The fundamental is shown on the plot.
3. FCC Part 15.209 general limits are shown on the pre-scan plot.
4. 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.
5. In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
6. 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.

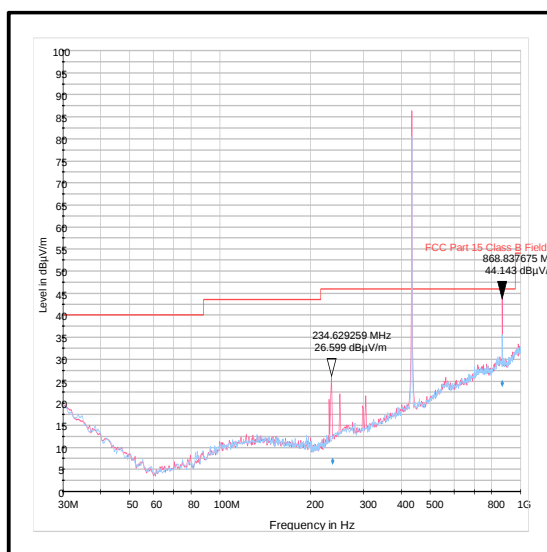
Transmitter Radiated Emissions (continued)**Test setup for radiated measurements:****Semi-anechoic chamber****Anechoic chamber**

Transmitter Radiated Emissions (continued)**Results: ASK**

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
868.838	Vertical	44.1	61.9	17.8	Complied

Results: FSK

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
868.838	Vertical	44.1	61.9	17.8	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

Test Equipment Used: :

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1945	Thermohygrometer	JM Handelspunkt	30.5015.01	None stated	23 Apr 2016	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	19 Mar 2016	12
A490	Antenna	Chase	CBL6111A	1590	30 Apr 2016	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	19 Mar 2016	12
G0543	Amplifier	Sonoma	310N	230801	06 Nov 2015	3
A1834	Attenuator	Hewlett Packard	8491B	10444	05 Mar 2016	12

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

Test Engineer:	David Doyle	Test Dates:	22 September 2015 & 15 October 2015
Test Sample Serial Number:	UL Sample #2		

FCC Reference:	Parts 15.231(b) & 15.209
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.6
Frequency Range	1 GHz to 4.4 GHz

Environmental Conditions:

Temperature (°C):	22 to 24
Relative Humidity (%):	37 to 44

Note(s):

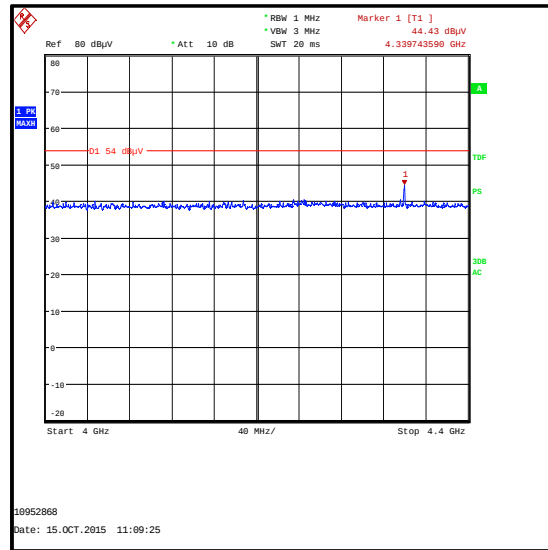
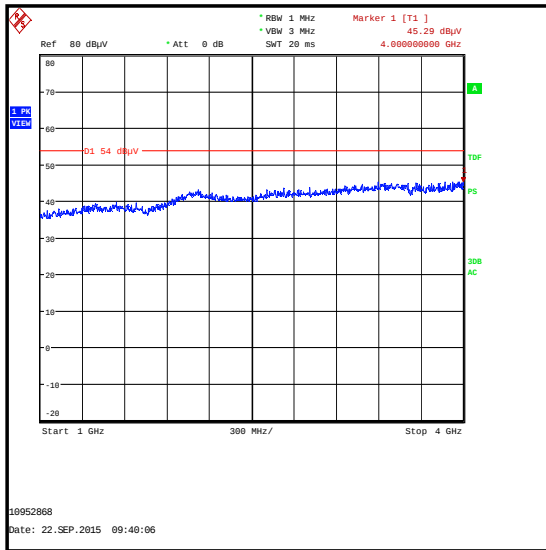
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. All other emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor.
3. FCC Part 15.209 general limits are shown on the pre-scan plots.
4. In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
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.

Results: ASK

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
4339.032	Vertical	45.5	54.0	8.5	Complied

Results: FSK

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
4339.160	Vertical	45.1	54.0	8.9	Complied

Transmitter Radiated Spurious 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	Not stated	23 Apr 2016	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 May 2016	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	21 Dec 2015	12
A1818	Antenna	EMCO	3115	00075692	20 Dec 2015	12
A253	Antenna	Flann Microwave	12240-20	128	20 Dec 2015	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	433.92 MHz	95%	±2.94 dB
20 dB Bandwidth	433.92 MHz	95%	±3.92 %
Transmitter Timeout / Duty Cycle	433.92 MHz	95%	± 0.29 ms
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 4.4 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	4	-	Customer address updated
3.0	-	-	Section 5.2.1 updated

--- END OF REPORT ---