

FCC LISTED, REGISTRATION
NUMBER: 720267

Informe de ensayo nº:
Test report No:

IC LISTED REGISTRATION
NUMBER IC 4621A-1

NIE: 45541RRF.003

Test report

USA FCC Part 15.231, 15.209

CANADA RSS-210, RSS-Gen

Radio Frequency Devices. Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

Licence-Exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
General Requirements and Information for the Certification of Radio Apparatus.

Identificación del objeto ensayado.....: Identification of item tested	Remote control car key
Marca Trademark	Continental
Modelo y/o referencia tipo Model and /or type reference	A2C978066
Other identification of the product	Commercial name: A2C978066 FCC ID: KR5A2C978066 IC: 7812D-A2C978066
Final HW version	A2C978066
Final SW version	---
Serial number	---
Características Features	Immobilizer, RKE, PASE.
Fabricante Manufacturer	Continental Automotive GmbH Siemensstr. 12, 93055 Regensburg, Germany.
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 15.231 10-1-14 Edition: Periodic operation in the band 40.66-40.70 MHz and above 70 MHz. USA FCC Part 15.209 10-1-14 Edition: Radiated emission limits; general requirements. CANADA RSS-210 Issue 8 (December 2010). CANADA RSS-Gen Issue 4 (November 2014). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) Approved by (name / position & signature)	A. Llamas / RF Lab. Manager
Fecha de realización Date of issue	2015-05-21
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Competences and guarantees

AT4 wireless is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

AT4 wireless is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: IC 4621A-1.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance program for its measurement equipment.

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of AT4 wireless.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the AT4 wireless internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**

Sample M/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
45541/012	Remote control car key with antenna connector	A2C978066	---	2015-04-30

1. Sample M/01 has undergone following test(s) in appendix A:
Subclause (c). 20 dB Emission Bandwidth and Occupied Bandwidth.

Sample M/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
45541/003	Remote control car key with integral antenna	A2C978066	---	2015-04-16

- Sample M/02 has undergone following test(s) in appendix A:
Section 15.231 Subclause (b) / 15.209. Field strength and Emission limitations radiated (Transmitter).

Sample M/03 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
45541/007	Remote control car key with integral antenna	A2C978066	---	2015-04-16

- Sample M/03 has undergone following test(s) in appendix A:
Subclause (a) (1). Transmitter deactivation.

Test sample description

The test sample consists of a remote control car key with 3 main operating modes: Immobilizer (Immobilizer transponder mode), RKE (Remote key functionality) and PASE (Passive key functionality).

Identification of the client

Continental Automotive GmbH
Siemensstr. 12, 93055 Regensburg, Germany.

Testing period

The performed test started on 2015-05-05 and finished on the same day.

The tests have been performed at AT4 wireless.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω

Remarks and comments

1: Used instrumentation:

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Spectrum Analyzer Agilent E4440A	2014/05	2016/05
2.	DC power supply R&S NGPE 40/40	2014/11	2017/11

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2014/03	2017/03
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2013/11	2016/11
5.	EMI Test Receiver R&S ESU 26	2013/08	2015/08
6.	Spectrum analyser Rohde & Schwarz FSW50	2013/10	2015/10
7.	RF pre-amplifier 10 MHz-6 GHz SCHWARZBECK BBV9743	2015/03	2016/03
8.	RF pre-amplifier 1-18 GHz Schwarzbeck BBV 9718	2015/02	2016/02

Testing verdicts

Not applicable	N/A
Pass	P
Fail	F
Not measured	N/M

FCC PART 15 PARAGRAPH / RSS-210		VERDICT			
		NA	P	F	NM
Section 15.231 Subclause (a) (1) / RSS-210 A1.1.1.	Transmitter deactivation		P		
Section 15.231 Subclause (c) / RSS-210 A1.1.3.	Bandwidth		P		
Section 15.231 Subclause (b) / 15.209 / RSS-210 A1.1.2.	Field strength and Emission limitations radiated (Transmitter)		P		

Appendix A – Test result

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TEST CONDITIONS

Power supply (V):

$$V_{\text{nominal}} = 3.0 \text{ Vdc}$$

Type of power supply = Lithium battery cell

Type of antenna = Integral antenna

TEST FREQUENCIES:

The equipment transmits at the nominal frequency of 433.92 MHz.

The equipment under test was scanned for spurious emissions in the frequency range 30 to 5000 MHz.

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-5 GHz (1 GHz-18 GHz Double ridge horn antenna).

For radiated emissions in the range 1 GHz-5 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance. The sample is prepared so that transmits continuously when the batteries are connected

The equipment under test was set up on a non-conductive (wooden) platform one meter above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

Section 15.231 Subclause (a) (1) / RSS-210 A1.1.1. Transmitter deactivation.

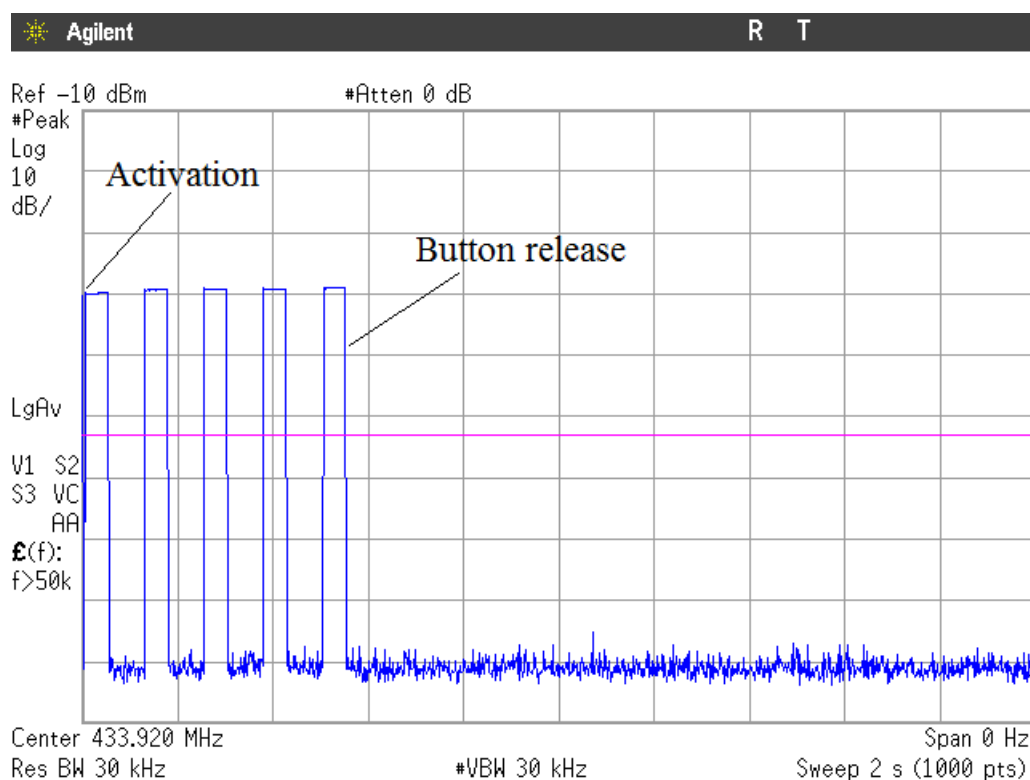
SPECIFICATION

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

RESULTS

The equipment can only operate in manual mode.

The transmission is activated by pressing a button and ceases after releasing it in less than 5 seconds (see next plot).



Verdict: Pass

Section 15.231 Subclause (c) / RSS-210 A1.1.3. Bandwidth

SPECIFICATION

FCC 15.231: The bandwidth of the emission shall be no wider than 0.25 % of the centre frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

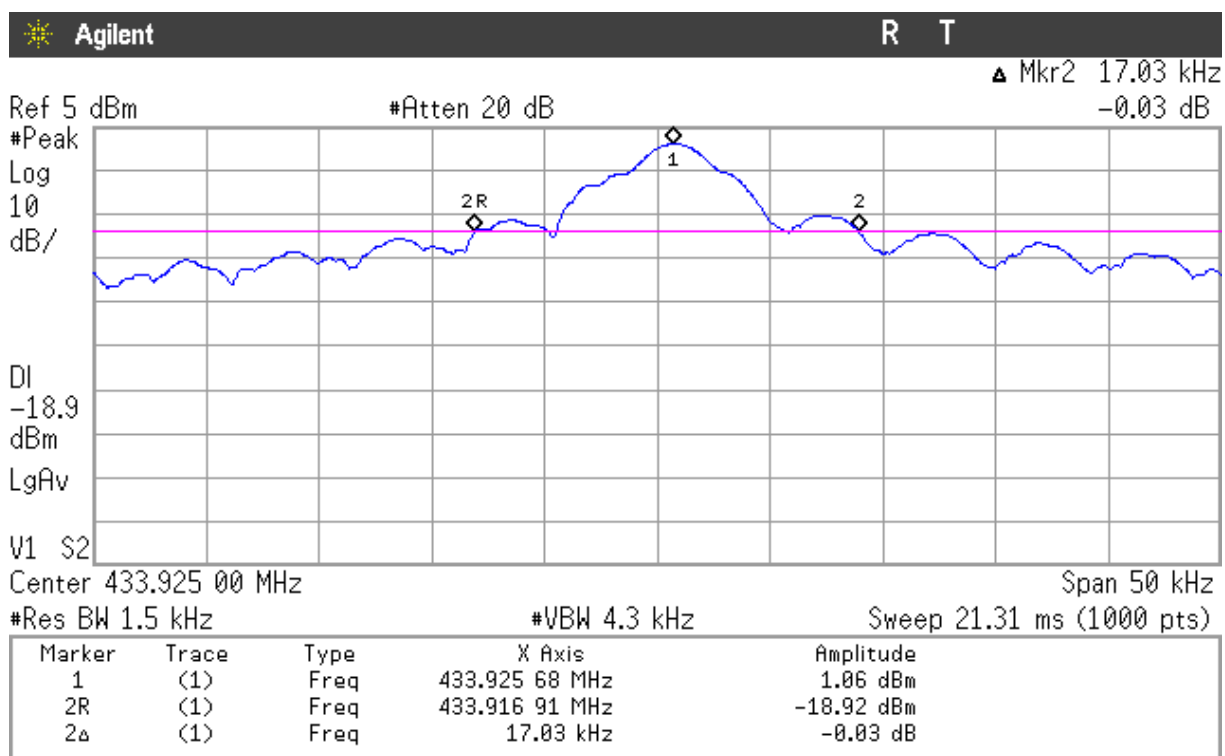
RESULTS (see next plots)

Nominal centre frequency = 433.92 MHz

Limit of spectrum bandwidth = 0.25 % of 433.92 MHz = 1084.80 kHz

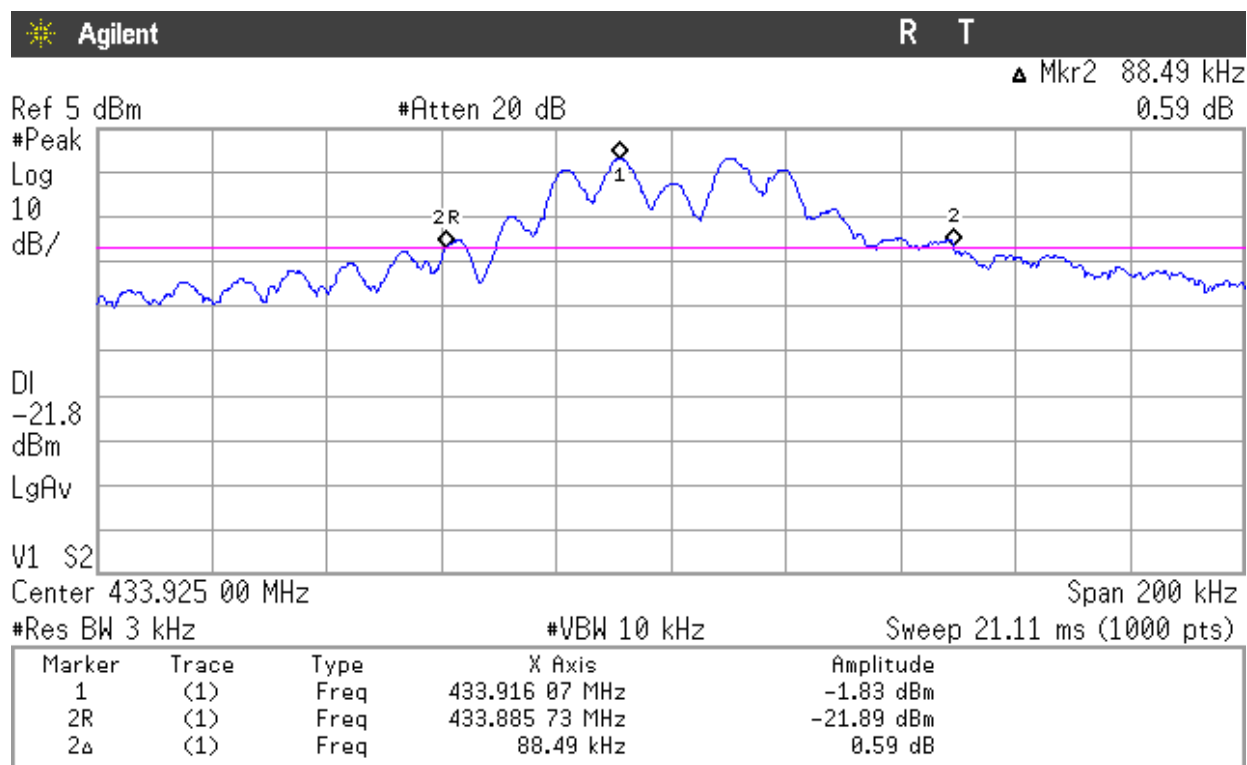
RKE functionality (ASK modulation):

Measured 20 dB Bandwidth (kHz)	17.03
Measurement uncertainty (Hz)	±319



PASE functionality (FSK modulation):

Measured 20 dB Bandwidth (kHz)	88.49
Measurement uncertainty (Hz)	±319



Verdict: PASS

Occupied Bandwidth

SPECIFICATION

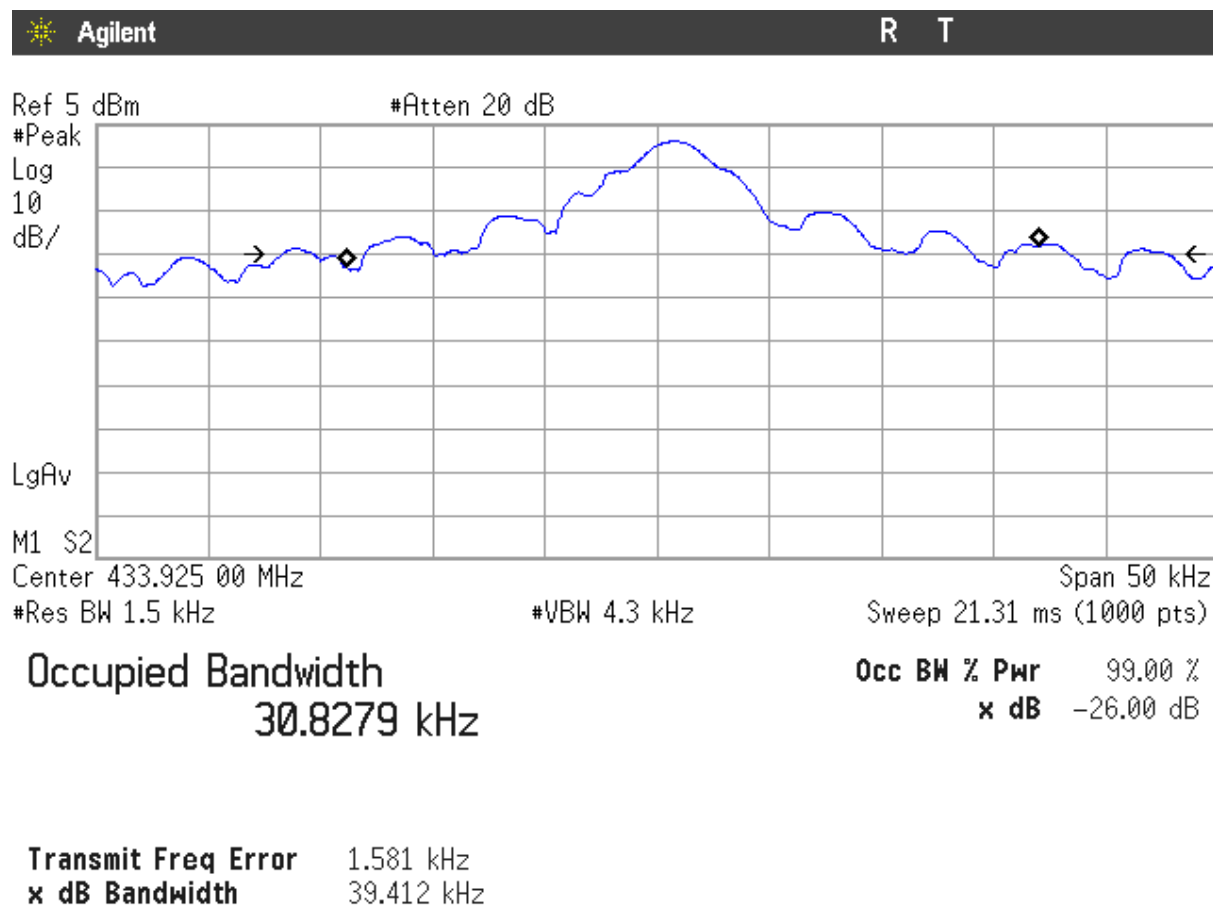
RSS-210. A.1.1.3.: the 99% bandwidth shall be no wider than 0.25% of the centrefrequency for devices operating between 70 MHz and 900 MHz.

RESULTS

(see next plots).

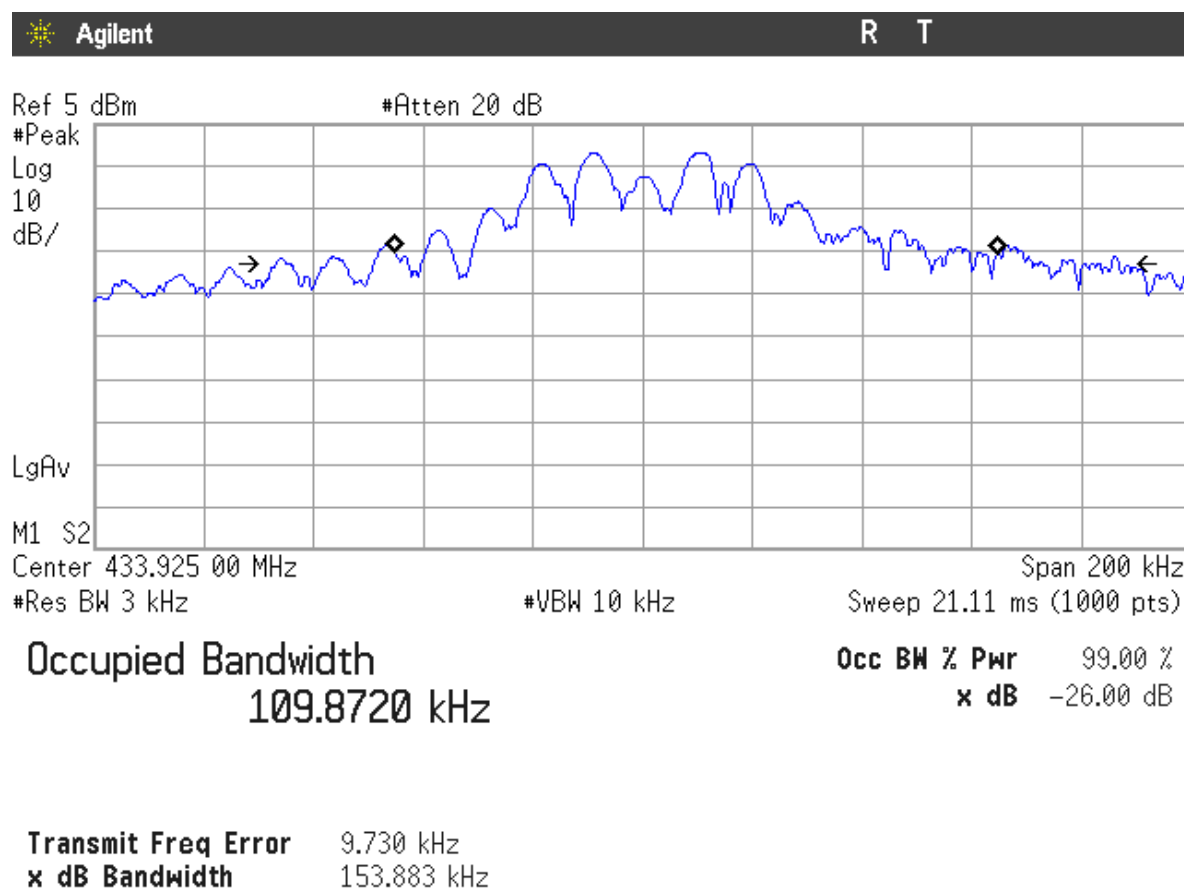
RKE functionality (ASK modulation):

99% bandwidth (kHz)	30.8279
-26 dBc bandwidth (kHz)	39.412
Measurement uncertainty (Hz)	±319



PASE functionality (FSK modulation):

99% bandwidth (kHz)	109.8720
-26 dBc bandwidth (kHz)	153.883
Measurement uncertainty (Hz)	±319



Section 15.231 Subclause (b)/15.209 / RSS-210 A1.1.2.. Field strength and Emission limitations radiated (Transmitter)

SPECIFICATION

The field strength of emissions from intentional radiators shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental ($\mu\text{V/m}$)	Field strength of spurious emissions ($\mu\text{V/m}$)
40.66 – 40.70	2,250	225
70 – 130	1,250	125
130 - 174	1,250 to 3,750 **	125 to 375 **
174 - 260	3,750	375
260 - 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** : Linear Interpolations. The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level.

Spurious emissions shall be attenuated to the limits shown in the above table or to the general limits shown in Section 15.209/RSS-Gen, whichever limit permits a higher field strength.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

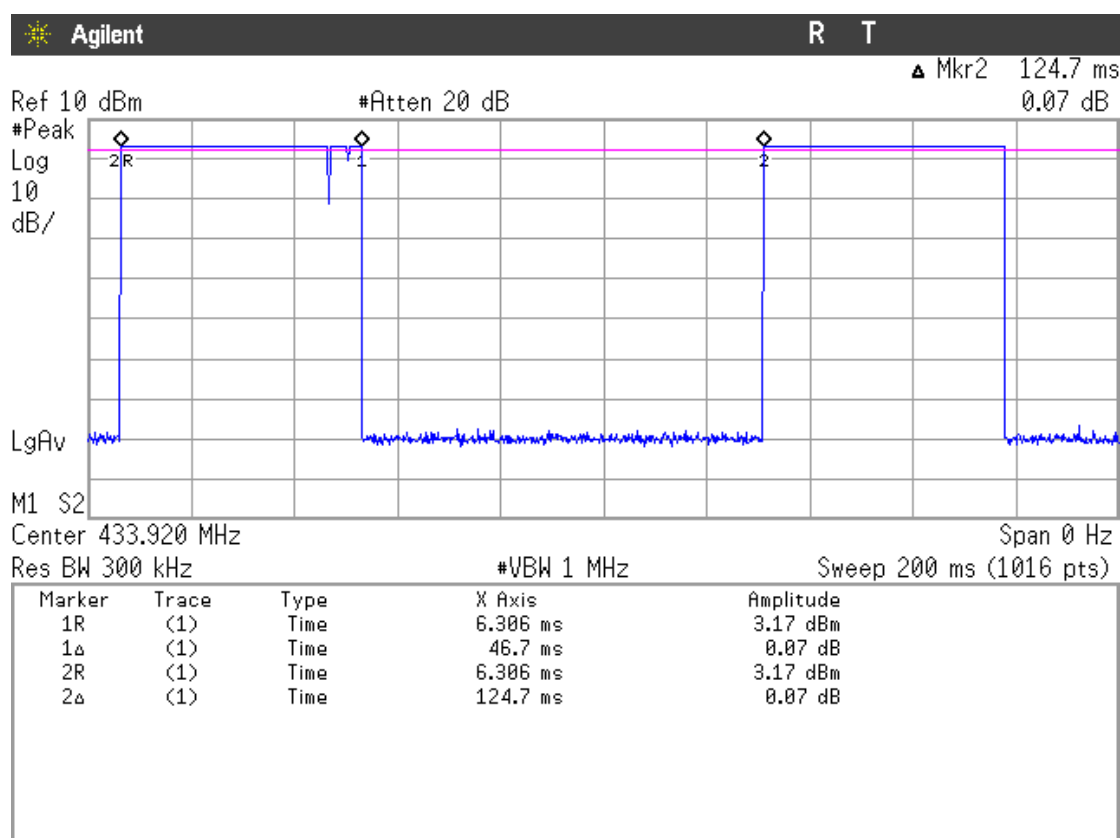
RESULTS:

The field strength is calculated by adding correction factor to the measured level from the spectrum analyser. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

For PASE functionality (FSK modulation) the transmission of sample is continuous modulated.

For RKE functionality (ASK modulation) the transmission of sample is pulsed so the average values of transmitter fundamental and spurious emissions are calculated from the measured peak values using the duty cycle correction factor δ as indicated in standard ANSI C63.10-2013.

Computation of duty-cycle correction factor for RKE functionality (ASK modulation).



Pulse train period: 124.7 ms
 Number of pulses within 100 ms: 1
 Pulse duration: 46.7 ms

Duty-cycle correction factor calculation.

Sub-pulse	Duration (ms)	Number of pulses	Sub-pulse "On Time" (ms)
1	46.7	1	46.7
		TOTAL ON TIME:	46.7

Duty cycle correction factor $\delta = 46.7 / 100 = 0.467$
 $\delta = 20 \log (0.467) = -6.61 \text{ dB}$

Frequency range 30 MHz-1000 MHz (see next plots)

RKE functionality (ASK modulation):

Frequency (MHz)	Polarization	Detector	Emission Level (µV/m)	Limits (µV/m) 15.231 (b) / 15.209
433.92 (Fundamental)	V	Peak	13,031.67	109,972.5 / ---
867.817	V	Peak	536.41	10,997.25 / 2000

Calculation for average level

Spurious frequency (MHz)	Emission Level (dBµV/m) Peak	Duty-cycle correction factor δ (dB)	Corrected Emission Level (dBµV/m) Average	Limits (µV/m) 15.231 (b) / 15.209
433.92 (Fundamental)	82.30	-6.61	75.69	10,997.25 (80.82 dBµV/m) / ---
867.817	54.49	-6.61	47.88	1,099.725 (60.82 dBµV/m) / 200 (46.02 dBµV/m)

Measurement uncertainty (dB): ± 3.8 dB.

PASE functionality (FSK modulation):

Frequency (MHz)	Polarization	Detector	Emission Level (µV/m)	Limits (µV/m) 15.231 (b) / 15.209
433.92 (Fundamental)	V	Peak	12,882.49	109,972.5 / ---
		Average	10,057.73	10,997.25 / ---
867.817	V	Peak	390.84	10,997.25 / 2000
		Average	364.75	1,099.725 / 200

Measurement uncertainty (dB): ± 3.8 dB.

Frequency range 1 GHz-5 GHz (see next plots)

RKE functionality (ASK modulation):

All peaks are more than 20 dB below the limit.

Highest spurious levels.

Frequency (GHz)	Polarization	Detector	Emission Level (μV/m)	Limits (μV/m) 15.231 (b) / 15.209
1.3020	V	Peak	108.51	10,997.25 / 5,000
4.3393	V	Peak	53.64	10,997.25 / 5,000

Calculation for average level

Spurious frequency (MHz)	Emission Level (dBμV/m) Peak	Duty-cycle correction factor δ (dB)	Corrected Emission Level (dBμV/m) Average	Limits (μV/m) 15.231 (b) / 15.209
1.3020	40.71	-6.61	34.10	1,099.725 (60.82 dBμV/m) / 500 (54 dBμV/m)
4.3393	34.59	-6.61	27.98	1,099.725 (60.82 dBμV/m) / 500 (54 dBμV/m)

PASE functionality (FSK modulation):

All peaks are more than 20 dB below the limit.

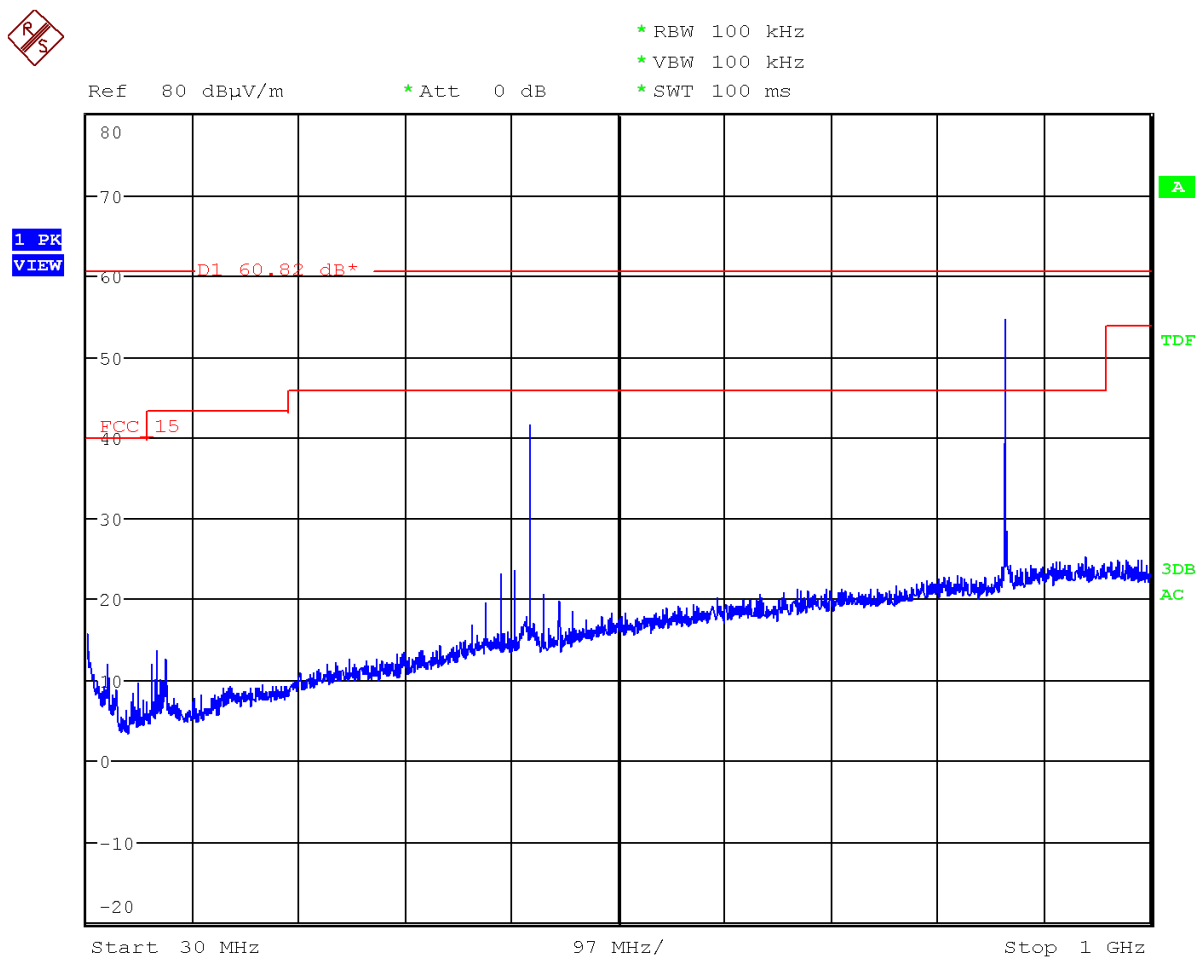
Highest spurious levels.

Frequency (GHz)	Polarization	Detector	Emission Level (μV/m)	Limits (μV/m) 15.231 (b) / 15.209
1.3020	V	Peak	102.56	10,997.25 / 5,000
		Average	98.97	1,099.725 / 500
4.3393	V	Peak	52.12	10,997.25 / 5,000
		Average	44.31	1,099.725 / 500

Verdict: PASS.

FREQUENCY RANGE 30 MHz-1000 MHz

RKE functionality (ASK modulation):



Note: The carrier frequency (fundamental) was attenuated using a notch filter.

PASE functionality (FSK modulation):



* RBW 100 kHz

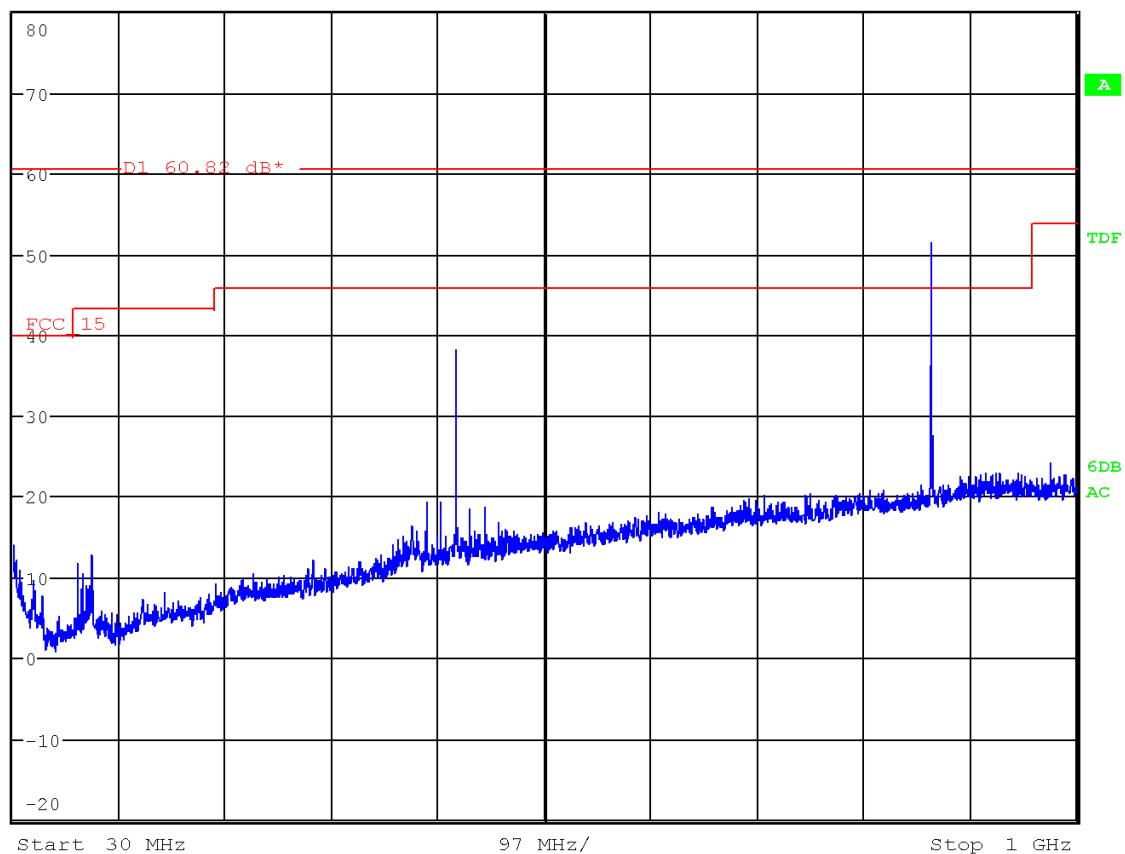
* VBW 100 kHz

SWT 235 ms

Ref 80 dBμV/m

* Att 0 dB

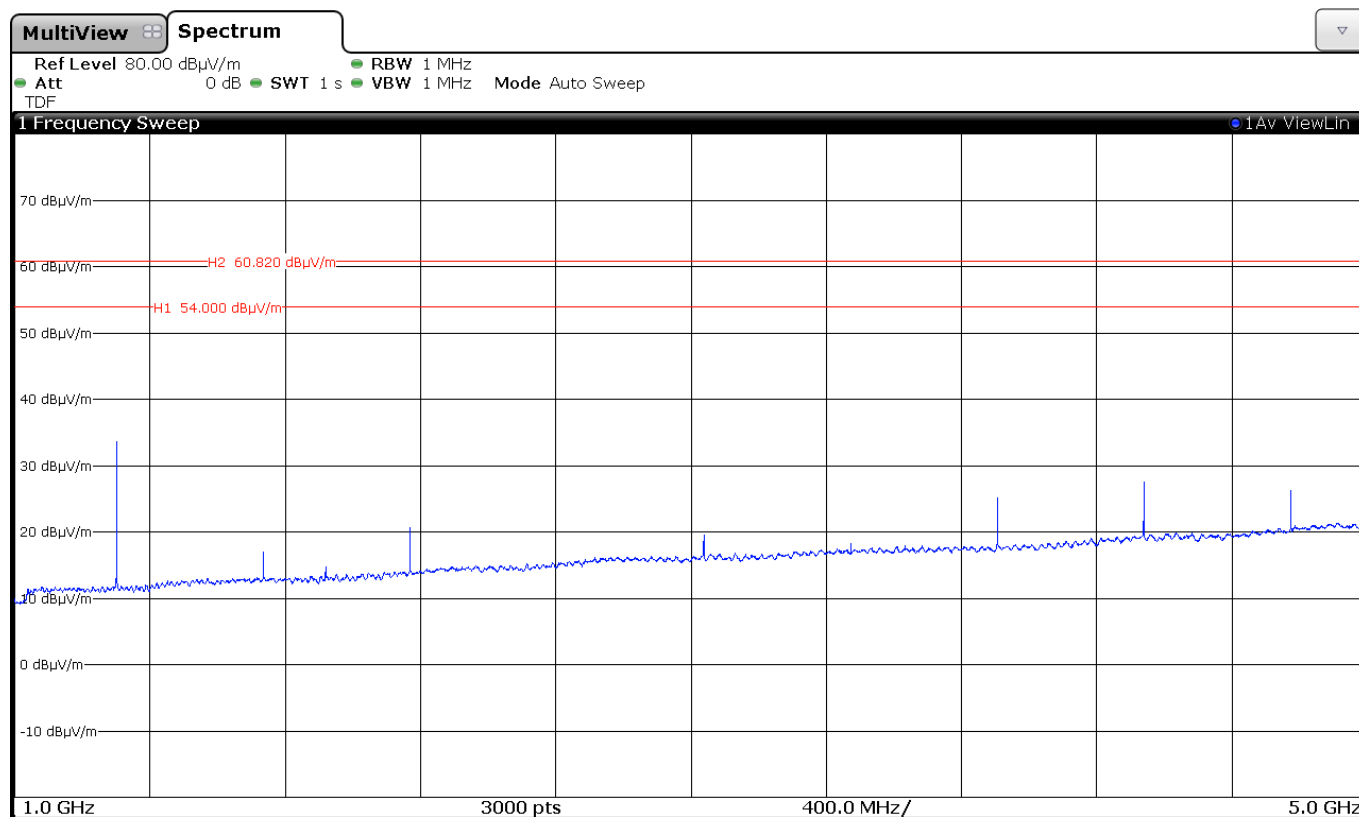
1 PK
VIEW



Note: The carrier frequency (fundamental) was attenuated using a notch filter.

FREQUENCY RANGE 1 GHz to 5 GHz

RKE functionality (ASK modulation):



PASE functionality (FSK modulation):

