



TEST REPORT

Test Report No. : UL-RPT-RP-12480272-116-FCC

Applicant : Kathrein Sachsen GmbH
Model No. : 52010301-000
FCC ID : WJ9-ARU3560
Technology : RFID 915 MHz
Test Standard(s) : FCC Parts 15.207, 15.209(a) & 15.247

For details of applied tests refer to test result summary

1. This test report shall not be reproduced in full or partial, without the written approval of UL International Germany GmbH.
2. The results in this report apply only to the sample tested.
3. The test results in this report are traceable to the national or international standards.
4. Test Report Version 1.0
5. Result of the tested sample: **PASS**

Prepared by: Abdoufataou Salifou
Title: Laboratory Engineer
Date: 25 January 2019

Approved by: Ajit Phadtare
Title: Lead Test Engineer
Date: 25 January 2019



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D-PL-19381-02-00

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The tests reported herein have been performed in
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Table of Contents

1. Customer Information..... 4
 1.1.Applicant Information 4
 1.2.Manufacturer Information 4

2. Summary of Testing..... 5
 2.1. General Information 5
 Applied Standards 5
 Location 5
 Date information 5
 2.2. Summary of Test Results 6
 2.3. Methods and Procedures 6
 2.4. Deviations from the Test Specification 6

3. Equipment Under Test (EUT) 7
 3.1. Identification of Equipment Under Test (EUT) 7
 3.2. Description of EUT 7
 3.3. Modifications Incorporated in the EUT 7
 3.4. Additional Information Related to Testing 8
 3.5. Antenna Information 9
 3.6. Support Equipment 10
 A. Support Equipment (In-house) 10
 B. Support Equipment (Manufacturer supplied) 10

4. Operation and Monitoring of the EUT during Testing11
 4.1. Operating Modes 11
 4.2. Configuration and Peripherals 11
 4.3. Used Power settings 12

5. Measurements, Examinations and Derived Results13
 5.1. General Comments 13
 5.2. Test Results 14
 5.2.1. Transmitter AC Conducted Spurious Emissions 14
 5.2.2. Transmitter 20 dB Bandwidth 17
 5.2.3. Transmitter Carrier Frequency Separation 19
 5.2.4. Transmitter Number of Hopping Frequencies and Average Time of
 Occupancy 21
 5.2.5. Transmitter Maximum Peak Output Power 24
 5.2.6. Transmitter Conducted Emissions 30
 5.2.7. Transmitter Band Edge Radiated Emissions 36

6. Measurement Uncertainty49

7. Used equipment50

8. Report Revision History52

1. Customer Information

1.1.Applicant Information

Company Name:	Kathrein Sachsen GmbH
Company Address:	Lindenstrasse 3, 09241 Muehlau, Germany
Contact Person:	Daniel Schkalda
Contact E-Mail:	d.schkalda@kathrein-sachsen.de
Contact Phone No.:	+49 3722 6073 79

1.2.Manufacturer Information

Company Name:	Kathrein Sachsen GmbH
Company Address:	Lindenstrasse 3, 09241 Muehlau,Germany
Contact Person:	Daniel Schkalda
Contact E-Mail:	d.schkalda@kathrein-sachsen.de
Contact Phone No.:	+49 3722 6073 79

2. Summary of Testing

2.1. General Information

Applied Standards

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Test Firm Registration:	399704

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany
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Date information

Order Date:	24 August 2018
EUT arrived:	27 August 2018
Test Dates:	30 August 2018 to 16 January 2019
EUT returned:	-/-

2.2. Summary of Test Results

Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.207	Transmitter AC Conducted Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(a)(1)	Transmitter 20 dB Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(a)(1)	Transmitter Carrier Frequency Separation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(a)(1)(i)	Transmitter Number of Hopping Frequencies and Average Time of Occupancy	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(b)(2)	Transmitter Maximum Peak Output Power	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(d)	Transmitter Conducted Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note:

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 558074 D01 15.247 Meas Guidance v05 August 24, 2018
Title:	Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules
Reference:	KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

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:	KATHREIN
Model Name or Number:	52010301-000
Test Sample Serial Number:	GOK4485947
Hardware Version Number:	52010301-000
Firmware Version Number:	3.03.03
FCC ID:	WJ9-ARU3560

3.2. Description of EUT

The equipment under test was a 915MHz RF ID Reader with an integrated WLAN module (FCC certified).

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:	RFID 902-928 MHz (FHSS)		
Power Supply Requirement:	Nominal	90 - 264(V AC)	
Type of Unit:	Transceiver		
Channel Spacing:	500 kHz		
Modulation:	PR-ASK		
Data Rate (kbps):	40	80	160
Transmit Frequency Range:	902 MHz to 928 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	1	902.25
	Middle	26	915.25
	Top	52	927.75

3.5. Antenna Information**Internal Antennas:**

Antenna Name:	ARU 3560 Antenna Reader Unit
Antenna Type:	Wide Range Antenna, 902MHz - 928MHz
Antenna Gain Linear / Circular	7 dBi / 6.5 dBiC
Antenna Beamwidth:	h/v: 65°
Antenna Polarisation:	Linear / Circular

External Antennas:

Antenna Name:	SMSH-30-30-ETSI-FCC
Antenna Type:	Smart Shelf Antenna 865-928MHz ©KRAI
Antenna Gain:	-10 dBi/ -7 dBiC
Antenna Beamwidth:	h/v: 60°
Antenna Polarisation:	Circular

Antenna Name:	WRA 7070 Antenna Unit
Antenna Type:	Wide Range Antenna 902MHz - 928MHz
Antenna Gain:	5.5 dBi / 8.5 dBiC
Antenna Beamwidth:	h/v: 65°
Antenna Polarisation:	Circular

Antenna Name:	WIRA-30-circular-FCC
Antenna Type:	Wide Range Antenna 902MHz - 928MHz
Antenna Gain:	8 dBi / 11 dBiC
Antenna Beamwidth:	h/v: 70°/30°
Antenna Polarisation:	Circular

Antenna Name:	WIRA-40-linear-FCC
Antenna Type:	Wide Range Antenna 902-928MHz
Antenna Gain:	10 dBi / 13 dBiC
Antenna Beamwidth:	h/v: 40°
Antenna Polarisation:	Linear

3.6. Support Equipment

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

A. Support Equipment (In-house)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Laptop	Lenovo	L560	MP-16X73B 16/11

B. Support Equipment (Manufacturer supplied)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	RRU/ARU AC/DC Adapter 24V/90 W	MEANWELL	GST90A24	EB79F85440
2	POE/LAN Cable 5 m (M12x Coded to RJ45)	Kathrein	Art. -Nr. 1407473	Not marked
3	Antenna RF Cable 3m R-AC 3 TNC(m)-TNCR (m) (LL 240 flex) 1 dB Attenuation	Kathrein	Art. -Nr. 52010174	Not marked

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

Transmitting Mode (Fixed Frequency Mode) Transmitting Mode (Frequency Hopping Mode)

4.2. Configuration and Peripherals

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

- The EUT was powered by 120 V AC 60Hz power supply.
- The test mode settings were activated using a customer supplied software application ReaderStart V3, rev.3.01.03.2531 installed Lab test laptop. The application was used to enable continuous transmission and to select the test channels as required.
- EUT was tested with maximum output power in both fixed channel frequencies and in hopping channels mode.
- EUT supports three data rates (40 kbps / 80 kbps/160 kbps) out of which worst case (40 kbps) data rate producing maximum peak power has been tested.
- All the supplied antennas as given in section 3.5 have been tested with used power settings section 4.3.

Internal Antennas:

- For Conducted tests EUT's with internal antenna EUT's test port (Port 2) was selected in GUI and Port 2 was connected to spectrum analyzer. The measured values takes into consideration the external attenuation correction factors. The RF cable attenuation from the EUT to Analyzer including the 10 dB attenuation at the Spectrum Analyzer input was added as a reference level offset (10.2 dB) to each of the conducted plots.
- For Radiated tests with internal antenna was selected.
- EUT's unused ports (Port 3 | Port 4) were terminated using 50 Ohm termination during testing.
- It is to be noted that the internal Antenna supports several polarisations (Circular / Linear) and all the supported polarisations have been tested.

External Antennas:

- For Conducted tests EUT's with external antenna EUT's test port (Port 2) was selected in GUI and Port 2 was connected to spectrum analyzer. The measured values takes into consideration the external attenuation correction factors. The RF cable attenuation from the EUT to Analyzer including the 10 dB attenuation at the Spectrum Analyzer input was added as a reference level offset (10.2 dB) to each of the conducted plots.
- For Radiated tests with external antenna EUT's test port (Port 2) was connected to Antenna using RF cable supplied by the customer. This cable introduced a loss of 1dB @ 902-928MHz. This has been taken in to account with the measured radiated values."
- EUT's unused ports (Port 3 | Port 4) were terminated using 50 Ohm termination during testing.

4.3. Used Power settings

The EUT was configured with the settings below based on the different antenna type. The antenna gain on the GUI was set to 0 dBi and Cable attenuation was set to 0 dB.

The port power settings selected in GUI is given as in the table below.

Antenna Type	Power Settings
ARU 3560 Antenna Reader Unit	26
SMSH-30-30-ETSI-FCC	30
WRA 7070 Antenna Unit	30
WIRA-30-circular-FCC	26
WIRA-40-linear-FCC	26

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 DAkkS 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 AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	M. Fawad Khan	Test Date:	25 September 2018
Test Sample Serial Number:	GOK4485947		
Test Site Identification	SR 7/8		

FCC Reference:	Part 15.207
Test Method Used:	ANSI C63.10 Section 6.2 / FCC KDB 174176 and notes below

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	33

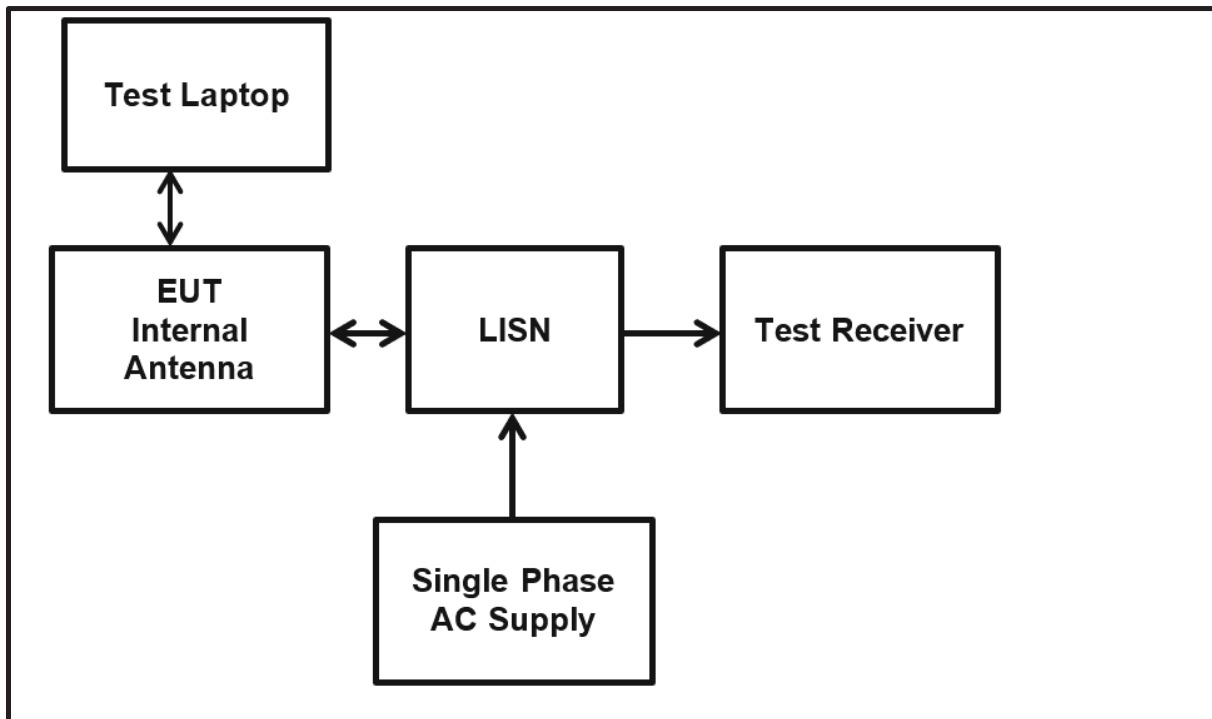
Settings of the Instrument

Detector	Quasi Peak /Average Peak
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Note:

1. The EUT was connected to 120 VAC 60 Hz single phase supply via a LISN.
2. The EUT was tested in Hopping Mode.

Test setup:



Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15939	Live	36.3	65.6	29.3	Complied
0.21393	Live	35.4	65	29.6	Complied
1.12872	Live	26.6	61.4	34.8	Complied
11.55636	Live	28.4	56	27.6	Complied
19.18002	Live	28.9	60	31.1	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15939	Live	25.2	55.6	30.4	Complied
0.21393	Live	22.9	55	32.1	Complied
1.12872	Live	17.7	51.4	33.7	Complied
11.55636	Live	19.4	46	26.6	Complied
19.18002	Live	22.7	50	27.3	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.17305	Neutral	34.1	64.8	30.7	Complied
0.18507	Neutral	33.6	64.3	30.7	Complied
0.25872	Neutral	26.2	61.5	35.3	Complied
0.41603	Neutral	21.7	57.5	35.8	Complied
21.53307	Neutral	28.9	60	31.1	Complied

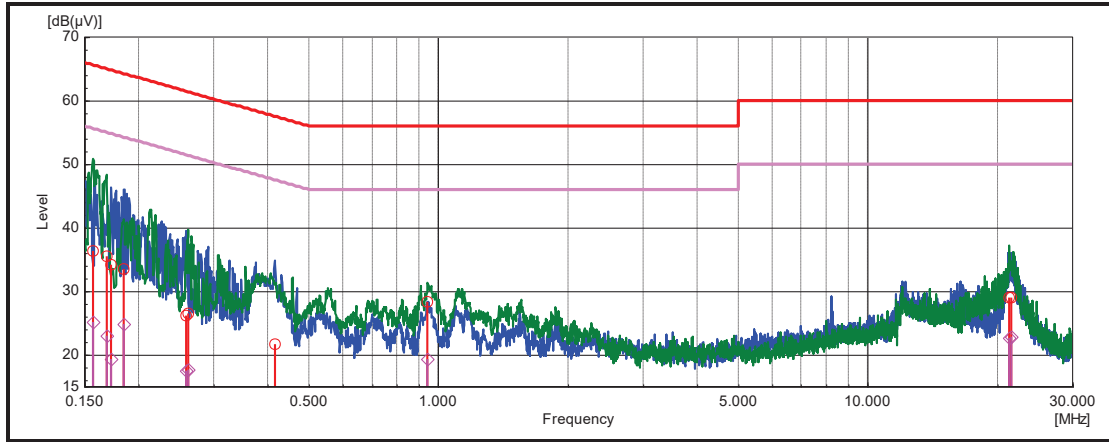
Results: Neutral / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.17305	Neutral	19.3	54.8	35.5	Complied
0.18507	Neutral	24.8	54.3	29.5	Complied
0.25872	Neutral	17.5	51.5	34	Complied
0.41603	Neutral	13	47.5	34.5	Complied
21.53307	Neutral	22.9	50	27.1	Complied

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line



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

5.2.2. Transmitter 20 dB Bandwidth

Test Summary:

Test Engineer:	Abdoufataou Salifou	Test Date:	30 August 2018
Test Sample Serial Number:	GOK4485947		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(1)
Test Method Used:	KDB 558074 Section 9 & ANSI C63.10 Section 6.9.2

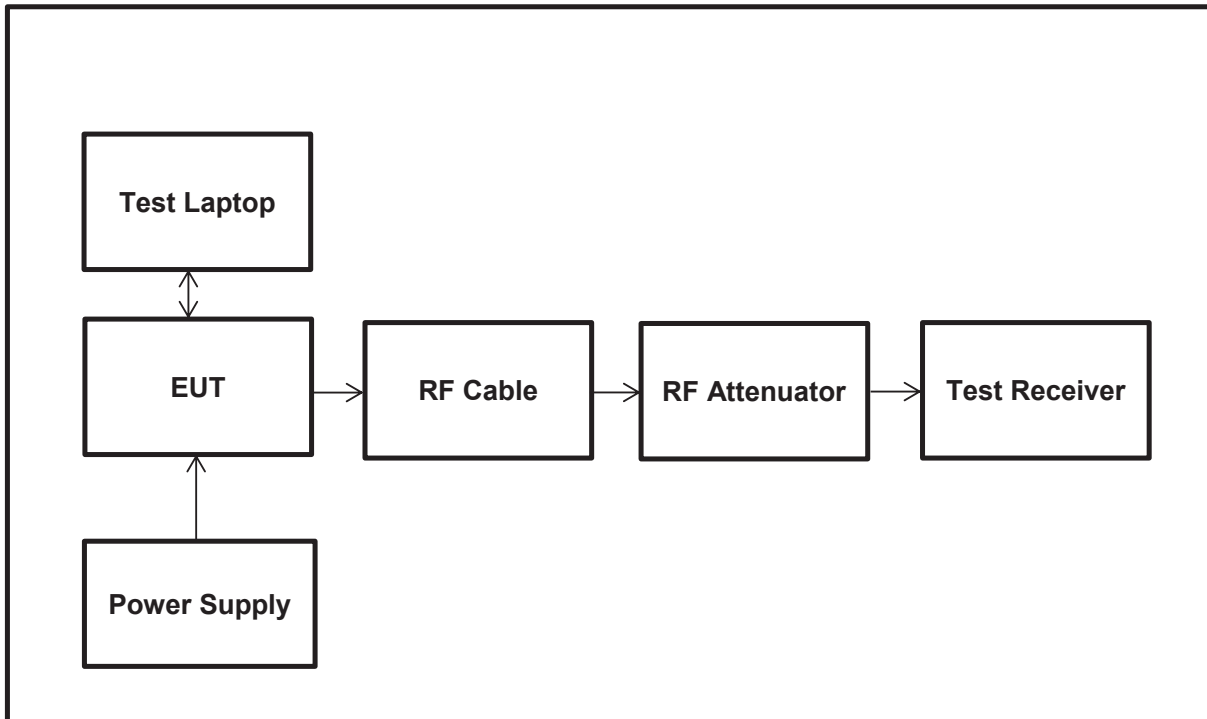
Environmental Conditions:

Temperature (°C):	23.4
Relative Humidity (%):	40

Notes:

1. The test receiver resolution bandwidth was set to 500 Hz and video bandwidth 2 kHz. A Peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 100 kHz. Normal and delta markers were placed 20 dB down from the peak of the carrier. These results are documented in the table below.
2. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable.

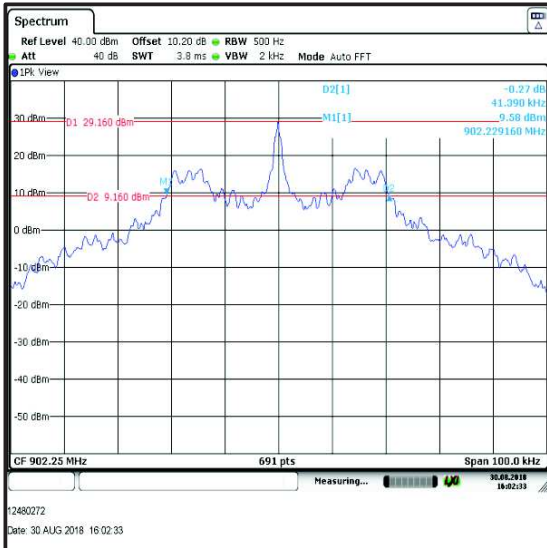
Test setup:



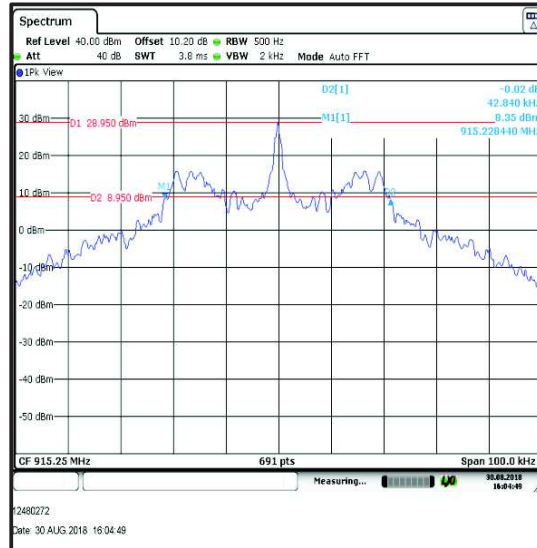
Transmitter 20 dB Bandwidth (continued)

Results :

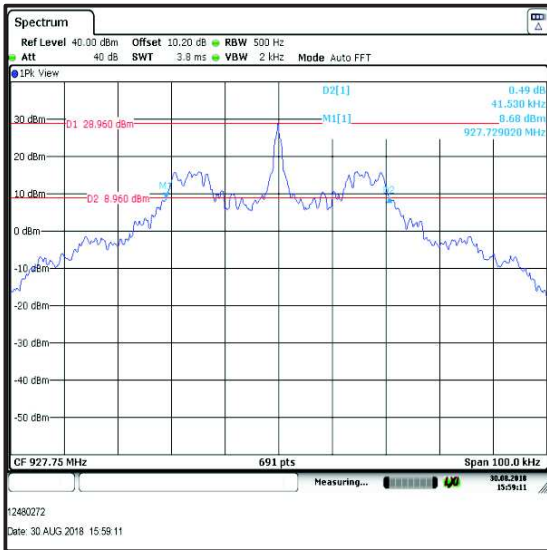
Channel	20 dB Bandwidth (kHz)
Bottom	41.390
Middle	42.840
Top	41.530



Bottom Channel



Middle Channel



Top Channel

Result: Pass

5.2.3. Transmitter Carrier Frequency Separation

Test Summary:

Test Engineer:	Abdoufataou Salifou	Test Date:	31 August 2018
Test Sample Serial Number:	GOK4485947		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(1)
Test Method Used:	KDB 558074 Section 9 & ANSI C63.10 Section 7.8.2

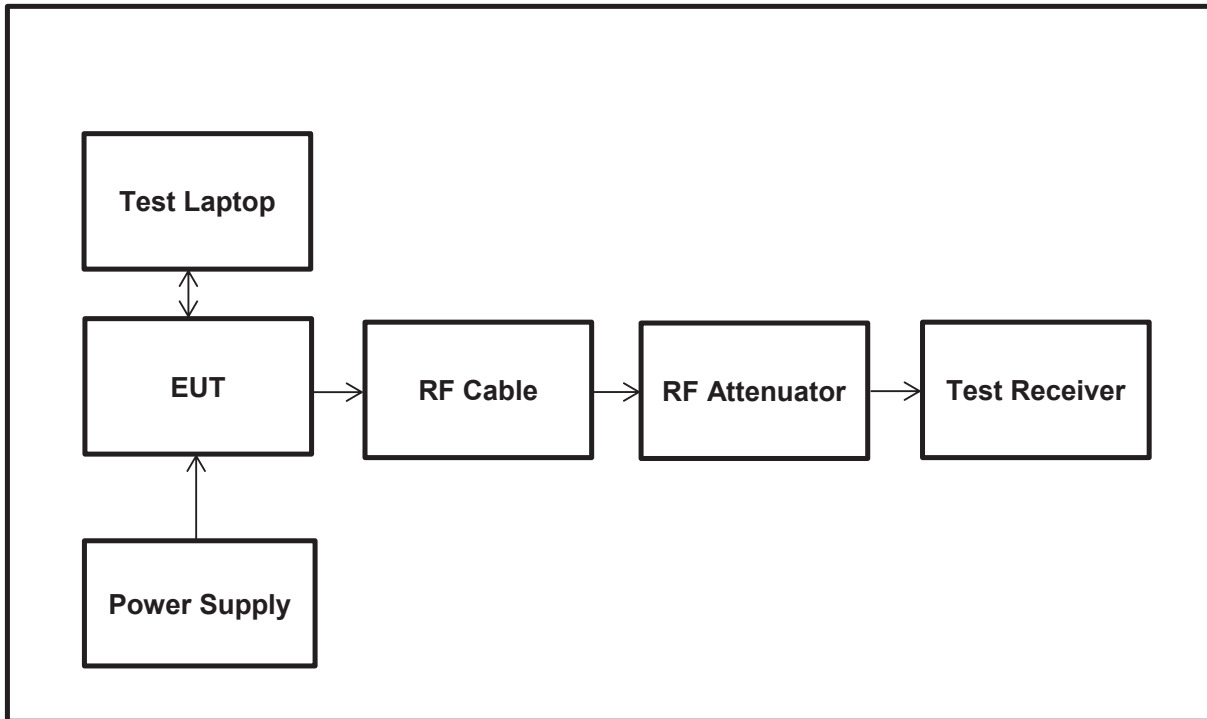
Environmental Conditions:

Temperature (°C):	22.4
Relative Humidity (%):	40

Notes:

1. The 20 dB bandwidth measured for the middle channel operating at 915.25 MHz was used to calculate the limit.
2. The test receiver resolution bandwidth was set to 200 kHz and video bandwidth of 500 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 1 MHz. A marker was placed at the centre of one signal and then a delta marker was placed in the same place on the second signal, the results are recorded in the table below.
3. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable.

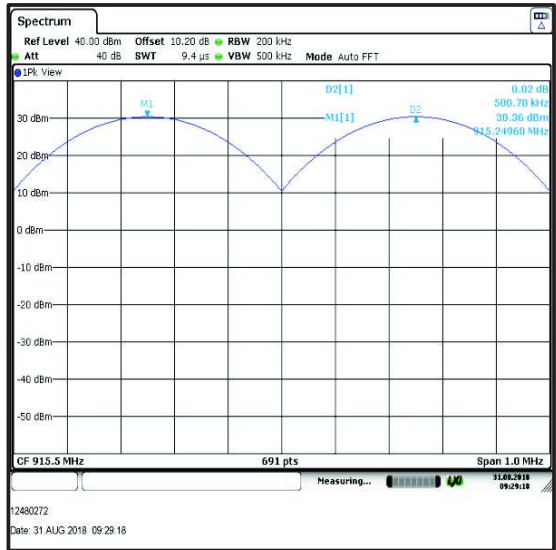
Test setup:



Transmitter Carrier Frequency Separation (continued)

Results:

Carrier Frequency Separation (kHz)	Limit (20 dB BW) (kHz)	Margin (kHz)	Result
500.700	42.840	457.860	Complied



Result: Pass

5.2.4. Transmitter Number of Hopping Frequencies and Average Time of Occupancy**Test Summary:**

Test Engineer:	Abdoufataou Salifou	Test Date:	31 August 2018
Test Sample Serial Number:	GOK4485947		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(1)(i)
Test Method Used:	KDB 558074 Section 9 & ANSI C63.10 Sections 7.8.3 & 7.8.4

Environmental Conditions:

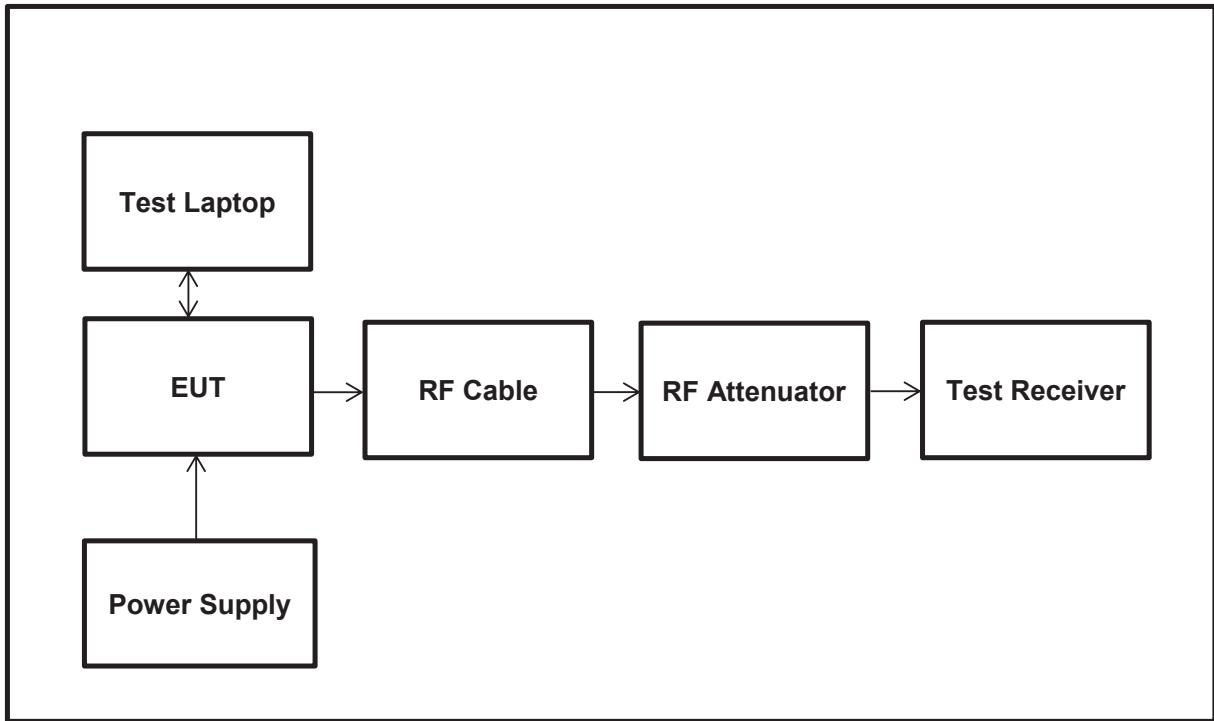
Temperature (°C):	22.4
Relative Humidity (%):	40

Notes:

1. For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.
2. The test receiver was set up for the Number of Hopping Frequencies measurement as follows: the resolution bandwidth was set to 30 kHz and video bandwidth of 100 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 28 MHz
3. The test receiver was set up for the Emission Width measurement as follows: the resolution bandwidth was set to 10 kHz and video bandwidth of 30 kHz. A peak detector was used and sweep time was set to auto with a span of zero Hz. The emission width is recorded in the table below
4. The test receiver was set up for the Number of Hopping Frequencies in 2 seconds measurement as follows: the resolution bandwidth was set to 30 kHz and video bandwidth of 100 kHz. A peak detector was used and sweep time was set to 2 seconds. The EUT was set to transmit in a hopping frequency mode with zero span. The total number of hopping frequencies were recorded in the table below.
5. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable.

Transmitter Number of Hopping Frequencies and Average Time of Occupancy
(continued)

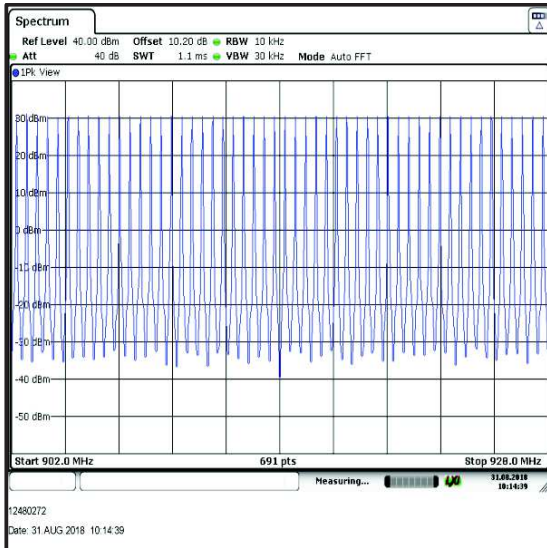
Test setup:



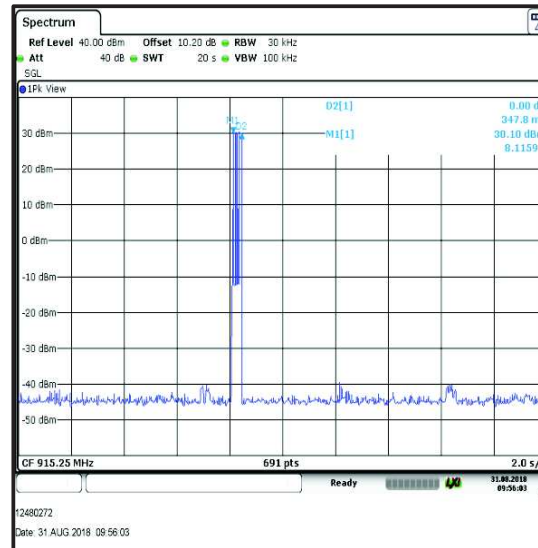
Transmitter Number of Hopping Frequencies and Average Time of Occupancy (continued)

Results:

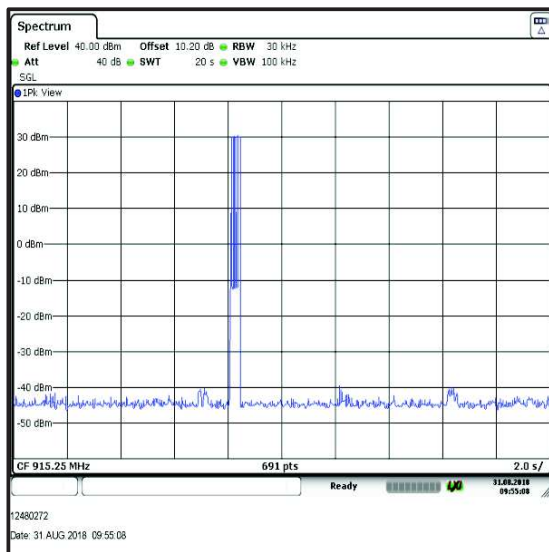
Emission Width (ms)	Number of Hops in 20 s	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
0.348	1	0.348	0.4	0.052	Complied



Number of Hopping Frequencies



Emission Width



Average Time of Occupancy in 20 s

Result: Pass

5.2.5. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Abdoufataou Salifou	Test Date:	30 August 2018 & 02 October 2018
Test Sample Serial Number:	GOK4485947		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(b)(2)
Test Method Used:	KDB 558074 Section 9 & ANSI C63.10 Section 7.8.5

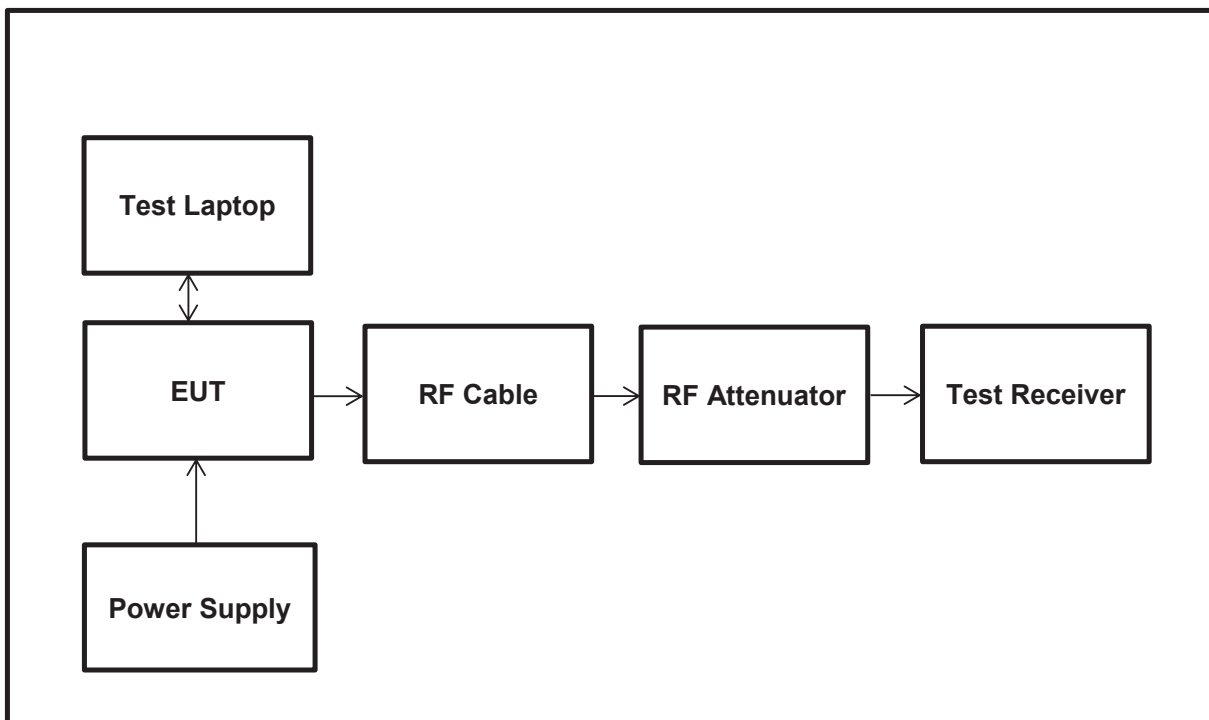
Environmental Conditions:

Temperature (°C):	23.4 & 22
Relative Humidity (%):	40 & 30

Notes:

1. The test receiver resolution bandwidth was set to 50 kHz (20 dB bandwidth) and video bandwidth of 200 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 200 kHz (approximately five times the 20 dB bandwidth). A marker was placed at the peak of the signal and the results recorded in the tables below.
2. These tests were performed radiated; therefore the EUT antenna gain is encompassed in the final result and not measurable.
3. The declared antenna gain was added to the conducted peak power to obtain the ERP.
4. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF offset level was entered on the test receiver to compensate for the loss of the attenuator and RF cable.

Test setup:



Transmitter Maximum Peak Output Power (continued)**Results: Valid for Antenna Type: SMSH-30-30-ETSI-FCC / WRA 7070 Antenna Unit**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	29.2	30.0	0.8	Complied
Middle	28.8	30.0	1.2	Complied
Top	29.1	30.0	0.9	Complied

Results: Valid for Antenna Type:**ARU 3560 Antenna Reader Unit / WIRA-40-linear-FCC / WIRA-30-circular-FCC**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	25.6	30.0	4.4	Complied
Middle	25.7	30.0	4.3	Complied
Top	25.6	30.0	4.4	Complied

Transmitter Maximum Peak Output Power (continued)**Transmitter Maximum Peak Output Power / ARU 3560 Antenna Reader Unit**

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	25.6	7	32.6	36.0	3.4	Complied
Middle	25.7	7	32.7	36.0	3.3	Complied
Top	25.6	7	32.6	36.0	3.4	Complied

Transmitter Maximum Peak Output Power / Antenna Type: WIRA-40-linear-FCC

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	25.6	10	35.6	36.0	0.4	Complied
Middle	25.7	10	35.7	36.0	0.3	Complied
Top	25.6	10	35.6	36.0	0.4	Complied

Transmitter Maximum Peak Output Power / Antenna Type: WIRA-30-circular-FCC

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	25.6	8	33.6	36.0	2.4	Complied
Middle	25.7	8	33.7	36.0	2.3	Complied
Top	25.6	8	33.6	36.0	2.4	Complied

Transmitter Maximum Peak Output Power (continued)**Transmitter Maximum Peak Output Power / Antenna Type: WRA 7070 Antenna Unit**

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	29.2	5.5	34.7	36.0	1.3	Complied
Middle	28.8	5.5	34.3	36.0	1.7	Complied
Top	29.1	5.5	34.6	36.0	1.4	Complied

Transmitter Maximum Peak Output Power / Antenna Type: SMSH-30-30-ETSI-FCC

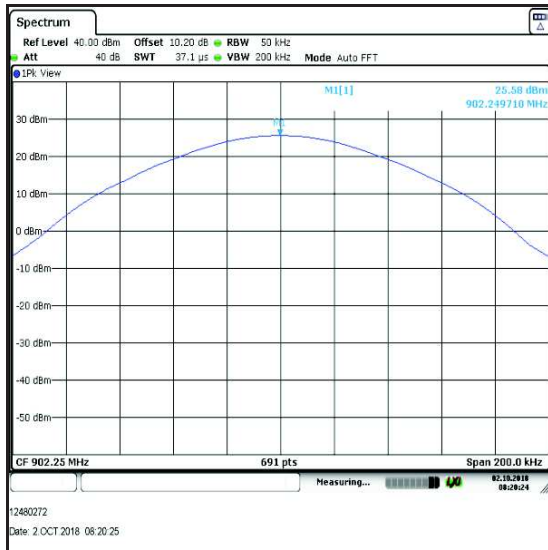
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	29.2	-10	19.2	36.0	16.8	Complied
Middle	28.8	-10	18.8	36.0	17.2	Complied
Top	29.1	-10	19.1	36.0	16.9	Complied

Result: Pass

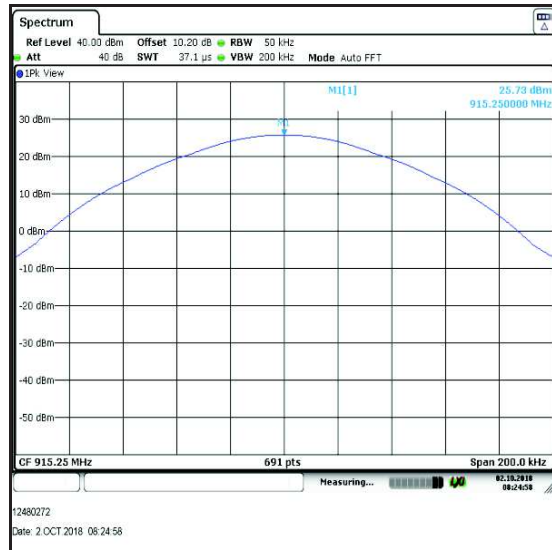
Transmitter Maximum Peak Conducted Output Power (continued)

Results: Antenna Type:

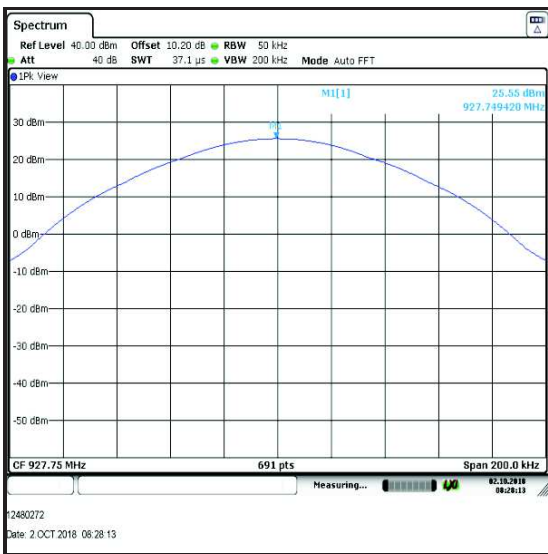
ARU 3560 Antenna Reader Unit / WIRA-40-linear-FCC / WIRA-30-circular-FCC



Bottom Channel



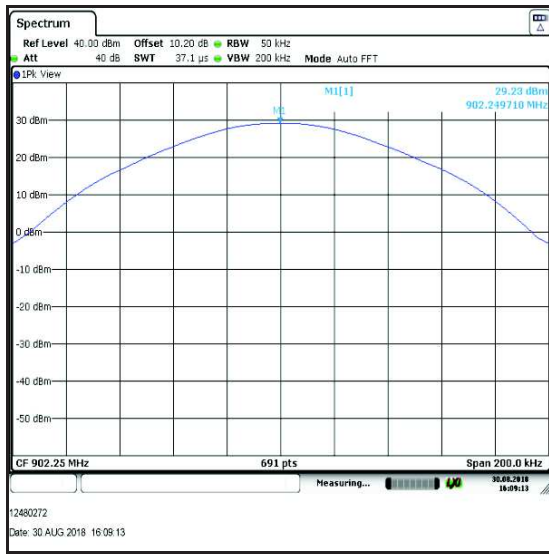
Middle Channel



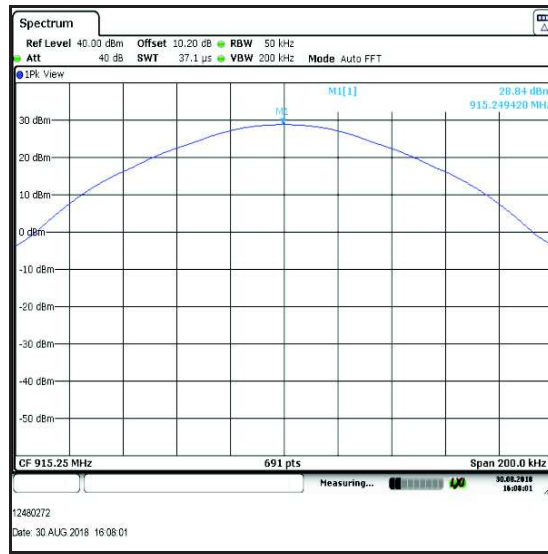
Top Channel

Transmitter Maximum Peak Output Power (continued)

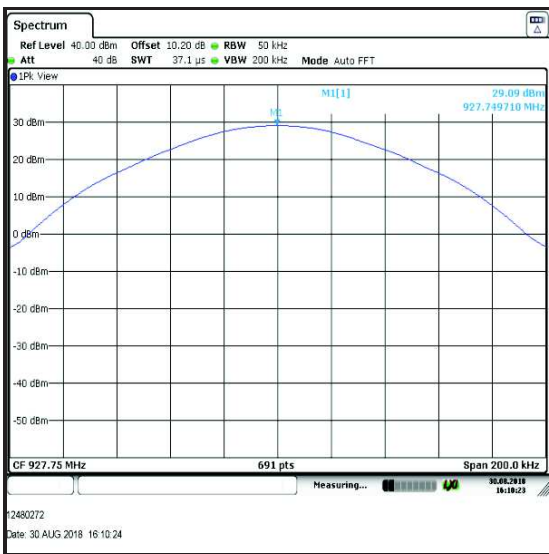
Results: SMSH-30-30-ETSI-FCC / WRA 7070 Antenna Unit



Bottom Channel



Middle Channel



Top Channel

5.2.6. Transmitter Conducted Emissions

Test Summary:

Test Engineer:	Abdoufataou Salifou	Test Date:	17 September 2018
Test Sample Serial Number:	GOK4485947		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(d)
Test Method Used:	KDB 558074 Section 9 & ANSI C63.10 Sections 6.7 and 7.8.8
Frequency Range	30 MHz to 1 GHz

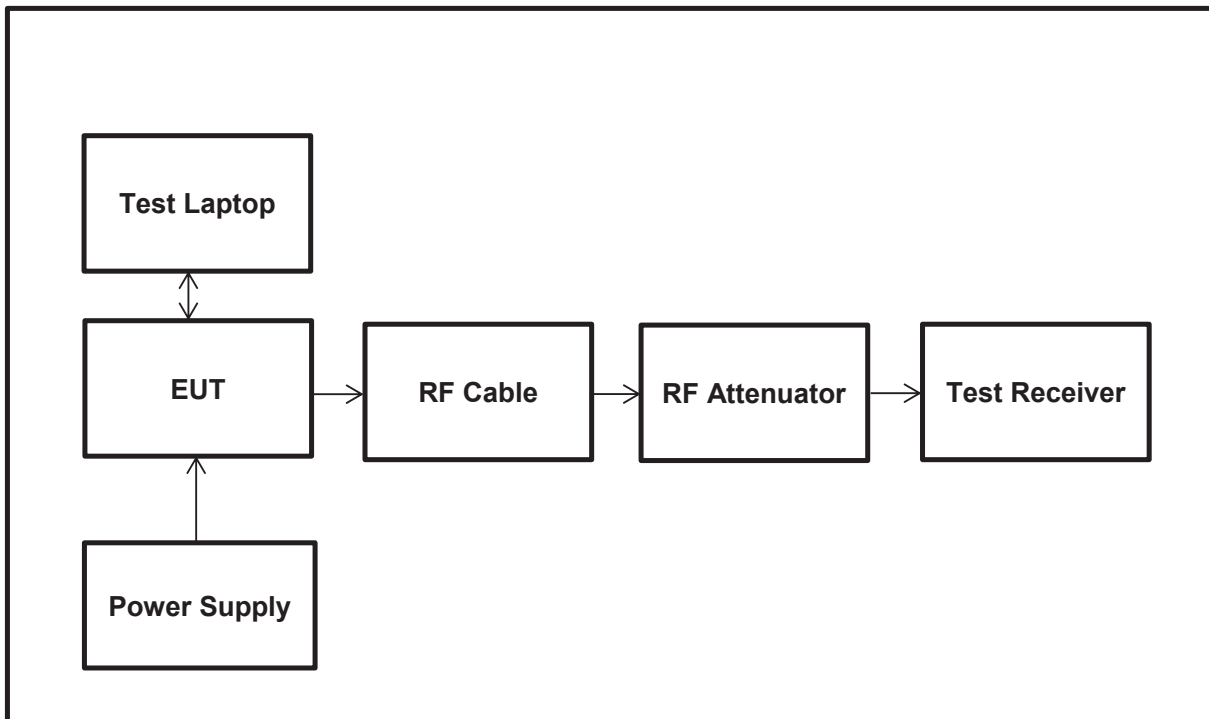
Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	40

Note:

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. 20 dBc Limit* from worst case Antenna has been selected to show compliance to all other supported antenna types.
3. For Transmitter Conducted Emissions WIRA-40-linear-FCC Antenna produced worst case with 20 dBc limit: 95.7 dBµV/m

Test setup:



Transmitter Conducted Emissions (continued) /**Results: Peak / Bottom Channel**

Frequency (MHz)	Level (dB μ V/m)	Antenna Gain (dBi)	Corrected EIRP Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
899.630	57.0	10.0	67.0	95.7	28.7	Complied
912.260	50.1	10.0	60.1	95.7	35.6	Complied

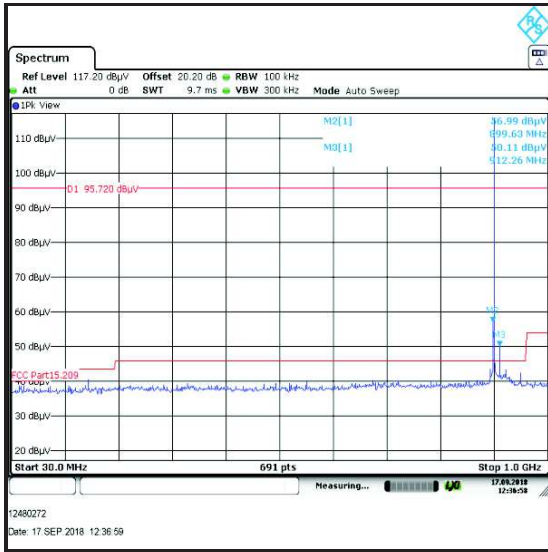
Results: Peak / Middle Channel

Frequency (MHz)	Level (dB μ V/m)	Antenna Gain (dBi)	Corrected EIRP Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
899.630	56.8	10.0	66.8	96.3	29.5	Complied
912.260	50.8	10.0	60.8	96.3	35.5	Complied

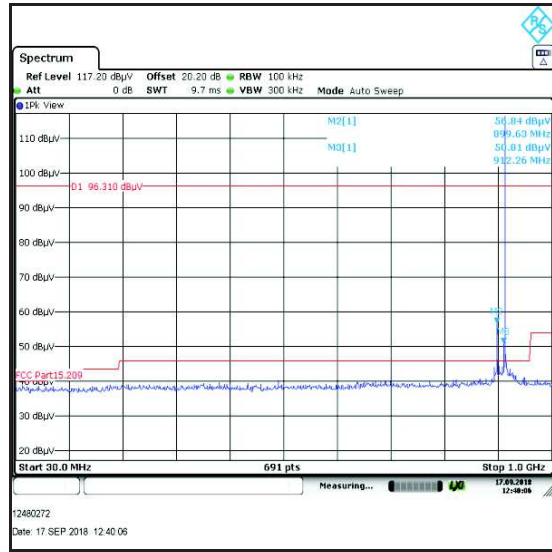
Results: Peak / Top Channel

Frequency (MHz)	Level (dB μ V/m)	Antenna Gain (dBi)	Corrected EIRP Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
899.630	57.9	10.0	67.9	96.1	28.2	Complied
912.260	51.4	10.0	61.4	96.1	34.7	Complied

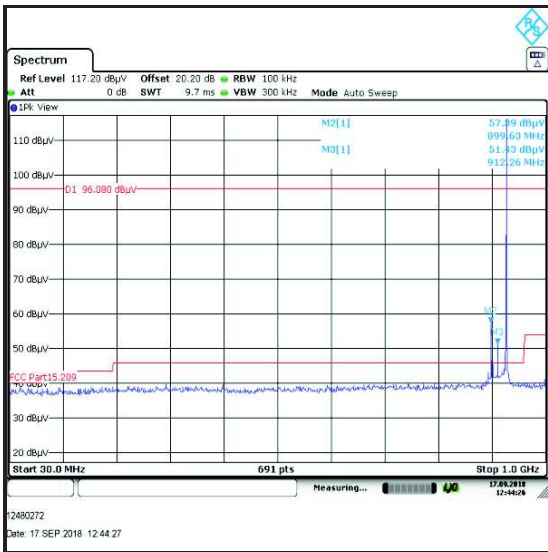
Transmitter Conducted Emissions (continued)



Bottom Channel



Middle Channel



Top Channel

Result: **Pass**

Test Summary:

Test Engineer:	Abdoufataou Salifou	Test Date:	17 September 2018
Test Sample Serial Number:	GOK4485947		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(d)
Test Method Used:	KDB 558074 Section 9 & ANSI C63.10 Sections 6.7 and 7.8.8
Frequency Range	1 GHz to 10 GHz

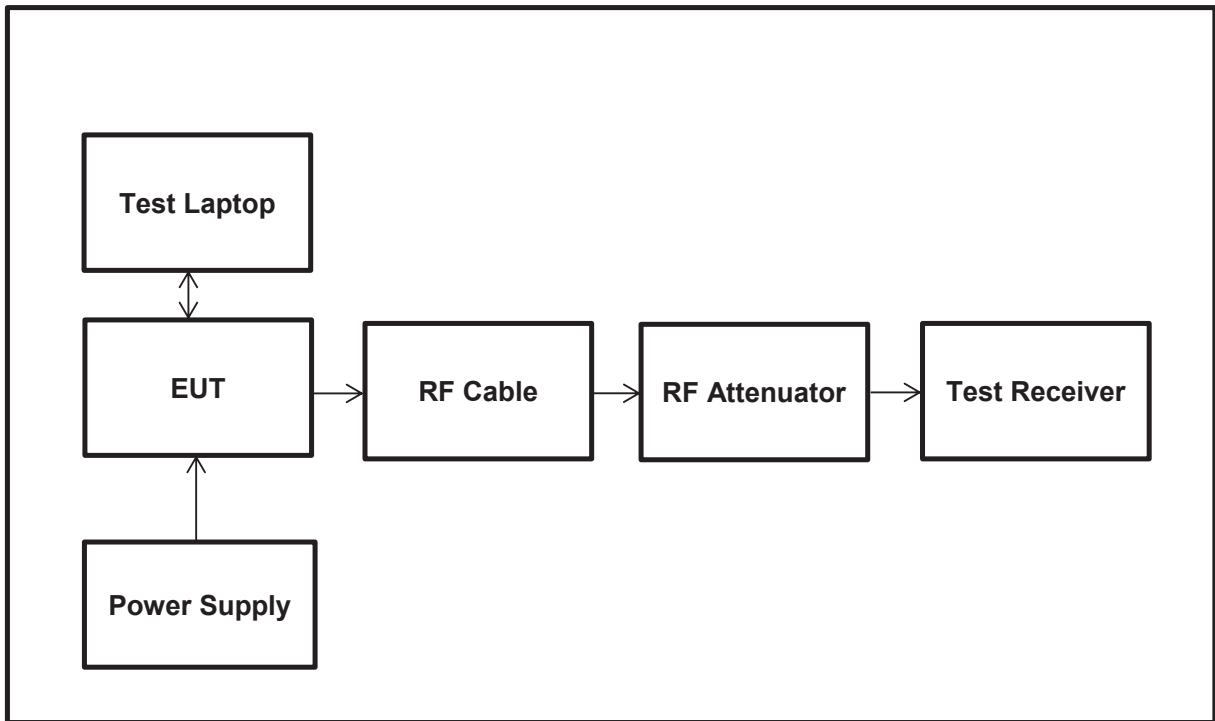
Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	40

Notes:

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. 20 dBc Limit* from worst case Antenna has been selected to show compliance to all other supported antenna types.
3. For Transmitter Conducted Emissions WIRA-40-linear-FCC Antenna produced worst case with 20 dBc limit: 95.7 dB μ V/m

Test setup:



Transmitter Conducted Emissions (continued)**Results: Peak / Bottom Channel**

Frequency (MHz)	Level (dB μ V/m)	Antenna Gain (dBi)	Corrected EIRP Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
1801.000	48.0	10.0	58.0	95.7	37.7	Complied

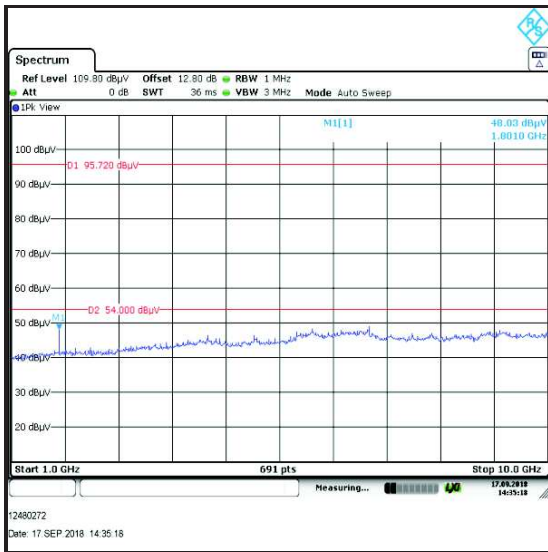
Results: Peak / Middle Channel

Frequency (MHz)	Level (dB μ V/m)	Antenna Gain (dBi)	Corrected EIRP Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
1827.000	47.6	10.0	57.6	96.3	38.7	Complied

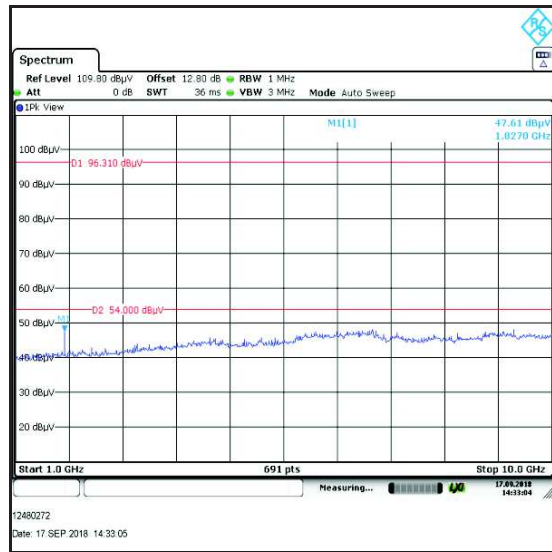
Results: Peak / Top Channel

Frequency (MHz)	Level (dB μ V/m)	Antenna Gain (dBi)	Corrected EIRP Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
1853.000	49.0	10.0	59.0	96.1	37.1	Complied

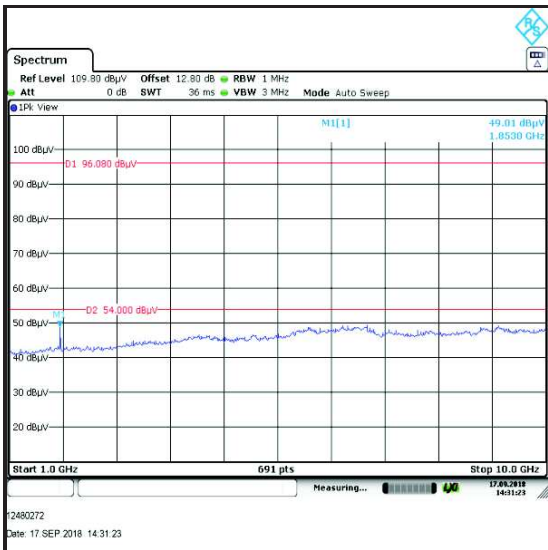
Transmitter Conducted Emissions (continued)



Bottom Channel



Middle Channel



Top Channel

Result: **Pass**

5.2.7. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	Abdoufataou Salifou	Test Date:	17, 24 & 26 September 2018 & 16 January 2019
Test Sample Serial Number:	GOK4485947		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	KDB 558074 Section 9 & ANSI C63.10 Section 6.10.4, 6.10.5

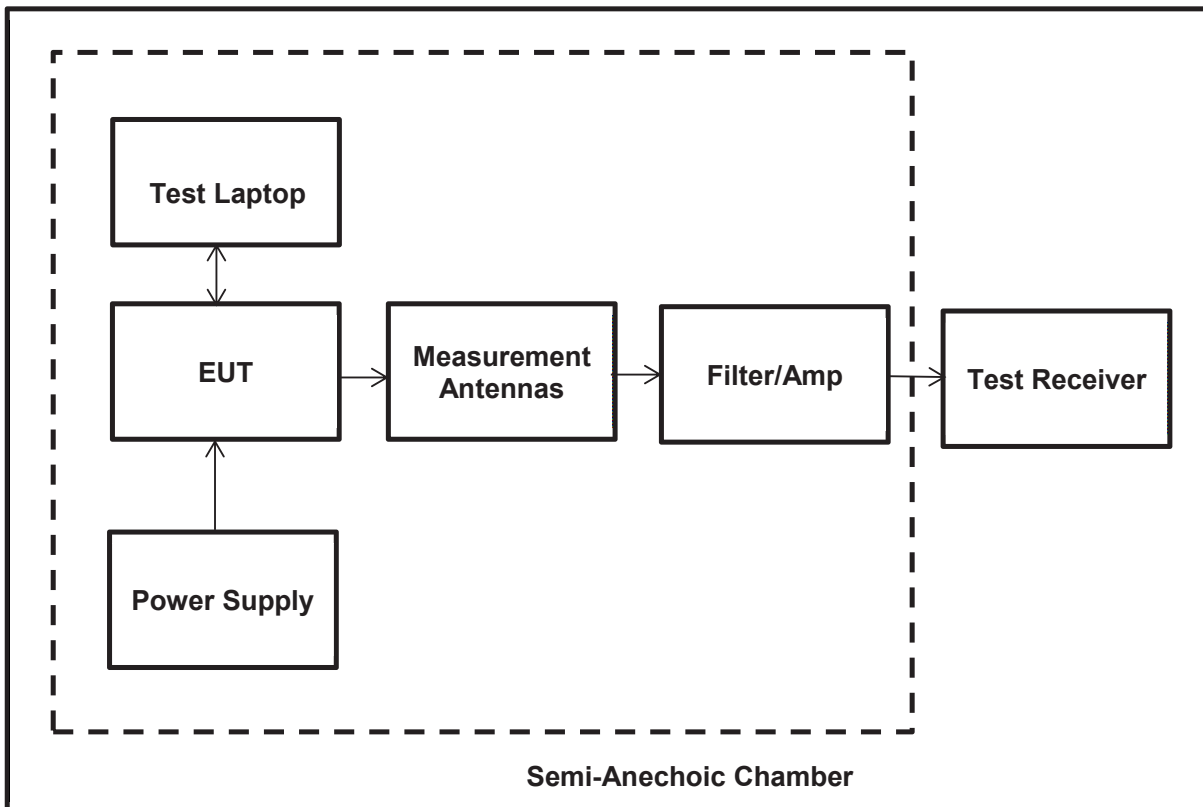
Environmental Conditions:

Temperature (°C):	21 & 22 & 20
Relative Humidity (%):	46 & 41 & 42

Notes:

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The plots shown on the following page were performed using a peak detector.
3. For the test made with the EUT in hopping mode, both Band Edge measurements are performed in one plot.

Test Setup:



Transmitter Band Edge Radiated Emissions (continued)**Internal Antenna: ARU 3560 Antenna Reader Unit - Linear polarisation****Results: Bottom**

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.000	Horizontal	59.7	97.2	37.5	Complied

Results: Top

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.000	Horizontal	58.1	95.7	37.6	Complied

Results: Bottom/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.000	Horizontal	78.6	98.4	19.8	Complied

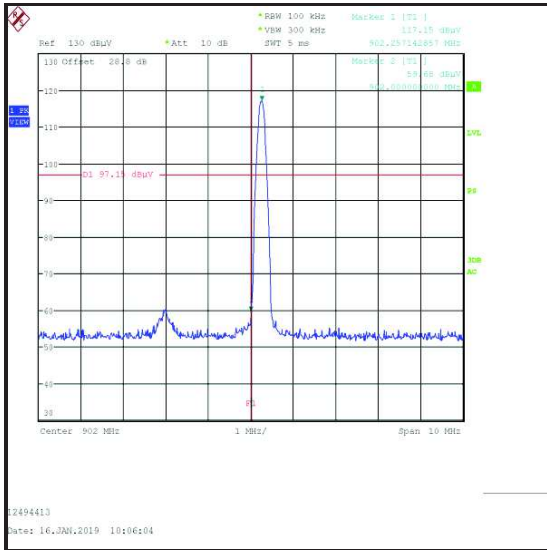
Results: Top/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.000	Horizontal	71.7	98.4	26.7	Complied

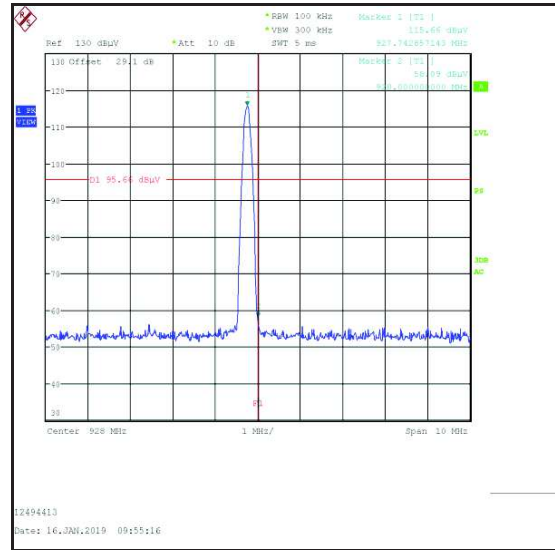
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

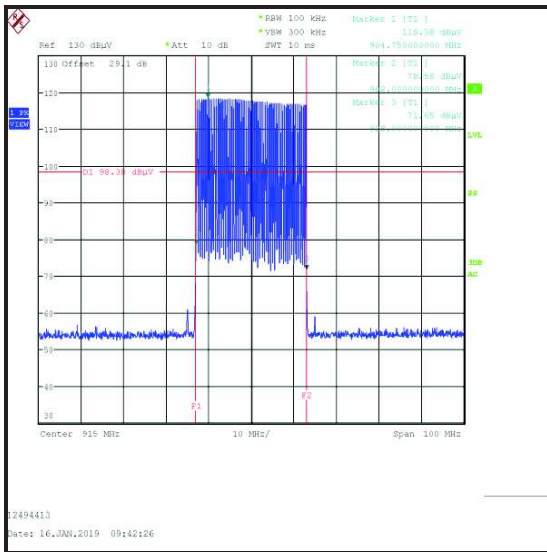
Internal Antenna: ARU 3560 Antenna Reader Unit - Linear polarisation



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Lower and Upper Band Edge measurement
Hopping mode

Transmitter Band Edge Radiated Emissions (continued)**Internal Antenna: ARU 3560 Antenna Reader Unit - Circular polarisation****Results: Bottom**

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.000	Horizontal	58.8	96.3	37.5	Complied

Results: Top

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.000	Horizontal	58.6	97.0	38.4	Complied

Results: Bottom/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.000	Horizontal	78.6	99.4	20.8	Complied

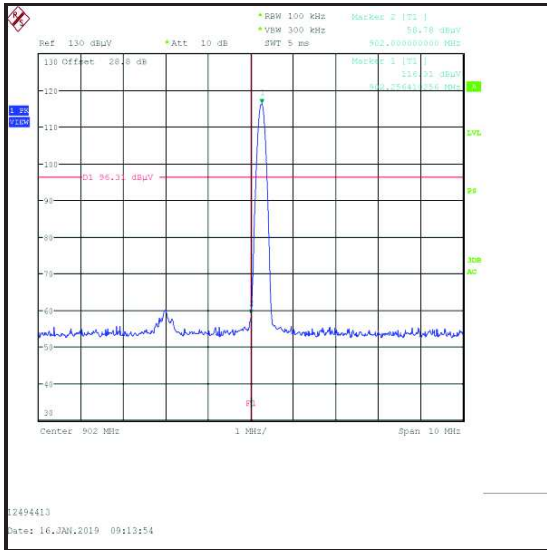
Results: Top/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.000	Horizontal	71.6	99.4	27.8	Complied

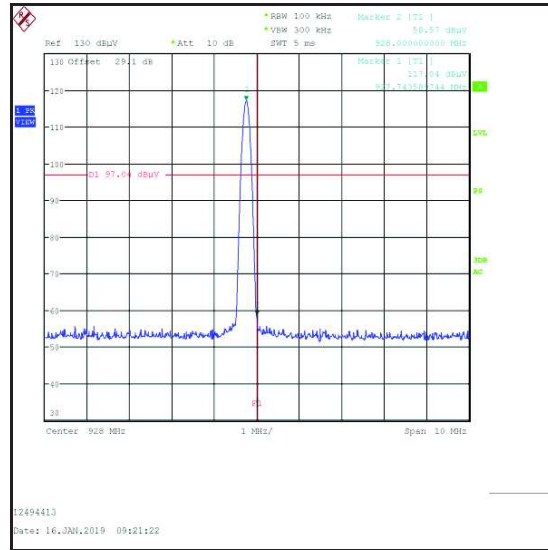
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

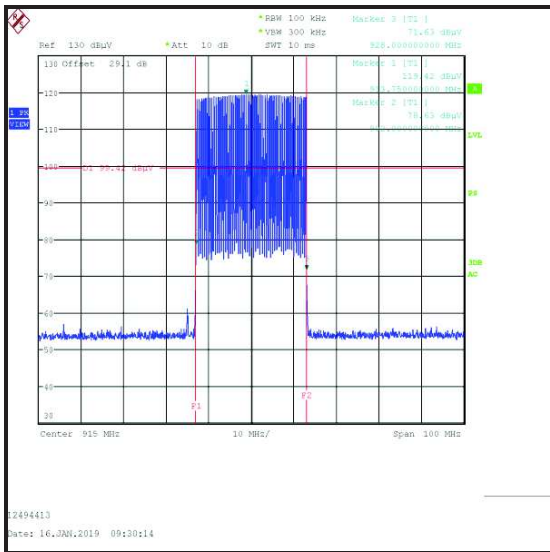
Internal Antenna: ARU 3560 Antenna Reader Unit - Circular polarisation



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Lower and Upper Band Edge measurement
Hopping mode

Transmitter Band Edge Radiated Emissions (continued)**External Antenna: WRA 7070 Antenna Unit****Results: Bottom**

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.000	Vertical	90.9	108.8	17.9	Complied

Results: Top

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.000	Vertical	92.4	109.6	17.2	Complied

Results: Bottom/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.000	Vertical	87.6	111.1	23.5	Complied

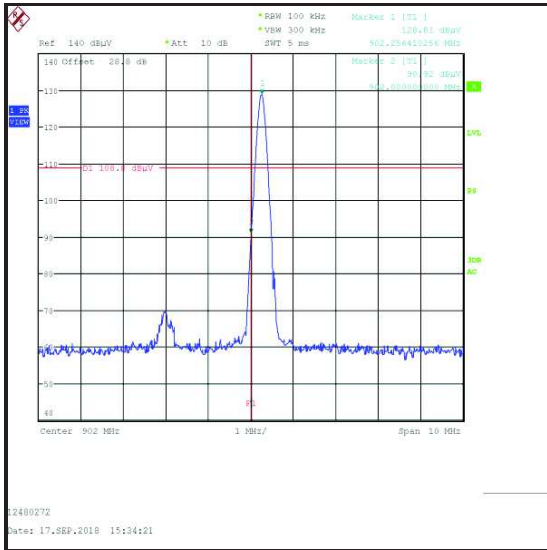
Results: Top/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.000	Vertical	84.1	111.1	27.0	Complied

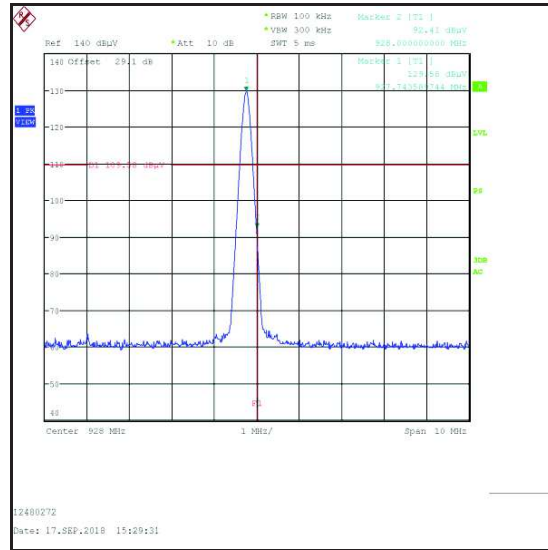
Result: Pass

Transmitter Band Edge Radiated Emissions (continued) /

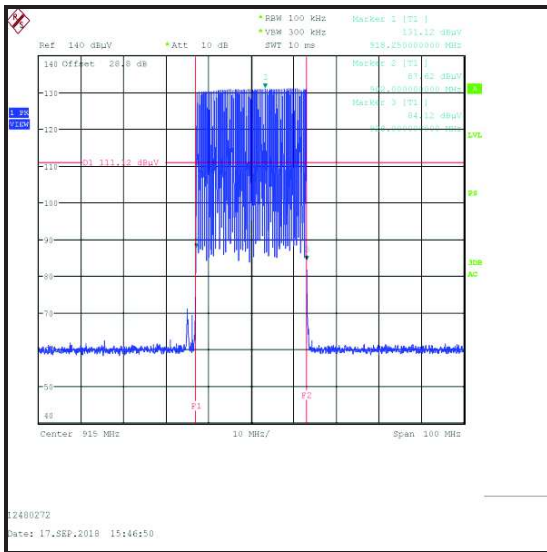
External Antenna: WRA 7070 Antenna Unit



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Lower and Upper Band Edge measurement
Hopping mode

Transmitter Band Edge Radiated Emissions (continued)**External Antenna: SSMH-30-30-ETSI-FCC****Results: Bottom**

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.00	Vertical	73.5	91.5	18.0	Complied

Results: Top

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.00	Vertical	73.7	92.3	18.6	Complied

Results: Bottom/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.00	Vertical	78.5	94.7	16.2	Complied

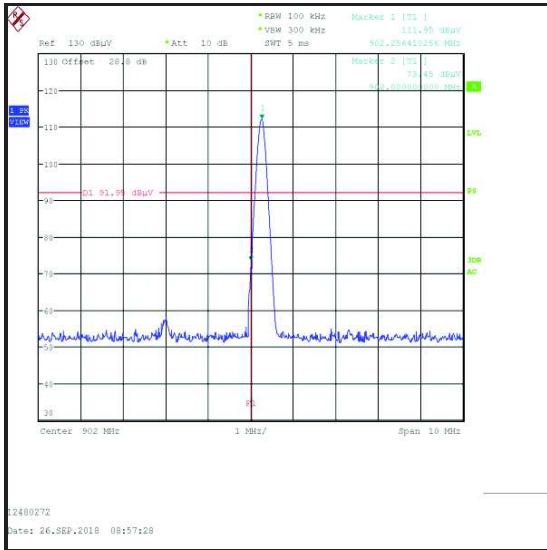
Results: Top/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.00	Vertical	78.9	94.7	15.8	Complied

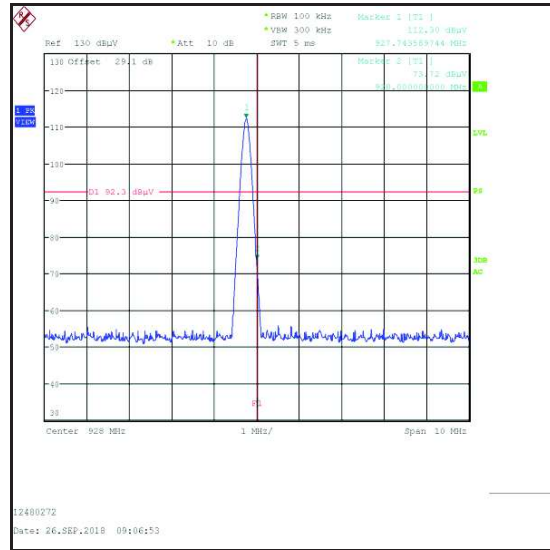
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

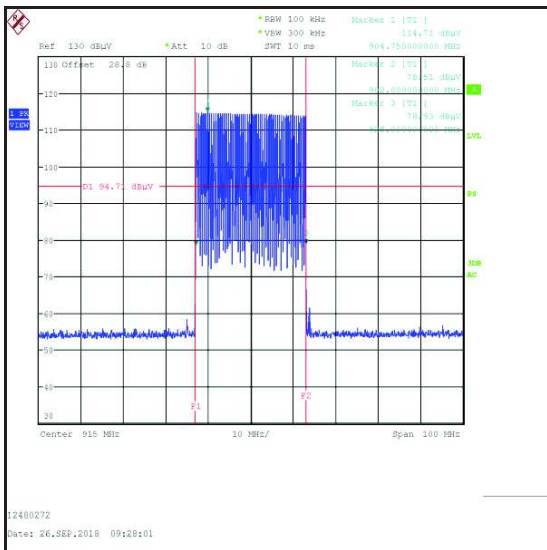
External Antenna: SSMH-30-30-ETSI-FCC



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Lower and Upper Band Edge measurement Hopping mode

Transmitter Band Edge Radiated Emissions (continued)**External Antenna: WIRA-40-linear-FCC****Results: Bottom**

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.00	Vertical	86.9	104.5	17.6	Complied

Results: Top

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.00	Vertical	86.6	104.6	18.0	Complied

Results: Bottom/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.00	Vertical	93.0	105.5	12.5	Complied

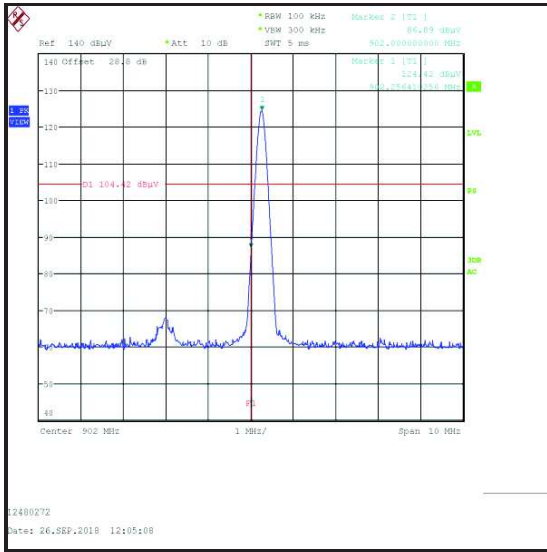
Results: Top/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.00	Vertical	90.2	105.5	15.3	Complied

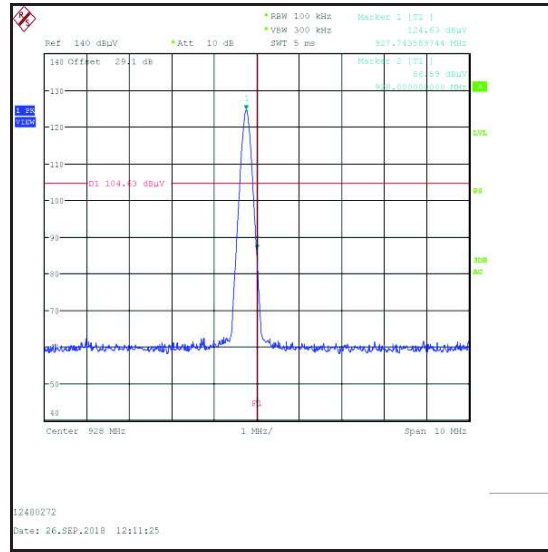
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

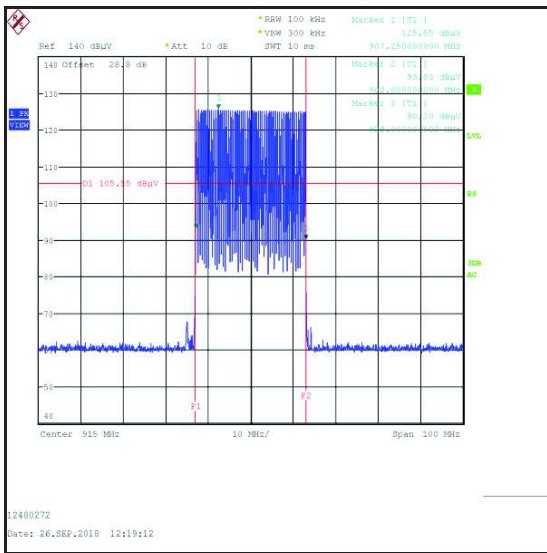
External Antenna: WIRA-40-linear-FCC



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Lower and Upper Band Edge measurement Hopping mode

Transmitter Band Edge Radiated Emissions (continued)**External Antenna: WIRA-30-circular-FCC****Results: Bottom**

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.00	Vertical	88.8	107.4	18.6	Complied

Results: Top

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.00	Vertical	93.1	110.8	17.7	Complied

Results: Bottom/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
902.00	Vertical	94.8	113.1	18.3	Complied

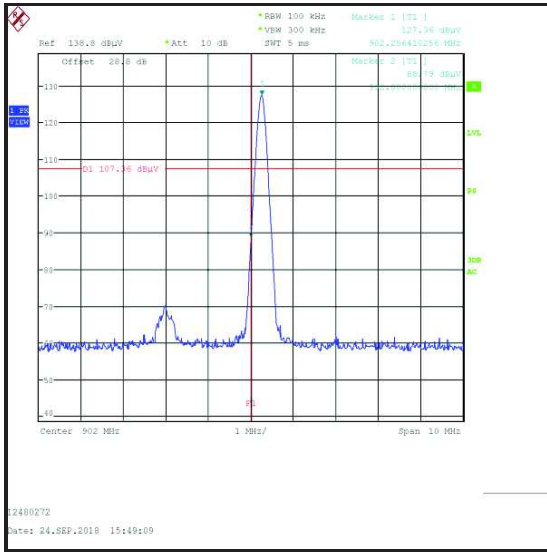
Results: Top/ Hopping

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	20 dBc Limit (dB μ V/m)	Margin (dB)	Result
928.00	Vertical	87.5	113.1	25.6	Complied

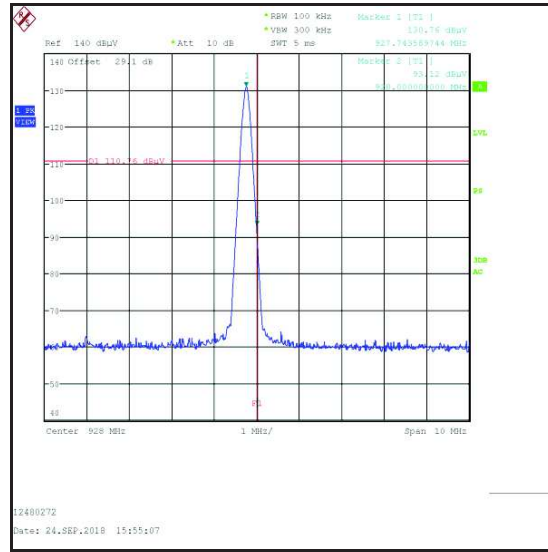
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

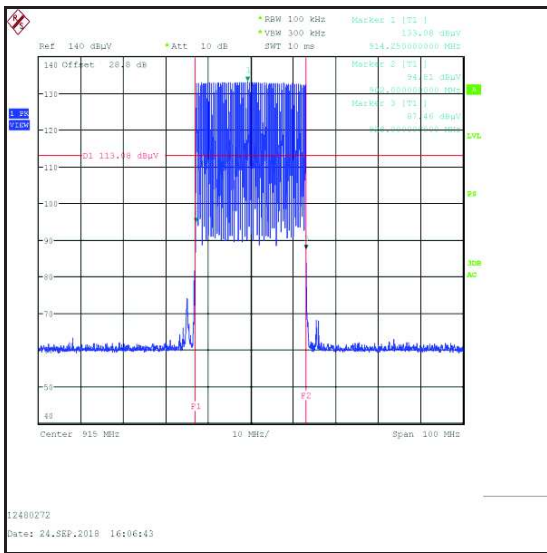
External Antenna: WIRA-30-circular-FCC



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Lower and Upper Band Edge measurement Hopping mode

6. Measurement Uncertainty

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	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	95%	±2.49 dB
Conducted Maximum Peak Output Power	95%	±0.59 dB
Conducted Spurious Emissions	95%	±0.59 dB
Band Edge Radiated Emissions	95%	±3.10 dB
Carrier Frequency Separation	95%	±92 Hz
Average Time of Occupancy	95%	±3.53 ns
20 dB Bandwidth	95%	±0.87 %

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. Used equipment

Test site: SR 1/2

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
103	EMCO	Antenna, Horn	3115	9008/3485	7/20/2016	36
104	EMCO	Antenna, Horn	3115	9008/3486	7/20/2016	36
156	Rohde & Schwarz	V-Network	ESH3-Z6	843864/004	7/11/2018	12
350	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/014	7/12/2018	12
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	7/12/2018	12
383	Rohde & Schwarz	Antenna, Rod	HFH2-Z1	890151/11	7/14/2017	24
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	055929	7/12/2018	12
424	EMCO	Antenna, Horn	EMCO 3116	00046537	7/28/2016	24
425	Agilent	Generator, CW Signal	E8247C	MY43320849	7/10/2018	24
426	Agilent	Spectrum Analyzer	E4446A	US44020316	7/11/2018	24
460	Deisl	Turntable	DT 4250 S		n/a	n/a
465	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	9/29/2017	24
474	Agilent	Analyzer, ENA Network	E5071C	MY46100912	7/13/2018	24
495	Rohde & Schwarz	Antenna, Log.- Periodical	HL050	100296	7/20/2016	24
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	7/20/2016	24
497	Schwarzbeck	Antenna, Biconical	VHBB 9124	423	7/7/2016	36
499	Schwarzbeck	Antenna, log.-per	VUSLP 9111	317	8/2/2016	36
587	Maturo	antenna mast, tilting	TAM 4.0-E	011/7180311	n/a	n/a
588	Maturo	Controller	NCD	029/7180311	n/a	n/a
591	Rohde & Schwarz	Receiver	ESU 40	100244/040	7/12/2018	12
607	Schwarzbeck	Antenna broadband horn antenna	BBHA 9170	9170-561	7/28/2016	24
608	Rohde & Schwarz	Switch Matrix	OSP 120	101227	4/8/2014	60
615	Wainwright Instruments	Highpass Filter 1GHz	WHKX12-	3	Lab verification	n/a
620	Bonn Elektronik	pre-amplifier	BLNA 0110-01N	1510111	7/12/2017	24
624	Wainwright	6 GHz high-pass filter	WHKX10-5850-6500-18000-40SS	5	Lab verification	n/a
628	Maturo	Antenna mast	CAM 4.0-P	224/19590716	n/a	n/a
629	Maturo	Kippeinrichtung	KE 2.5-R-M	MAT002	n/a	n/a

Test site: SR 9

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
472	Rohde & Schwarz	Generator, Vektorsignal	SMU200A	102409	7/11/2018	12
592	Rohde & Schwarz	Wideband Radio Communication tester	CMW 500	119593	8/15/2017	12
622	Rohde & Schwarz	Step Attenuator	RSC	101904	7/12/2018	12
625	Schwarzbeck	Antenna, H-field	HFSL 7101	109	Verification - only relative measurements	n/a
626	Rohde & Schwarz	Bluetooth Tester	CBT	100481	Signaling Only	24
635	Rohde & Schwarz	Signal generator	SMB100A	179875	7/10/2018	12
636	Rohde & Schwarz	switching unit	OSP120	101698	7/12/2018	12
637	Rohde & Schwarz	Spectrum Analyzer	FSV40	101587	7/11/2018	12
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	55929	7/12/2018	24
451	Rohde & Schwarz	Power Meter, Dual Channel	NRVD	101190	7/10/2018	12
427	Rohde & Schwarz	Probe, Power Sensor	NRV-Z5	100106	7/12/2018	12
195	SPS	Power Supply	TOE8842-24	51455	Verified by Multimeter	12
216	Agilent	Multimeter	34401A	US36017458	7/11/2017	24
378	ESPEC/ Thermotec	Climatic Chamber	PL-1FT	5100869	8/9/2016	36

Test site: SR 7/8

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
22	Rohde & Schwarz	Artificial Mains	50 Ohm// 50uH	831767/014	7/11/2018	12
215	Rohde & Schwarz	Artificial Mains Network	9 kHz - 30 MHz; 3 phase	879675/002	7/11/2018	12
349	Rohde & Schwarz	Receiver, EMI Test	20 Hz - 7 GHz	836697/009	7/10/2018	12
616	Rohde & Schwarz	ISN	8 wire ISN for CAT6	101656	7/12/2018	12

8. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	52	-	Initial Version