DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

DEKRA

ilac-MRA ENAC ENSAYOS Nº 51/LE147

Test report No:
NIE: 59196RRF.002

Test Report

USA FCC Part 15.247, 15.209
CANADA RSS-247, RSS-Gen

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.
General Requirements and Information for the Certification of Radio Apparatus.

(*) Identification of item tested	LoRa sensor to detect the open / closed status of a valve
(*) Trademark	TWTG
(*) Model and /or type reference	VS-915-01-QT02
Other identification of the product	HW version: V2.0.2 SW version: v0-3-1-86de4a23-1557416690 FCC ID: 2ATYF-C19-001
(*) Features	Valve open / closed status reporting, heartbeat messaging
Applicant	TWTG Schaardijk 386, 2909 LA, Capelle a/d IJssel, Nederland
Test method requested, standard	USA FCC Part 15.247 (10-1-18 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-18 Edition): Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (April 2018). Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid Systems Devices Operating Under Section 15.247 of the FCC Rules. 558074 D01 Meas Guidance v05r02 dated April 2, 2019. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Jose Carlos Luque RF Lab. Supervisor 74841983Y JOSE CARLOS LUQUE (C:A29507456) Firmado digitalmente por 74841983Y JOSE CARLOS LUQUE (C:A29507456) Fecha: 2019.10.30 08:50:18 +01'00'
Date of issue	2019-10-30
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

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

DEKRA Testing and Certification 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 DEKRA Testing and Certification at the time of performance of the test.

DEKRA Testing and Certification 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.

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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.
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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample of the model VS-fff-01-xx consists of sensor that detects the open / closed status of a valve by sensing the field created by a magnet placed on the valve stem. It reports the status when it changes, using LoRa modulation. It also provides a daily “heartbeat” message.

3. Derived model not tested.

Declaration of Cross-Model Compatibility

Concerning products:

- TS-fff-01-xxyy
- VS-fff-01-xxyy

Where:

- TS indicates the temperature sensor product.
- VS indicates the valve sensor product.
- fff indicates operating frequency (868 or 915 MHz).
- xx indicates the software functionality
- yy indicates a regional variant, such as EU or US.

Specifically:

Intended region		
Europe	United States	Singapore
TS-868-01-01	TS-915-01-02	TS-915-01-03
VS-868-01-QT01	VS-915-01-QT02	VS-915-01-QT03
VS-868-01-MT01	VS-915-01-MT02	VS-915-01-MT03

NB - presence in the same **column** above indicates electromagnetically comparable devices. The columns are separated based on operating frequency only.

NB - The model TS-868-01-01 was tested for safety, owing to its mounting arrangements leading to the most onerous conditions. All models are exactly comparable in this respect, as they will not exceed the worst cases brought about by the TS model.

NB - The model VS-868-01-QT01 was tested for European EM compliance, as it is believed this model offers the most onerous conditions.

NB - The model VS-915-01-QT01 was tested for FCC compliance, as it is believed this model offers the most onerous conditions.

Hereby, TWTG (The Manufacturer), declares the equivalence of the two listed products with respect to EMC / RED directive requirements. Given that only the VS product appears on the reporting, we include this to confirm compliance of the TS product also. This is evidenced as follows:

Software differences between the products:

- Both products are based on the Mbed "operating system", including the supplied LoRa software stack.
    - Mbed-OS 5.8.
    - Supporting v1.0.3 of the LoRaWAN standard.
        - Valid at time of testing.
- Where operating frequencies differ, this is done by changing a particular variable within the application software.
- Where the main products differ, this is done with different application software, but uses the same major and LoRa stacks.
- No changes are made to the LoRa stack as supplied by Mbed.

Hardware differences between the products:

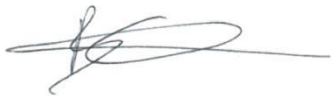
- Both products use the same PCB base files, and a base schematic, for production.
- Differences between the products are handled by the appropriate mounting and dismounting of components.
    - TS
        - FIT - C38; U8.
        - NO-FIT - C31,32,33,40,41,42,43; R7,8; U6,7,11.
    - VS
        - FIT - C31,32,33,40,41,42,43; R7,8; U6,7,11.
        - NO-FIT - C38; U8.
- U6 and 7 supply a low frequency analogue output to the MCU.
- U8 and U11 are both I^2C components, so no signaling changes between models, including the bus clock, though obviously individual data changes
- The remaining components are supporting passives for the semiconductors which are placed or otherwise.

Operational differences between the products:

- Both products send a single daily heartbeat message. The valve sensor also transmits on events, whereas the temperature sensor sends at (configurable) pre-defined intervals. Both transmission schemes fully respect the LoRa standards.
- Both products have configurable sense rates, which affect only the duty cycle of the I^2C bus, with the same maximum. This will have negligible impact, if any, on EM emissions.

From the provided information, it is clear that the proffered declaration is valid, based on the overwhelming similarity between the devices at a technical level.

Authorised by signatories:



Berin Casey, responsible engineer;
Capelle a/d IJssel, 28/08/19.

Joost Peters, product owner;
Capelle a/d IJssel, 28/08/19.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of result.

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
59196C/007	LoRa sensor to detect the open / closed status of a valve	VS-915-01-QT02	--	2019/05/17

Sample S/01 has undergone the following test(s): All RADIATED tests indicated in Appendix A.

- Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
59196C/001	LoRa sensor to detect the open / closed status of a valve	VS-915-01-QT02	--	2019/05/17

Sample S/02 has undergone the following test(s): All CONDUCTED tests indicated in Appendix A.

Test sample description

Ports…… :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)		
	None		☐	☐	☐		
Supplementary information to the ports……..:	-						
Rated power supply.....:	Voltage and Frequency			Reference poles			
				L1	L2	L3	N	PE
	☐	AC:		☐	☐	☐	☐	☐
	☒	DC: 3.6 V LiSOCl2 cell						
Rated Power .....:	0.36 W						
Clock frequencies.....:	32 MHz XTAL / TCXO, 48 MHz mcu internal						
Other parameters.....:	1020 MHz generated by RF chip						
Software version .....:	v0-3-1-86de4a23-1557416690						
Hardware version.....:	V2.0.2 PCBA, from V2.0.1 PCB files						
Dimensions in cm (W x H x D)....:	9.57 x 3.60 x 6.40						
Mounting position.....:	☒	Other: Various mounting options - see supplied documentation					
Modules/parts .....:	Module/parts of test item			Type		Manufacturer	
	Main product					TWTG	
Accessories (not part of the test item) .....:	Description			Type		Manufacturer	
	N/A						
Documents as provided by the applicant .....:	Description			File name		Issue date	
	-						

Identification of the client

TWTG
Schaardijk 386, 2909 LA, Capelle a/d IJssel, Nederland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2019-09-11
Date (finish)	2019-09-12

Document history

Report number	Date	Description
59196RRF.002	2019-10-29	First release
59196RRF.002A1	2019-10-30	First modification: Change of Declaration of Cross-Model Compatibility on page 4 This modification test report cancels and replaces the test report 59196RRF.002

Environmental conditions

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Miguel Ángel Torres, Jaime Barranquero.

Used instrumentation:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Shielded Room ETS LINDGREN S101	N.A.	N.A.
2.	Spectrum Analyzer PSA 3Hz-26.5 GHz AGILENT TECHNOLOGIES E4440A	2017/10	2019/10

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2018/10	2020/10
3.	RF Pre-amplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2019/02	2020/08
4.	Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2017/09	2020/09
5.	Multimeter FLUKE 179	2019/06	2020/06
6.	DC Power Supply, 30V, 5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
5.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2018/02	2020/02
6.	RF Pre-amplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2019/04	2020/04
7.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01

Testing verdicts

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

Summary

1. LoRa

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		**Verdict**	**Remark**
Section 15.247 Subclause (a) (1) / RSS-247 5.1. (b)	20 dB Bandwidth and Carrier frequency separation	P	
Section 15.247 Subclause (f) / RSS-247 Clause 5.3 (a)	Time of occupancy (Dwell Time)	P	
Section 15.247 Subclause (b) / RSS-247 5.4. (a)	Maximum peak output power and antenna gain	P	
Section 15.247 Subclause (d) / RSS-247 5.5.	Band-edge compliance of conducted emissions (Transmitter)	P	
Section 15.247 Subclause (d) / RSS-247 5.5	Emission limitations conducted (Transmitter)	P	
Section 15.247 Subclause (f) / RSS-247 5.3. (b)	Power spectral density for hybrid systems	P	
Section 15.247 Subclause (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	
Supplementary information and remarks: None.			

Appendix A: Test results. LoRa

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TEST CONDITIONS

POWER SUPPLY (V):

V nonimal:	3.6 Vdc
Type of Power Supply:	Battery LiSOCl2 cell
Type of Antenna:	Internal (PCB Trace)
Maximum Declared Antenna Gain:	-4 dBi

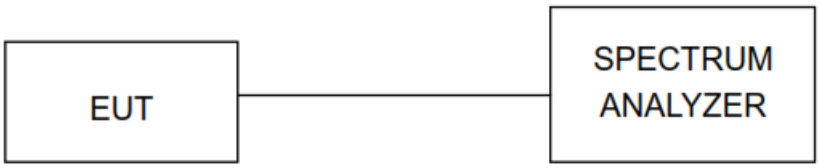
TEST FREQUENCIES:

Low Channel:	902.3 MHz
High Channel:	903.7 MHz

The equipment can operate as a hybrid system using 8 hopping channels.

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is directly connected to the spectrum analyzer.



The DC supply voltage is applied using an external calibrated power supply.

RADIATED MEASUREMENTS

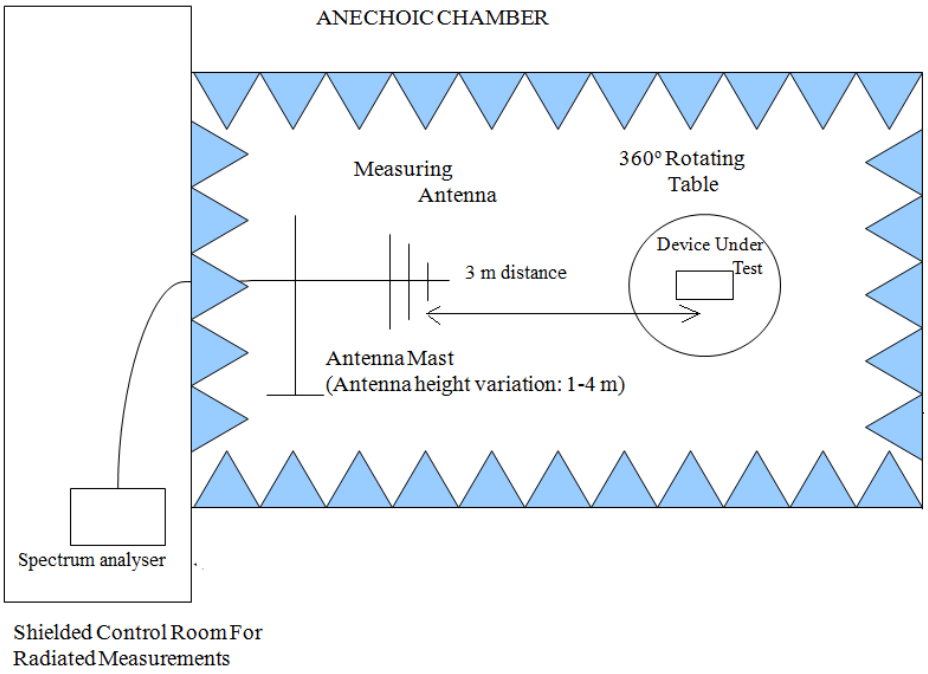
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-10 GHz (1 GHz-18 GHz Double ridge horn antenna).

For radiated emissions in the range 1 GHz-10 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.

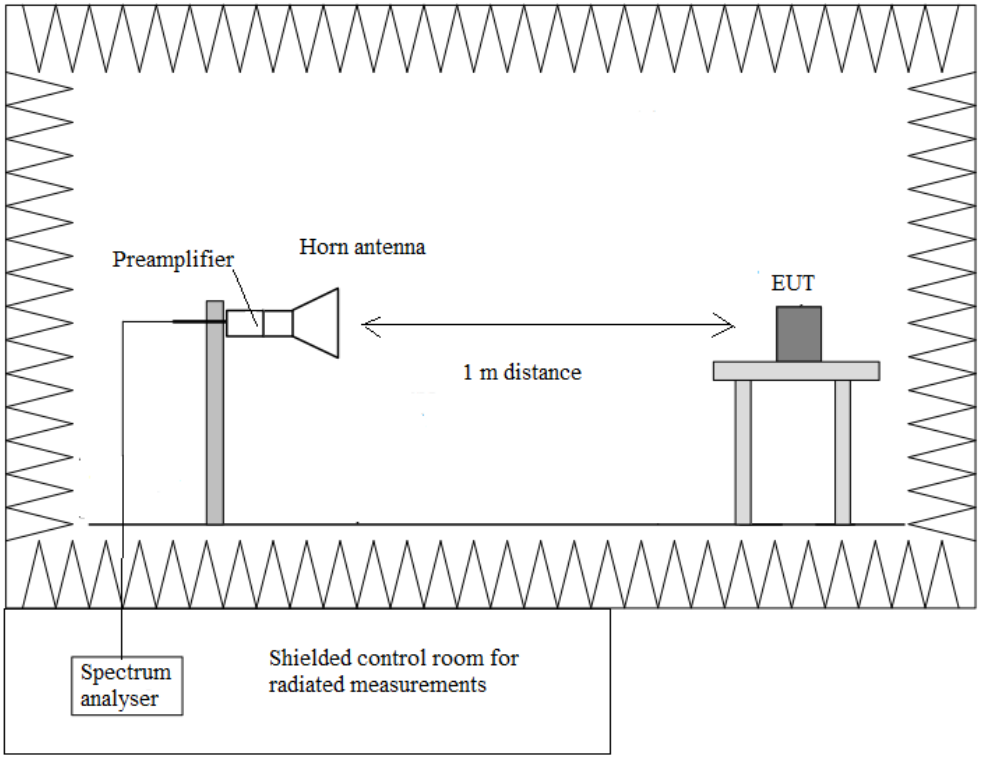
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

Radiated measurements setup f < 1 GHz



Radiated measurements setup f > 1 GHz



Occupied Bandwidth

SPECIFICATION:

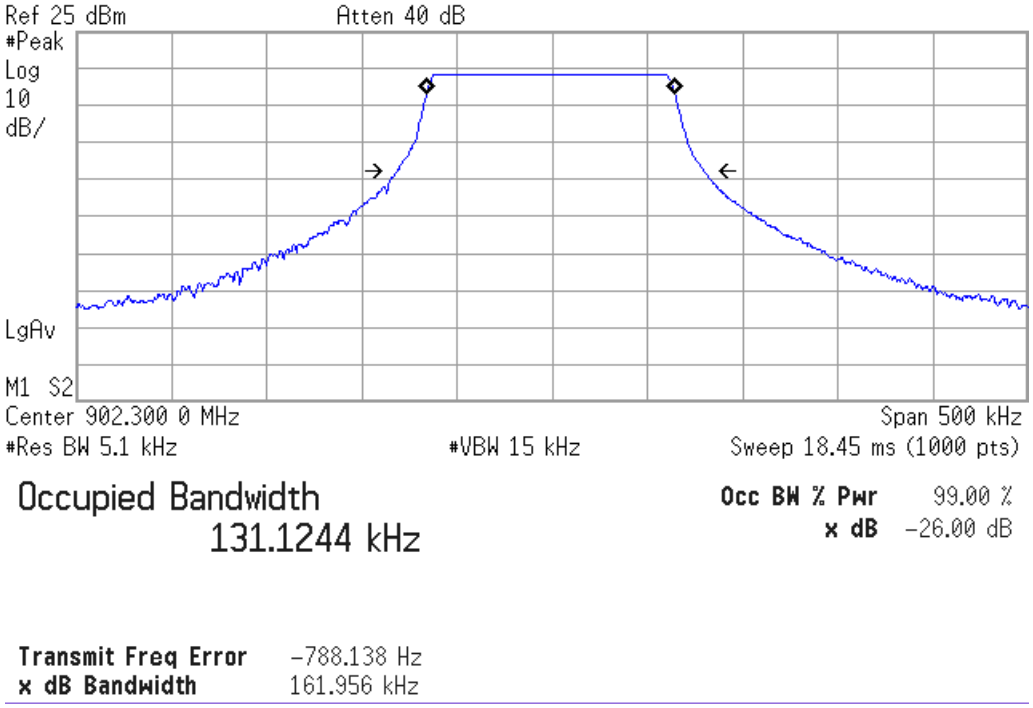
FCC §2.1049. Measurements required: Occupied bandwidth.

RSS-Gen Clause 6.7.

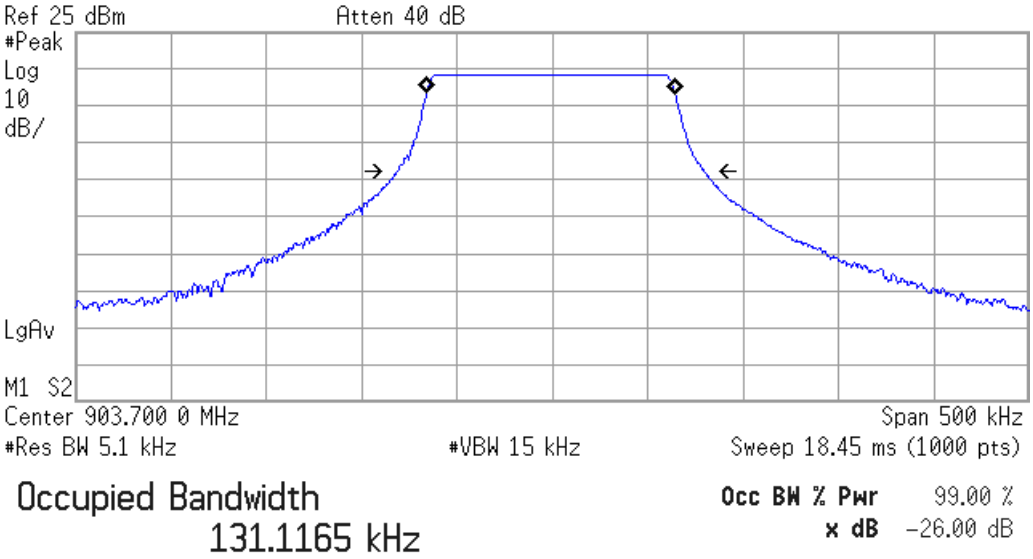
RESULTS

	Lowest Channel 902.3 MHz	Highest Channel 903.7 MHz
99% bandwidth (kHz)	131.124	131.116
-26 dBc bandwidth (kHz)	161.956	161.923
Measurement uncertainty (kHz)	<± 0.67	

Lowest Channel:



High Channel:



FCC Section 15.247 Subclause (a) (1) / RSS-247 Clause 5.1. (b) 20 dB Bandwidth and Carrier frequency separation.

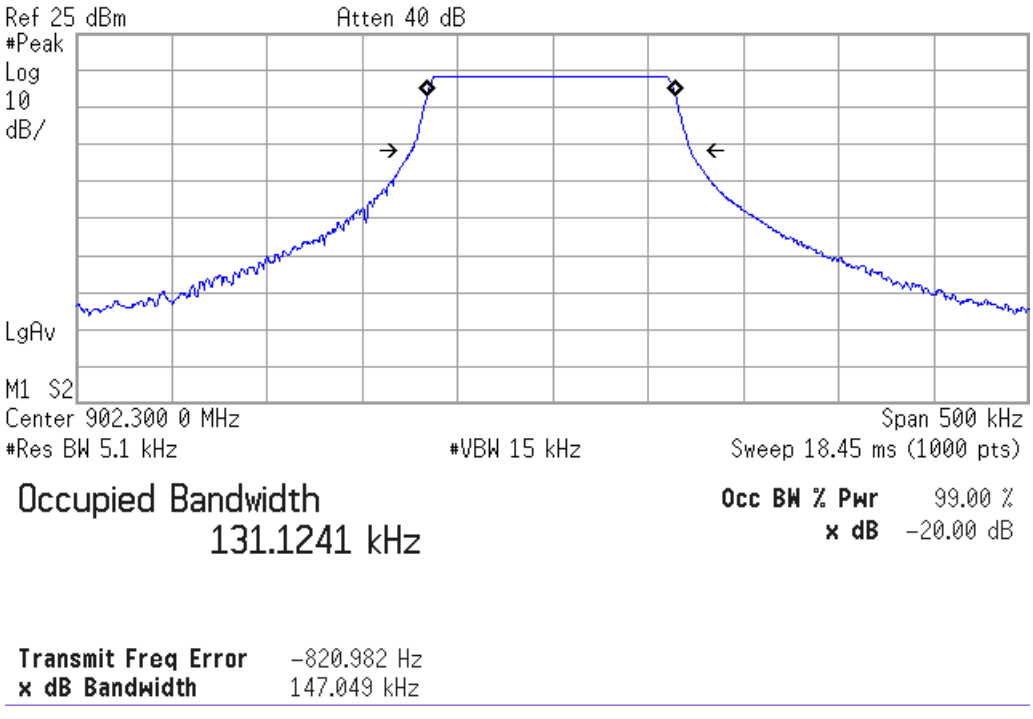
SPECIFICATION

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

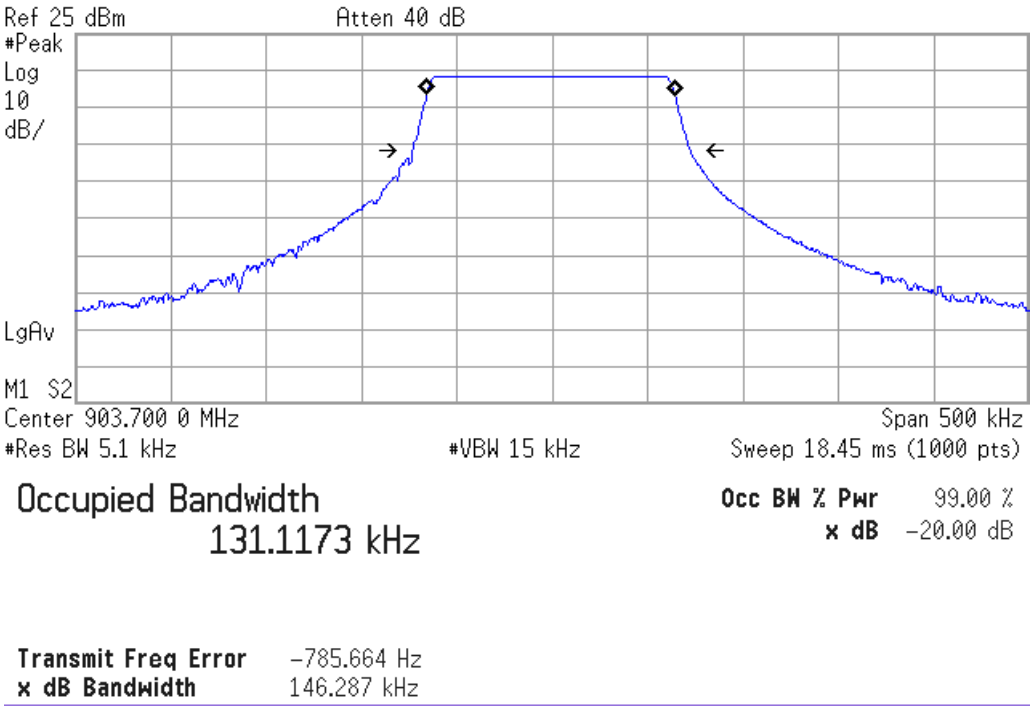
RESULTS

	Lowest Channel 902.3 MHz	Highest Channel 903.7 MHz
20 dB Spectrum bandwidth (kHz)	147.049	146.287
Measurement uncertainty (kHz)	<± 0.67	

Lowest Channel:

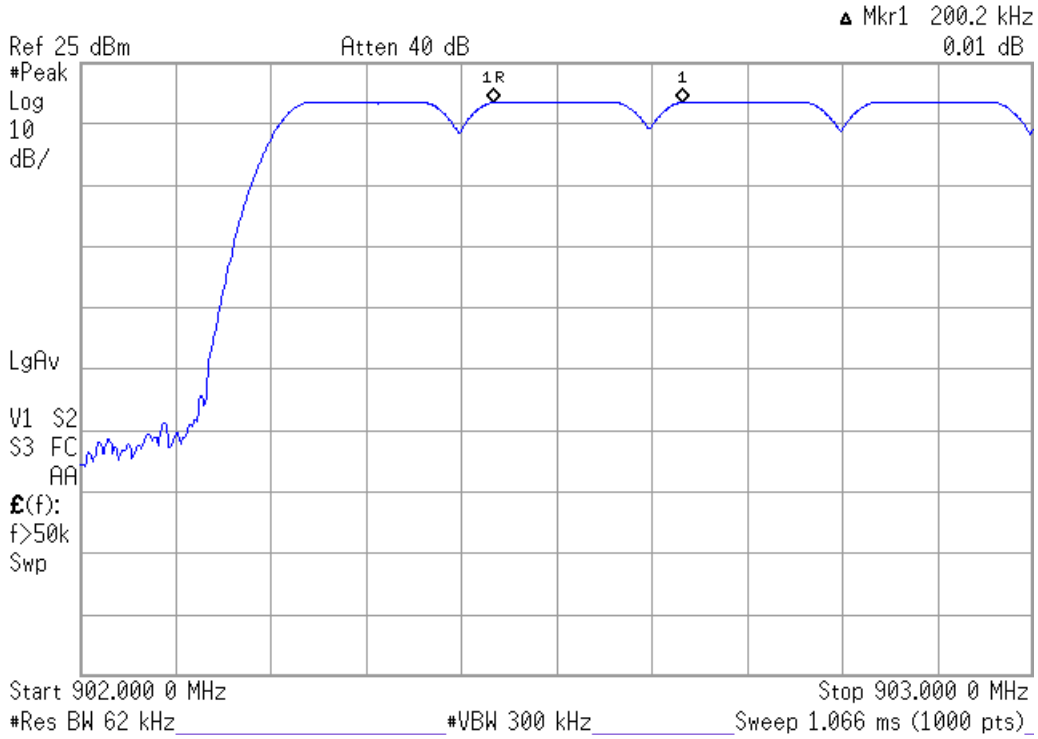


Highest Channel:



Carrier frequency separation

200.2 kHz



The hopping channel carrier frequencies are separated by a minimum of the 20 dB bandwidth of the hopping channel.

Verdict: PASS

FCC Section 15.247 Subclause (f) / RSS-247 Clause 5.3 (a) Time of occupancy (Dwell Time).

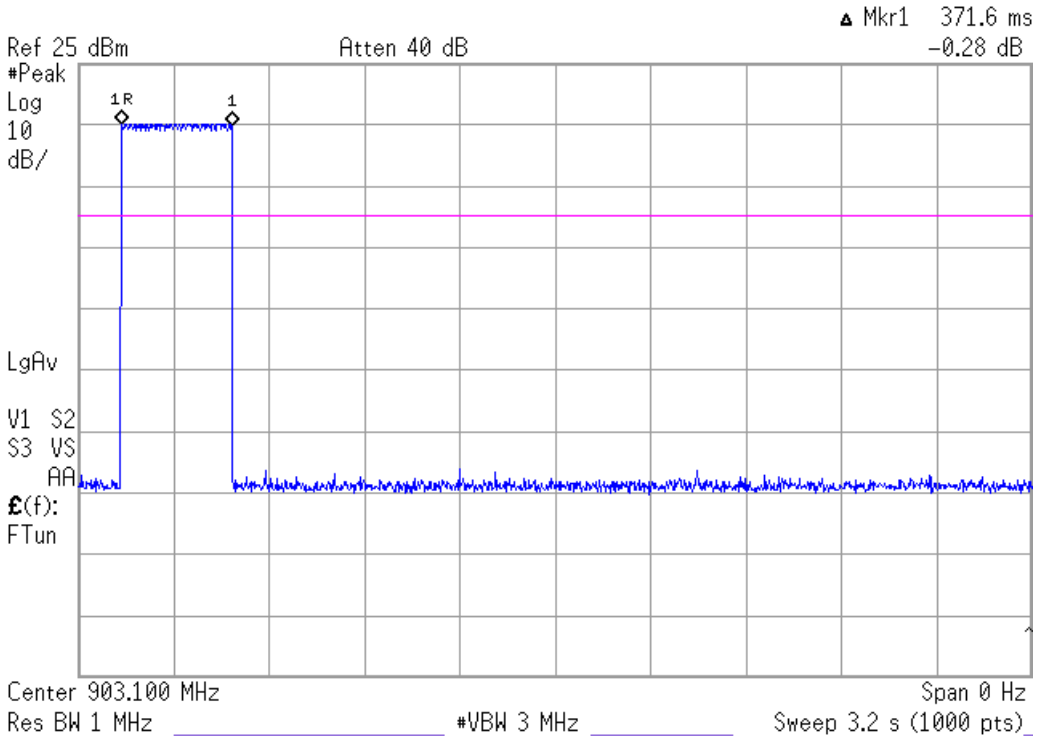
SPECIFICATION:

For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4 (0.4 x 8 = 3.2 seconds).

RESULTS:

1. OPERATION AS FREQUENCY HOPPING SYSTEM USING 8 HOPPING CHANNELS:

- TX time per hop: 371.6 ms (see next plot)
- Number of hops over a period of 3.2 s: 1 (see next plot)



- Average time of occupancy = 371.6 ms x 1 hop = 371.6 ms per 3.2 s.

Measurement uncertainty (%)	<±0.01

Verdict: PASS

FCC Section 15.247 Subclause (b) / RSS-247 Clause 5.4 (a) Maximum output power and antenna gain

SPECIFICATION:

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels. Hybrid systems shall comply with the 1 W limit.
Additionally for RSS-247:

For FHSs operating in the band 902-928 MHz, the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

RESULTS:

The maximum conducted (average) output power was measured using the method AVGSA-1 (trace averaging across on and off times of the EUT transmissions) according to point 11.9.2.2.1 of ANSI C.63.10-2013".

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

Maximum Declared Antenna Gain: -4 dBi

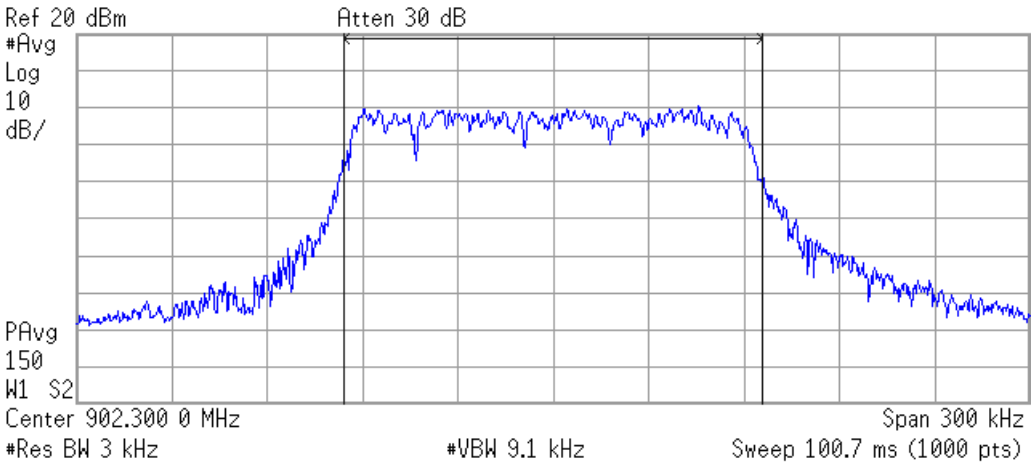
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

	Lowest Channel 902.3 MHz	Highest Channel 903.7 MHz
Maximum Average conducted power (dBm)	12.85	12.92
Maximum Average EIRP power (dBm)	8.85	8.92
Measurement uncertainty (dB)	<± 0.66	

Verdict: PASS

Maximum Average Output Power:

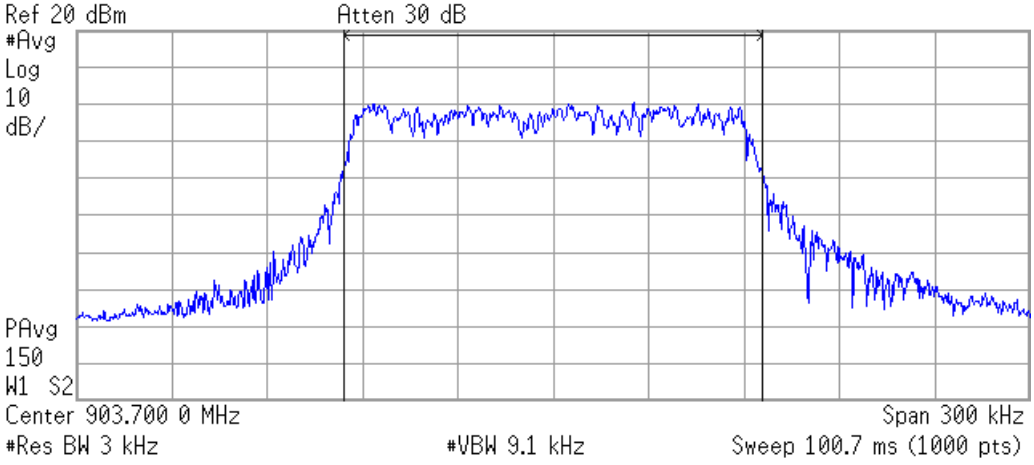
Lowest Channel:



Channel Power
12.85 dBm /131.1244 kHz

Power Spectral Density
-38.32 dBm/Hz

Highest Channel:



Channel Power
12.92 dBm /131.1165 kHz

Power Spectral Density
-38.26 dBm/Hz

FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Band-edge compliance of conducted emissions (Transmitter)

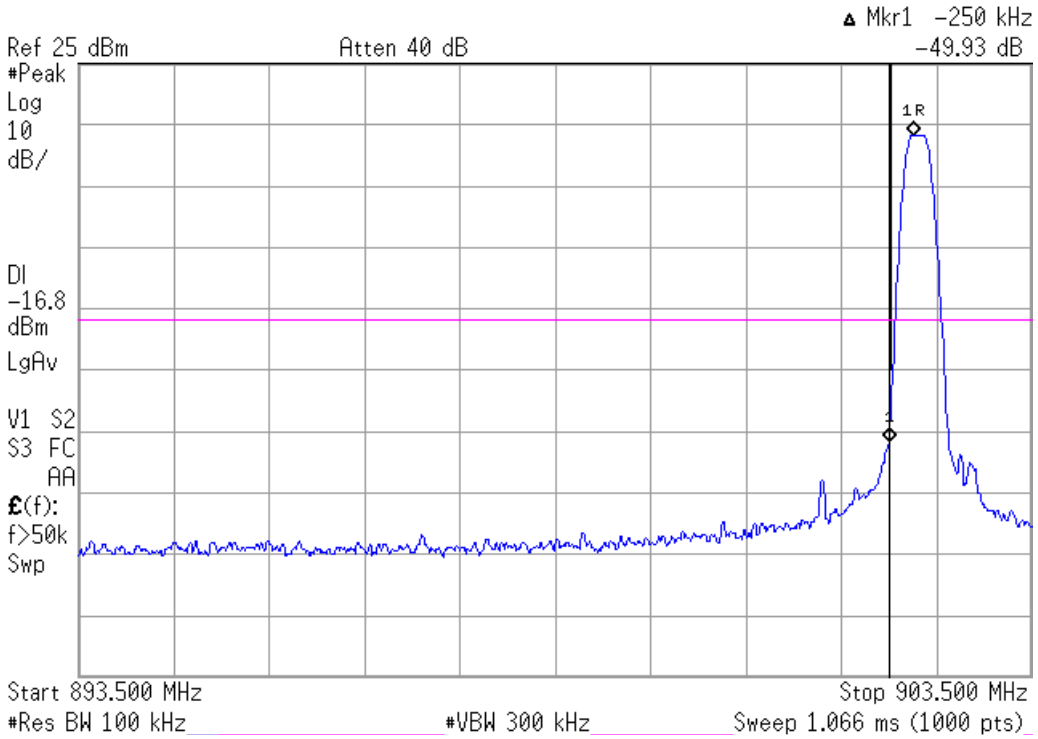
SPECIFICATION

In any 100 kHz bandwidths outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

RESULTS:

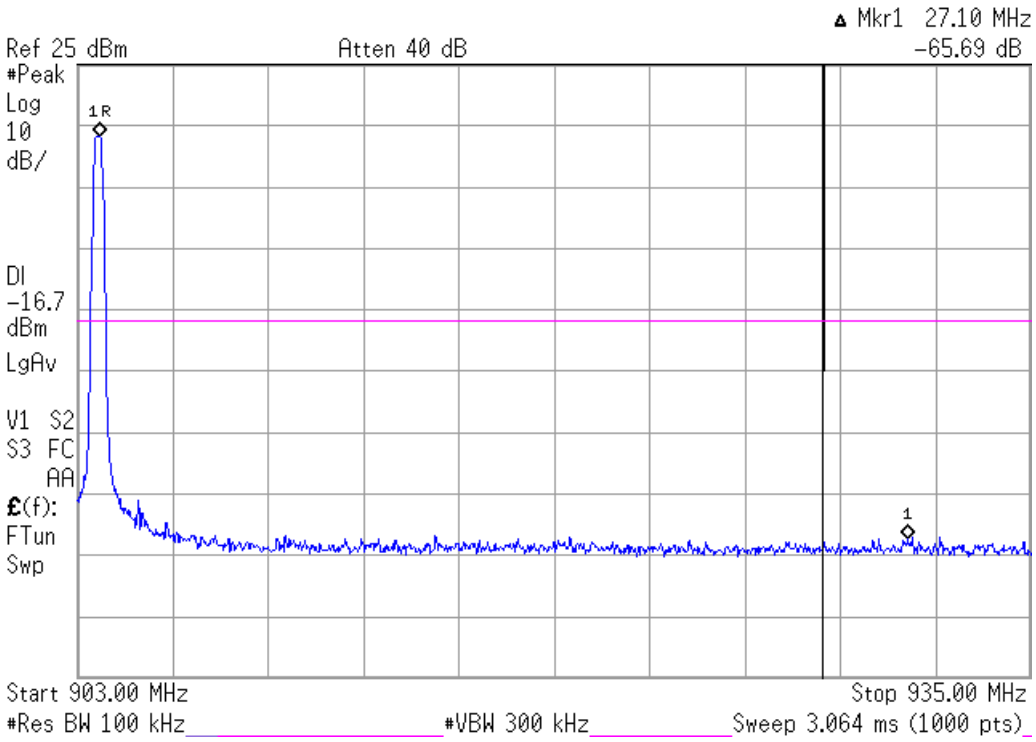
The attenuation of highest emissions at the band-edge is more than 30 dB respect to the highest level of the desired power.

- HOPPING OFF:
  - LOW FREQUENCY SECTION:



Verdict: PASS

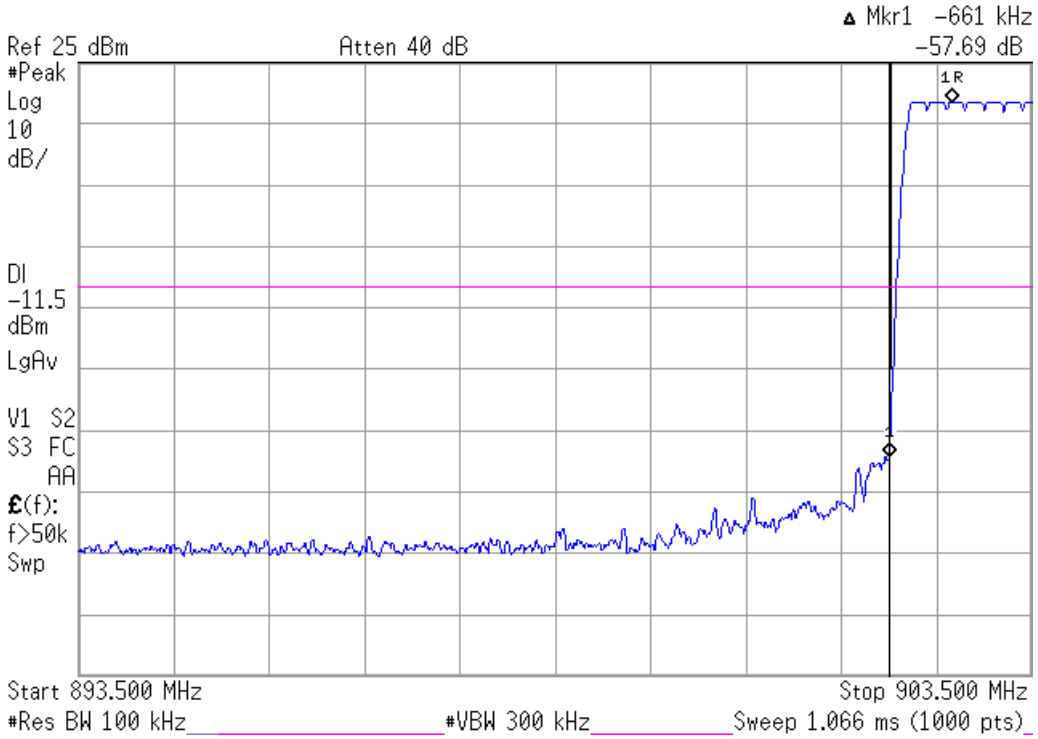
- HIGH FREQUENCY SECTION:



Verdict: PASS

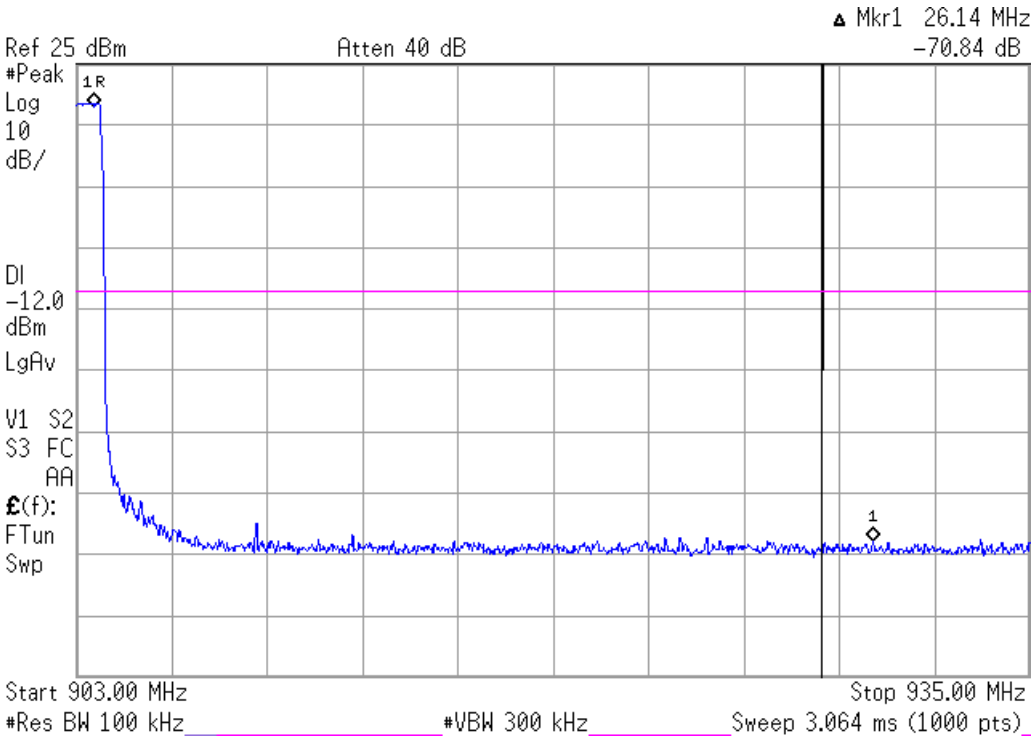
- HOPPING ON:

- LOW FREQUENCY SECTION:



Verdict: PASS

- HIGH FREQUENCY SECTION:



Verdict: PASS

Measurement uncertainty (dB)	<±2.03

FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations conducted (Transmitter)

SPECIFICATION:

In any 100 kHz bandwidths outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

RESULTS:

	Low Channel 902.3 MHz	High Channel 903.7 MHz
Reference Level Measurement (dBm)	13.31	13.21
Measurement uncertainty (dB)	<±2.03	

- Low Channel:

No spurious frequencies detected at less than 20 dB below the limit.

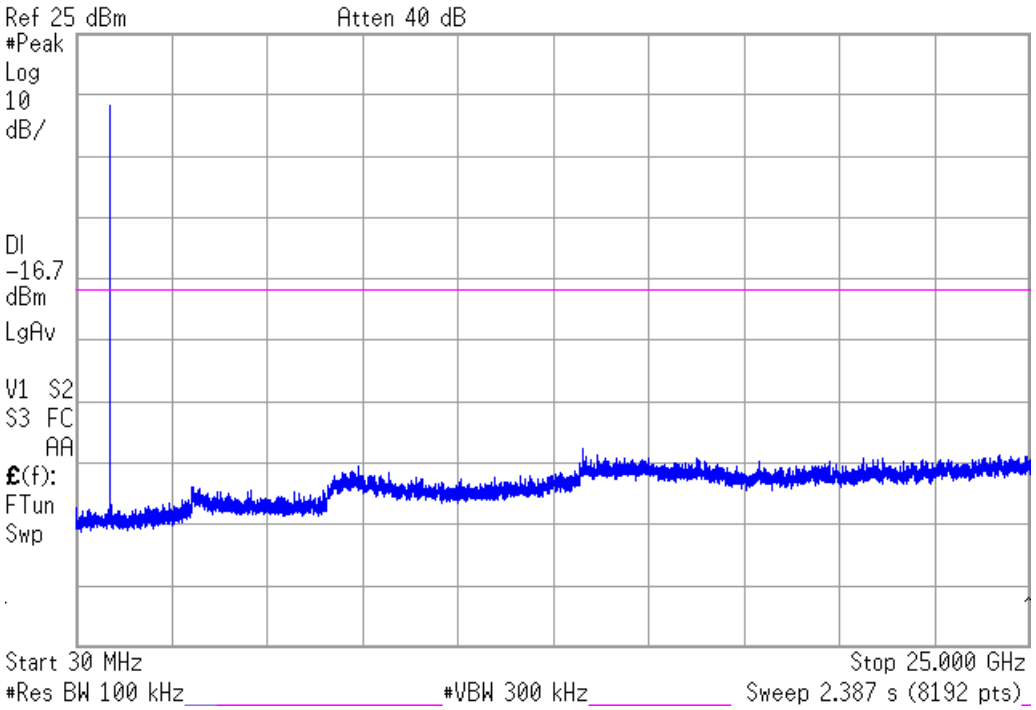
- High Channel:

No spurious frequencies detected at less than 20 dB below the limit.

Measurement uncertainty (dB)	<±2.03

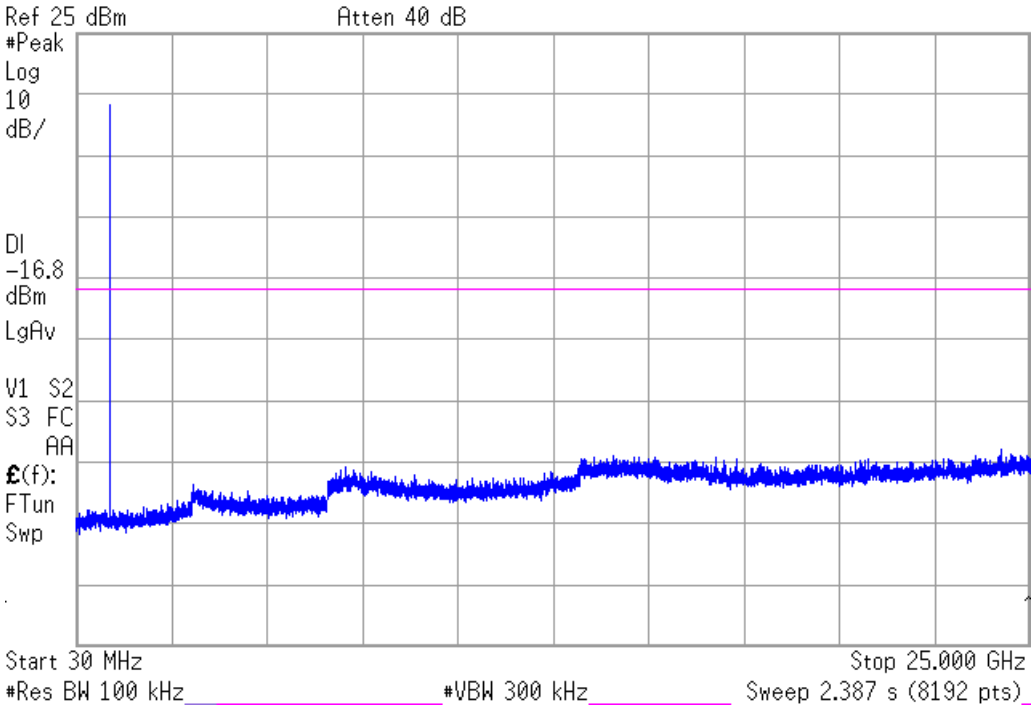
Verdict: PASS

- Low Channel:



The peak shown in the plot above the limit is the carrier frequency.

- High Channel:



The peak shown in the plot above the limit is the carrier frequency.

FCC Section 15.247 Subclause (f) / RSS-247 5.3. (b) Power spectral density for hybrid systems

SPECIFICATION

For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques.

The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

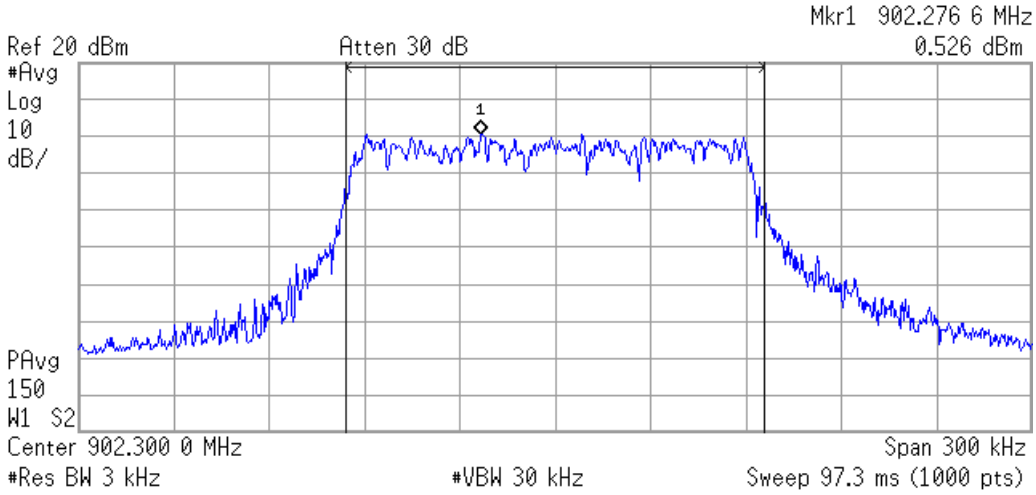
The maximum power spectral density level was measured using the method AVGPSD-1 according to point 11.10.3 of ANSI C.63.10-2013.

	Lowest Channel 902.3 MHz	Highest Channel 903.7 MHz
Average Power Spectral Density (dBm)	0.526	-0.02
Measurement uncertainty (dB)	<±0.78	

Verdict: PASS

Power Spectral Density:

Lowest Channel:



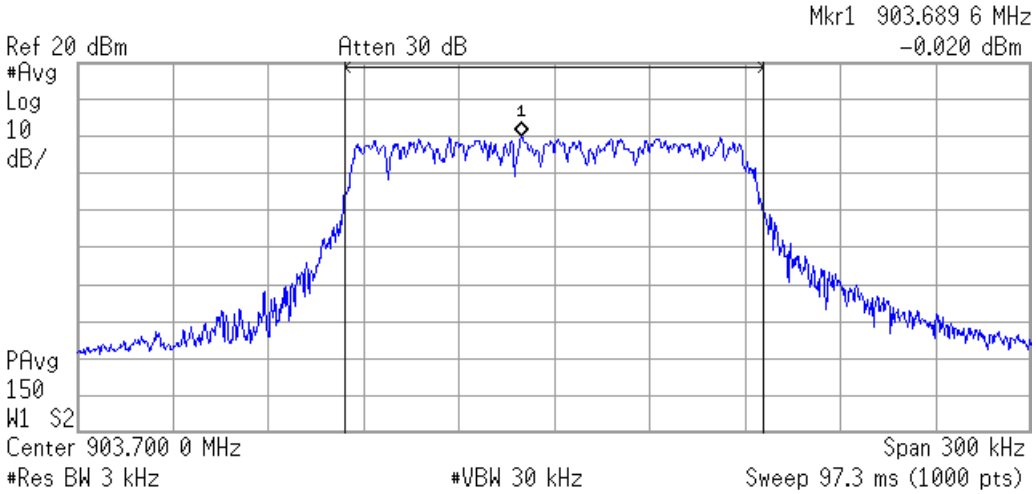
Channel Power

12.91 dBm /131.1244 kHz

Power Spectral Density

-38.27 dBm/Hz

Highest Channel:



Channel Power

12.83 dBm /131.1165 kHz

Power Spectral Density

-38.34 dBm/Hz

FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations radiated. (Transmitter)

SPECIFICATION:

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)/RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 10000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
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.

RSS-247. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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.
All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-10 GHz.
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

RADIATED:

Frequency range 30 MHz - 1 GHz:

The spurious emissions below 1 GHz do not depend neither on the operating channel nor the modulation mode selected in the EUT.

No spurious frequencies detected at less than 20 dB below the limit.

Frequency range 1 - 10 GHz:

The results in the next tables show the maximum measured levels in the 1-10 GHz range (see next plots).

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- Low Channel (902.3 MHz). Spurious frequencies operating (radiated) at less than 20 dB below the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
1.804367 (*)	Peak	59.34	H	<± 3.70
	Average	57.61		<± 3.70
3.6088	Peak	42.78	V	<± 3.70
4.51188	Peak	43.06	H	<± 3.70
5.41348	Peak	43.31	H	<± 3.70
6.31578 (*)	Peak	58.70	H	<± 3.70
	Average	58.20		<± 3.70
7.21855	Peak	49.78	H	<± 3.70
8.12108	Peak	50.45	V	<± 3.70
9.02292	Peak	51.26	V	<± 3.70
9.92475	Peak	51.72	V	<± 3.70

(*): This spurious frequency is outside the restricted bands as defined in §15.205(a). The measured maximum carrier level at 3 m was 103.27 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

- High Channel (903.7 MHz). Spurious frequencies operating (radiated) at less than 20 dB below the limit:

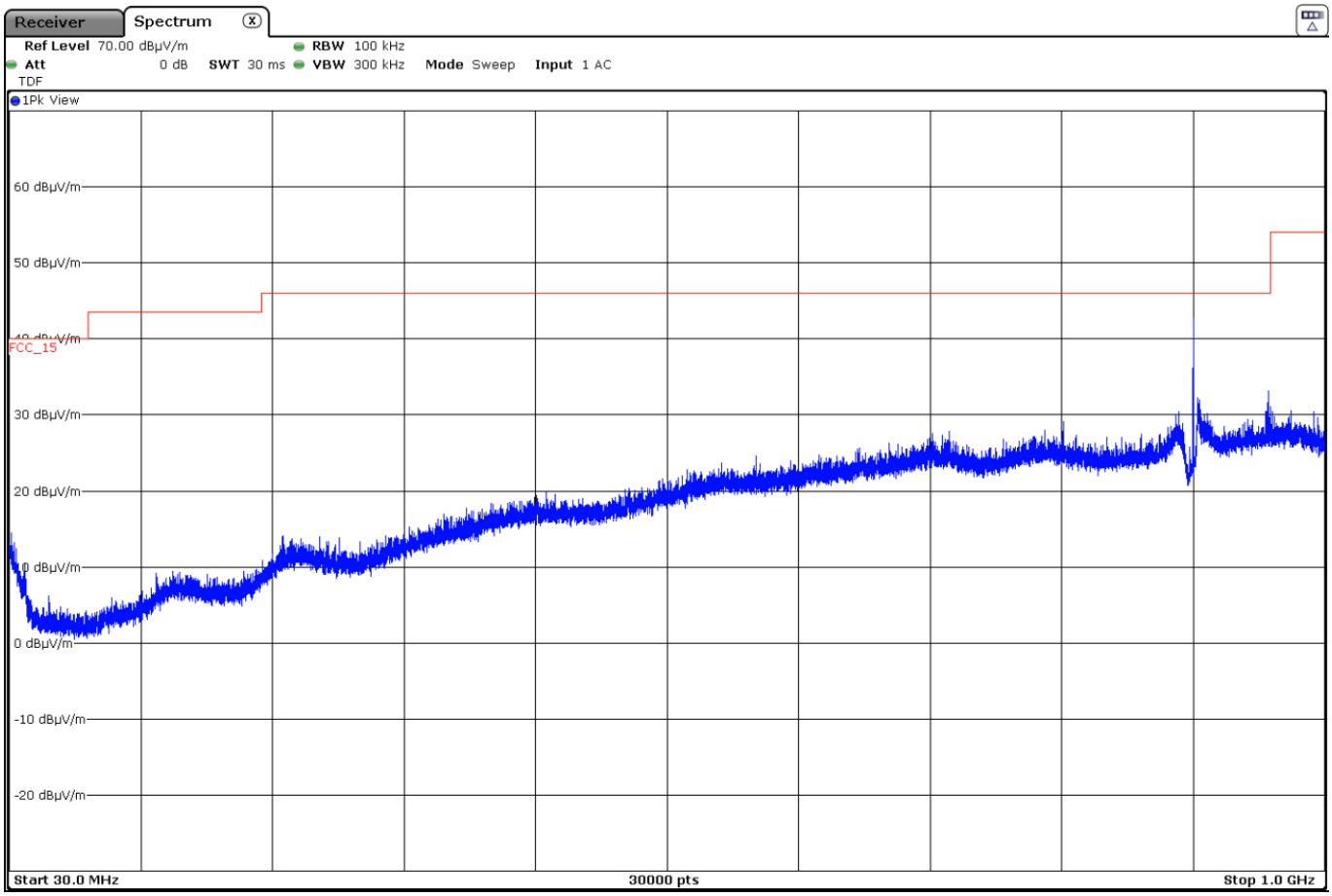
Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
1.807433(*)	Peak	61.47	H	<± 3.70
	Average	60.11		<± 3.70
3.61472	Peak	43.45	V	<± 3.70
4.5181	Peak	51.59	V	<± 3.70
5.12212	Peak	41.08	V	<± 3.70
5.42258	Peak	43.27	H	<± 3.70
6.32605(*)	Peak	59.45	H	<± 3.70
	Average	58.9		
7.22952	Peak	49.44	H	<± 3.70
8.13392	Peak	50.17	V	<± 3.70
9.03645	Peak	51.06	V	<± 3.70
9.94038	Peak	51.4	V	<± 3.70

(*): This spurious frequency is outside the restricted bands as defined in §15.205(a). The measured maximum carrier level at 3 m was 102.57 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

Verdict: PASS

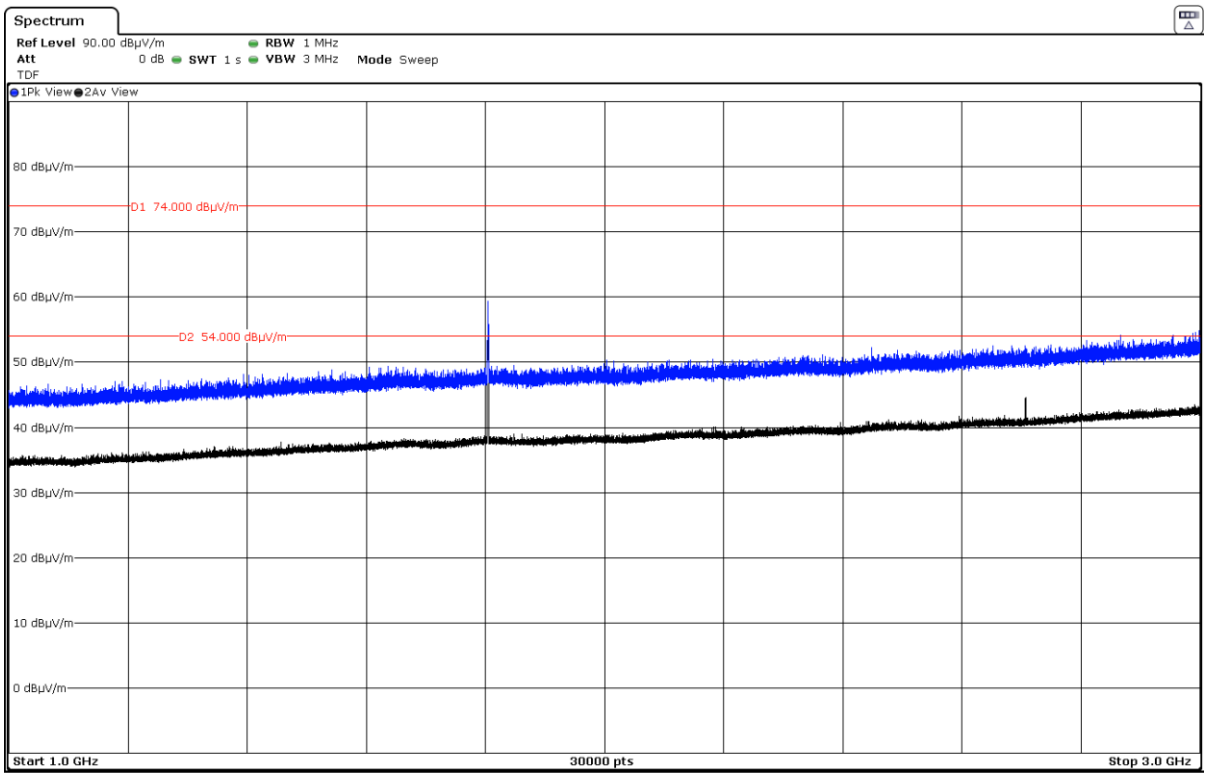
FREQUENCY RANGE 30 MHz - 1 GHz:

This plot is valid for the Low and High Channels.



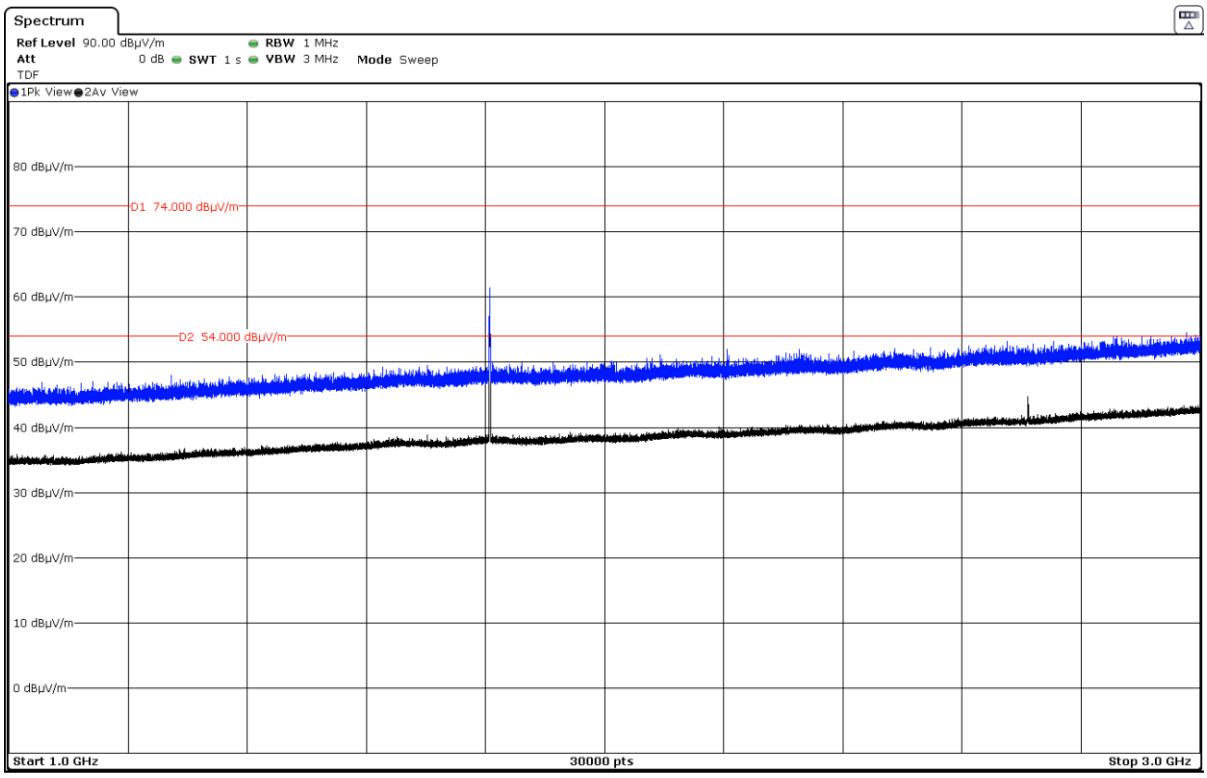
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel (902.3 MHz):



The peak above the limit is the carrier frequency.

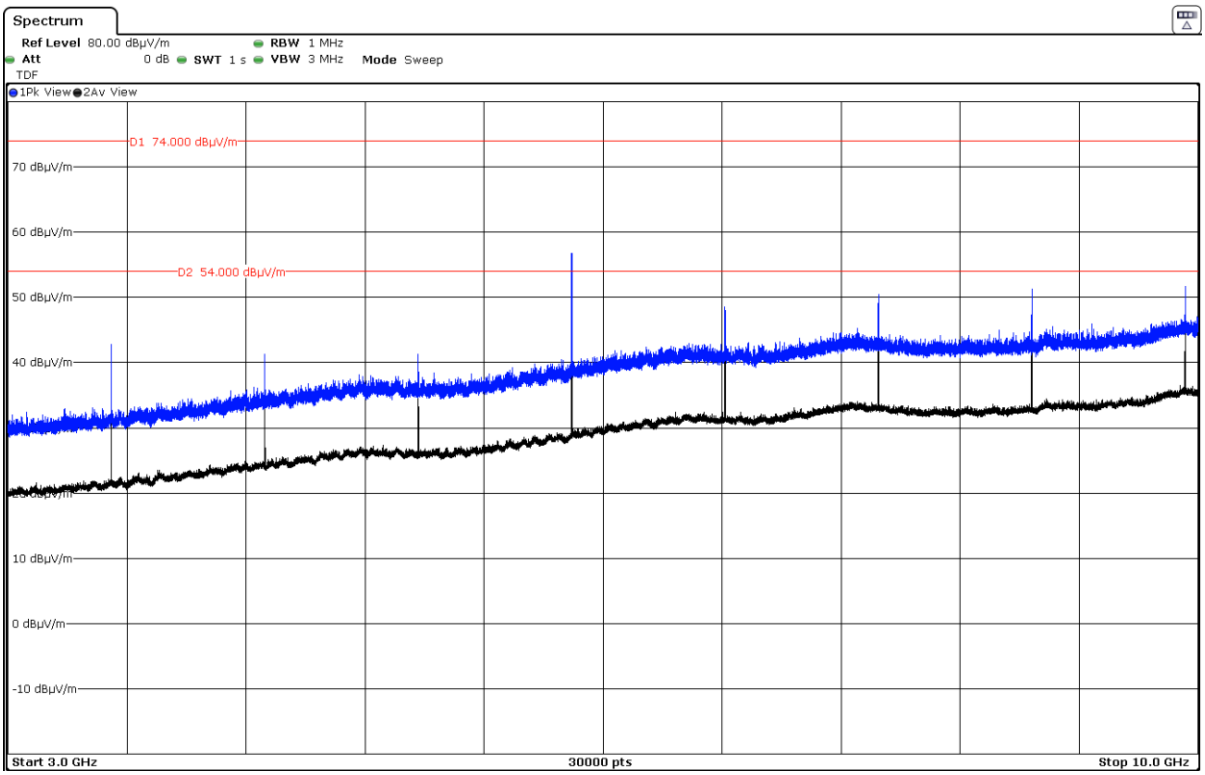
- High Channel (903.7 MHz):



The peak above the limit is the carrier frequency.

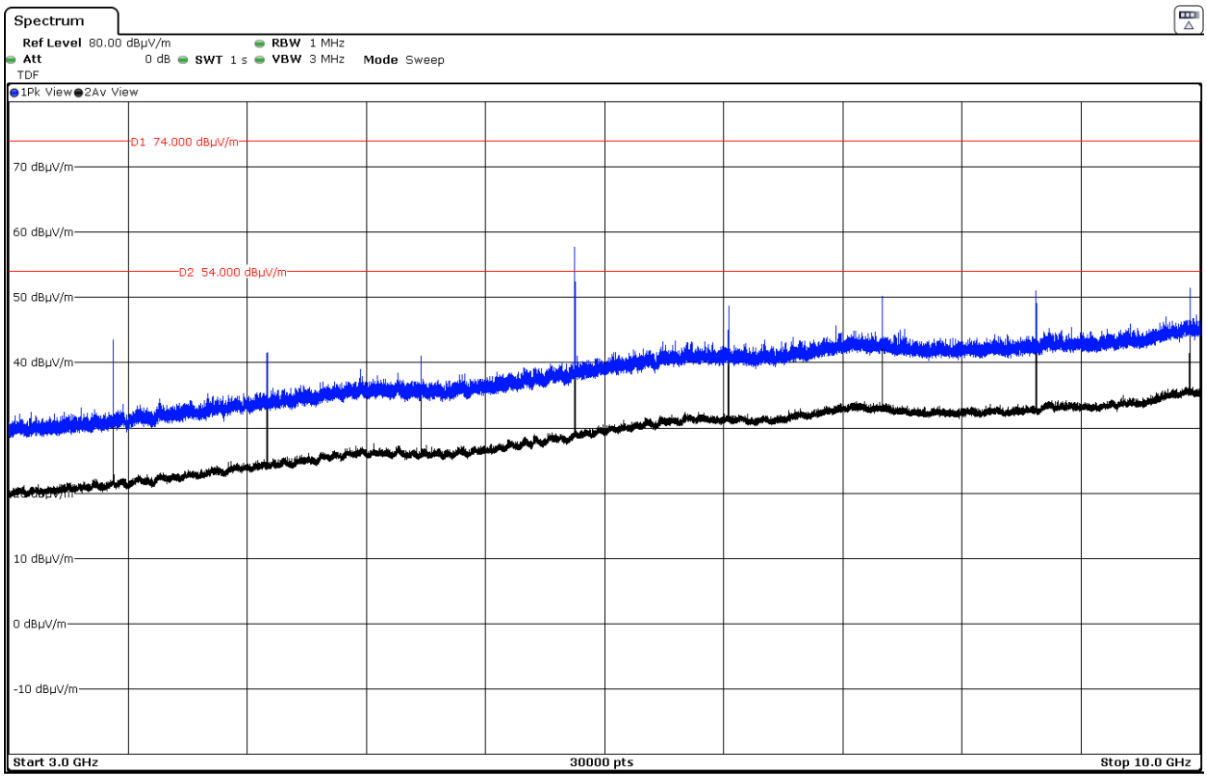
FREQUENCY RANGE 3 - 10 GHz:

- Low Channel (902.3 MHz):



The peak above the limit is the carrier frequency.

- High Channel (903.7 MHz):



The peak above the limit is the carrier frequency.