QAI Laboratories
3980 North Fraser Way
Burnaby, BC, V5J 5K5 Canada

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

PREPARED FOR TANTALUS SYSTEMS CORP.
BY QAI LABORATORIES

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EMC Test Laboratory:	**QAI Laboratories Inc.**
Address:	3980 North Fraser Way, Burnaby, BC, V5J 5K5 Canada
Phone:	(604) 527-8378
Fax:	(604) 527-8368

Laboratory Accreditations (per ISO/IEC 17025:2005):

American Association for Laboratory Accreditation Certificate Number: 3657.02

EMC Client:	Tantalus Systems Corp.
Address:	200-3555 Gilmore Way Burnaby, BC, Canada, V5G 0B3
Phone:	(604) 299-0458

Applicable Test Standards:	FCC Title 47 CFR Part 15: Subpart B FCC Title 47 CFR Part 15: Subpart C - § 15.247, 15.212

Equipment Tested	Single Phase Meter
Tantalus Part Number:	TC-1214
FCC ID:	OZFTC1214
ISED Certification Number:	3669A-TC1214
Manufacturer:	Tantalus Systems Corp.

REVISION HISTORY

Date	Report Number	Rev #	Details	Author's Initials
August 29, 2018	E10402-1801_Tantalus-240V Single Phase Meter and Multimeter	0.0	Initial Release	RA
September 14, 2018	E10402-1801_Tantalus-240V Single Phase Meter and Multimeter	1.0	Update Release	JQ
September 17, 2018	E10402-1801_Tantalus Single Phase Meter	1.1	Updating data	JQ
September 17, 2018	E10402-1801_Tantalus Single Phase Meter	1.2	Updating as per Timco	JQ
October 22, 2018	E10402-1801_Tantalus Single Phase Meter	1.3	Updating as per Timco	JQ
All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.				

REPORT AUTHORIZATION

The data documented in this report is for the test equipment provided by Tantalus Systems Corp. Tests were conducted on the sample equipment as requested by Tantalus Systems Corp. for the purpose of demonstrating compliance with FCC Title 47 CFR Part 15: Subpart B & C as agreed upon by Tantalus Systems Corp. as per Quote 18SH05031R2.

Tantalus Systems Corp. is responsible for the tested product configuration, continued product compliance, and for the appropriate auditing of subsequent products as required. This report may comprise partial list of tests that are required for FCC Declaration of Conformity and can only be produced by the manufacturer.

This is to certify that the following report is true and correct to the best of our knowledge.

X 

Written by Jack Qin
RF/EMC Test Engineer/Technical Writer

QAI FACILITIES

Founded in 1994 by a group of experienced certification and testing experts, QAI is an independent third-party testing, inspection and certification organization which serves the building industry, government and individuals with cost effective solutions through our in-house capabilities / services, and an established world-wide network of qualified affiliates. To help get your product to market, trust the provider that many leading global manufacturers do: QAI.

British Columbia
QAI Laboratories Inc.
Main Laboratory/Headquarters
3980 North Fraser Way,
Burnaby, BC V5J Canada

Ontario
QAI Laboratories Inc.
1081 Meyerside Drive, Unit #14
Mississauga, ON L5T 1M4 Canada

Virginia
QAI Laboratories Ltd.
1047 Zachary Taylor Hwy,
Suite A Huntly, VA 22640 USA

California
QAI Laboratories Ltd.
8385 White Oak Avenue Rancho
Cucamonga, CA 91730 USA

Oklahoma
QAI Laboratories Ltd.
108th East Avenue,
Tulsa, OK 74116 USA

QAI EMC ACCREDITATION

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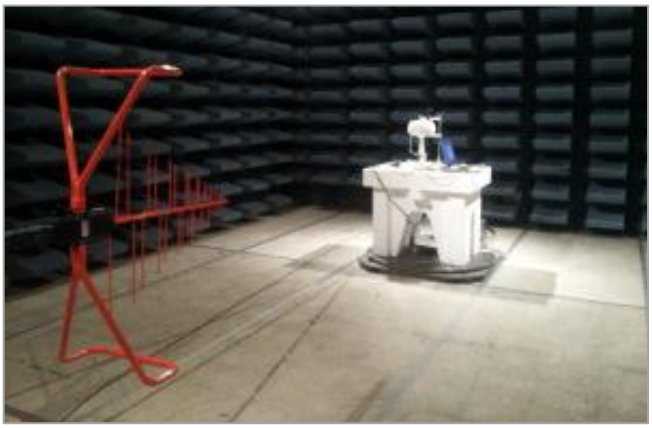
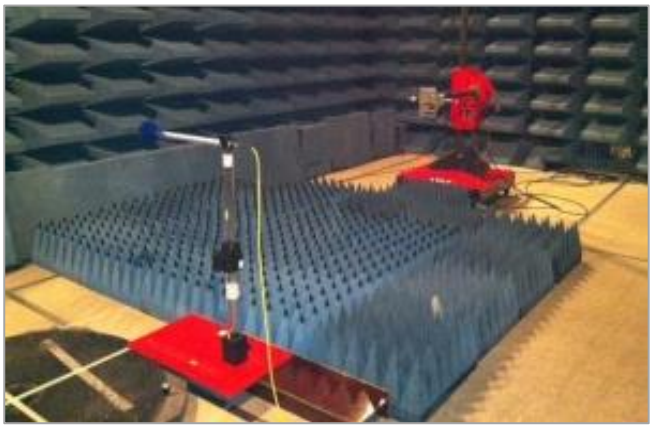
EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC, Canada	CA9543	21146-1	3657.02

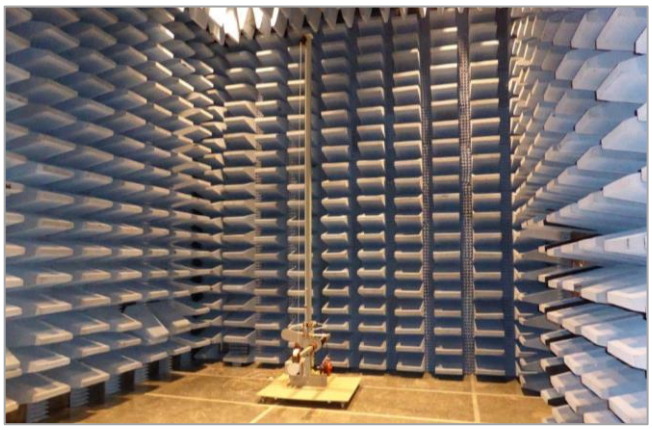
Headquarters & EMC Laboratory in Burnaby, BC



Chamber 1- 3m Semi-Anechoic Chamber (SAC) in Burnaby, BC



Chamber 1- 3m Semi-Anechoic Chamber (SAC) in Burnaby, BC



Chamber 2- 3m Semi-Anechoic Chamber (SAC) in Burnaby, BC

10m Open Area Test Site (OATS) in British Columbia, Canada

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Section I: EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of 120V and 240V Single Phase Meters of various class and forms when enabled with the Tantalus communication module as per Sections 1.2 & 1.3.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 18SH05031R2:

- **FCC Title 47 CFR Part 15** – Radio Frequency Devices, Subpart **B** - Unintentional Radiators.
  - § 15.107 – Conducted Emissions
  - § 15.109 – Radiated Emissions
- **FCC Title 47 CFR Part 15** – Radio Frequency Devices, Subpart **C** - Intentional Radiators.
  - § 15.201 – Antenna Requirement
  - § 15.205 – Restricted Bands
  - § 15.207 – Conducted Emissions
  - § 15.209 – Radiated Emissions
  - § 15.212 – Modular Transmitters
  - § 15.247 – Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

The tests documented in this report were performed in accordance with ANSI C63.4-2014, ANSI C63.10-2013, and FCC KDB 558074 D01 DTS Meas Guidance v05.

1.3 Summary of Results

The following tests demonstrate the testimony to "FCC" Mark Electromagnetic compatibility testing for 120V and 240V Single Phase Meters manufactured by Landis & Gyr and enabled with a communication module manufactured by Tantalus Systems Corp.
Tantalus is applying for a limited modular approval certification. For this reason the host device was tested in a stand-alone configuration for intentional emission measurements.
To ensure compliance to AC conducted and unintentional emissions the host device was tested in 4 different single-phase meters that are representative of the entire product suite of single phase meters from Landis & Gyr.

The following tests were performed pursuant to the FCC Unintentional Radiated Emissions, Intentional Radiated Emissions, and Radio Testing Standards:

No.	Test Description	FCC Part 15B & C Standard Clause	Result
1	Antenna Requirement	§15.203	Complies
2	RF Peak Power Output	§15.247 (b)(2)	Complies
3	20 dB Bandwidth	§15.247 (a)(1)(i)	Complies
4	Out-of-Band Emissions (Band Edge)	§15.247 (d)	Complies
5	Channel Separation	§15.247 (a)(1)	Complies
6	Number of Hopping Channels	§15.247 (a)(1)(i)	Complies
7	Dwell Time	§15.247 (a)(1)(i)	Complies
8	Time Occupancy	§15.247 (a)(1)(i)	Complies
9	Intentional Radiated Spurious Emissions	§15.209, 15.205,	Complies

10	Modular Transmitters	15.212	Complies
11	Unintentional Radiated Spurious Emissions	§15.109,	Complies
12	AC Mains Conducted Emissions	§15.107, 15.207	Complies

Section II: GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as a complete system.

Equipment Under Test (EUT) Information

EUT	120V and 240V Single Phase Meter of various class and forms
Functional Description	Single Phase Wattmeter
Operating Frequency	902.17MHz to 927.83MHz
FCC ID	OZFTC1214
IC Certification Number	3669A-TC1214
Manufacturer	Tantalus Systems Corp.
Tantalus Part No.	TC-1214
Serial No.	002C8418B7
Landis & Gyr Part No.	RXRe-SD: Forms 1S & 2S. RXRe: Forms 3S & 4S
Serial No.	148 104 334, 142 653 047, 148 108 673, 145 760 028

2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	22-28ºC
Relative Humidity	39.7 - 54.4%

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1.5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1ºC
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohdes & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	QPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Quasi Peak reading shown in the table above is already corrected by the software using correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

Or

Corr.(dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)

The final Quasi peak reading shown in the data is calculated by the software using following equation:

Corrected Quasi Peak(dBµV/m) = Raw Quasi Peak Reading + Antenna factor + Cable loss

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	QPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	44.3	1000.000	9.000	GND	0.6	21.7	66.0

Frequency (MHz)	QPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	27.2	1000.000	9.000	GND	0.6	28.8	56.0

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

The final Quasi peak or Average reading shown in the data is calculated by the software using following equation:

Corr. Quasi Peak/Average Reading (dBµV) = Raw Quasi Peak/Average Reading + Antenna factor + Cable loss

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

Margin(dB) = Limit – Quasi-Peak or Average reading

2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.3.

Emissions Test Equipment

Manufacturer	Model	Description	Serial No.	Last Calibration Date	Calibration Due Date
Sunol Sciences	SM46C	Turntable	051204-2	N/A	N/A
Sunol Sciences	TWR95	Mast	TREML0001	N/A	N/A
Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A120106	2017-Sep-24	2020-Sep-24
Sunol Sciences	DRH-118	Horn Antenna 1GHz-18GHz	A050905	2016-Mar-10	2019-Mar-10
ETS Lindgren	2165	Turntable	00043677	N/A	N/A
ETS Lindgren	2125	Mast	00077487	N/A	N/A
Rohde & Schwarz	ESU40	EMI Receiver	100011	2017-Nov-20	2020-Nov-20
Fischer	FCC-LISN-50-25-2-08	LISN (150kHz-30MHz)	2041	2015-Nov-19	2018-Nov-19
ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A	N/A
AH Systems	PAM118	Amplifier 10KHz-18GHz	189	N/A	N/A
EMCO	6502	Loop Antenna	6502	11/13/2017	11/13/2020
Insulated Wire Inc.	SPS-1753-1140-SPS	Yellow cable, 3m	102395	N/A	N/A
Insulated Wire Inc.	SPS-1753-2400-SPS	Yellow cable, 6m	091096	N/A	N/A
WEINSCHEL ENGINEERING	44	6db attenuator	665	N/A	N/A
Insulated Wire Inc.	SPS-1753-1140-SPS	Yellow cable, 3m	102395	N/A	N/A
Insulated Wire Inc.	SPS-1753-2400-SPS	Yellow cable, 6m	091096	N/A	N/A

Note: *Equipment marked N/A is verified as a complete signal path with a calibrated instrument.*

Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	6.20.0	Emissions Test Software
ETS-Lindgren	Tile7	7.3.15	Emissions Test Software

Section III: TEST RESULTS

3.1 Antenna Requirements

Date Performed:

Jul 26, 2018

Test Standard:

- FCC Title 47 CFR Part 15: Subpart C §15.203

Applicable Regulation:

The purpose of this requirement is to make certain that no other antenna, except for that provided by the responsible party, shall be used with the Equipment-Under-Test (EUT) as defined in FCC CFR 47 Part 15.203 & RSS-Gen Issue 4:

> "An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited." … "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

Modifications:

No modification was required to comply for this test.

Result:

An integrated antenna is used on this product and it is not field replaceable.

3.2 RF Peak Power Output

Date Performed: Jul 26, 2018

Test Standard: FCC Title 47 CFR Part 15: Subpart C - §15.247 (b)(2)

Test Method: FCC KDB 558074 D01 DTS Meas Guidance v05

Test Requirement: For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels. The maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

Test Setup: The antenna port of EUT was directly connected to a spectrum analyzer.

Measurement Method: As called in FCC KDB 558074 D01 DTS Meas Guidance v05.

Modifications: No modification was required to comply for this test.

Result: The EUT complies with the applicable standard.

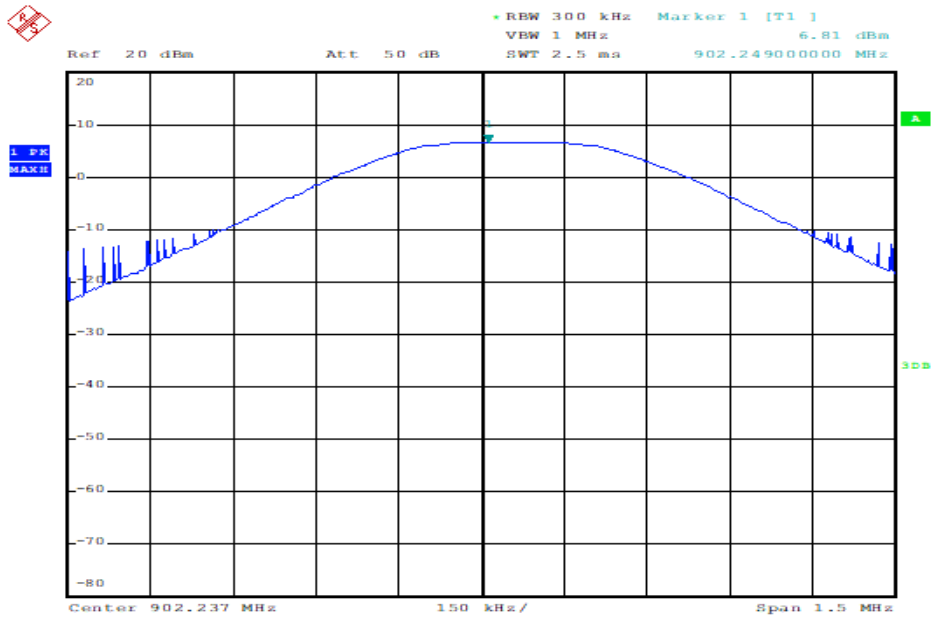
Measurement Data and Plot:

Table 1: E.I.R.P measurements

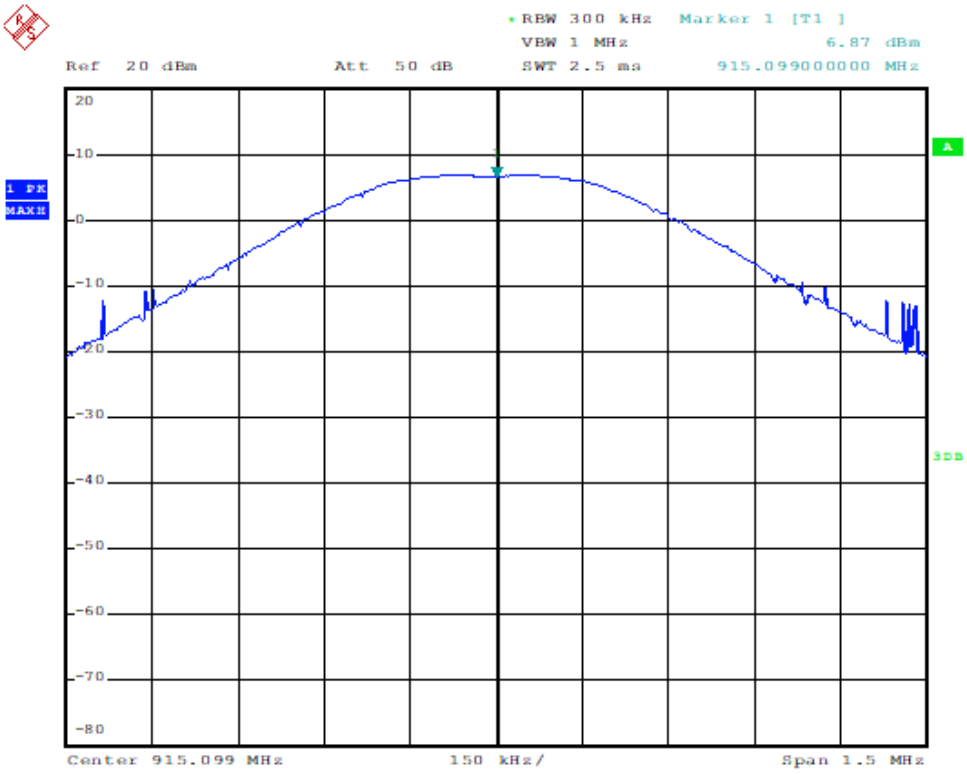
Channel	Freq. (MHz)	Raw Peak (dBµV)	Pol (V/ H)	Turn Tbl. deg)	Ant. Ht. (cm)	Ant. Fact. (dBµV)	Cable Loss (dB)	Atten. (dB)	Corr. Peak (dBµV)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Low	902.17	93.5	H	200	100	22.2	9.55	0	125.3	30.02	36	6.0
	902.17	85.8	V	0	100	22.35	9.55	0	117.7	22.47	36	13.5
Middle	915.01	96.8	H	210	100	22.5	9.55	0	128.9	33.66	36	2.3
	915.01	90.0	V	0	100	22.2	9.55	0	121.8	26.52	36	9.5
High	927.83	97.8	H	180	100	22.35	9.55	0	129.7	34.47	36	1.5
	927.83	89.8	V	0	100	22.5	9.55	0	121.9	26.62	36	9.4

Table 2: Conducted output power measurements

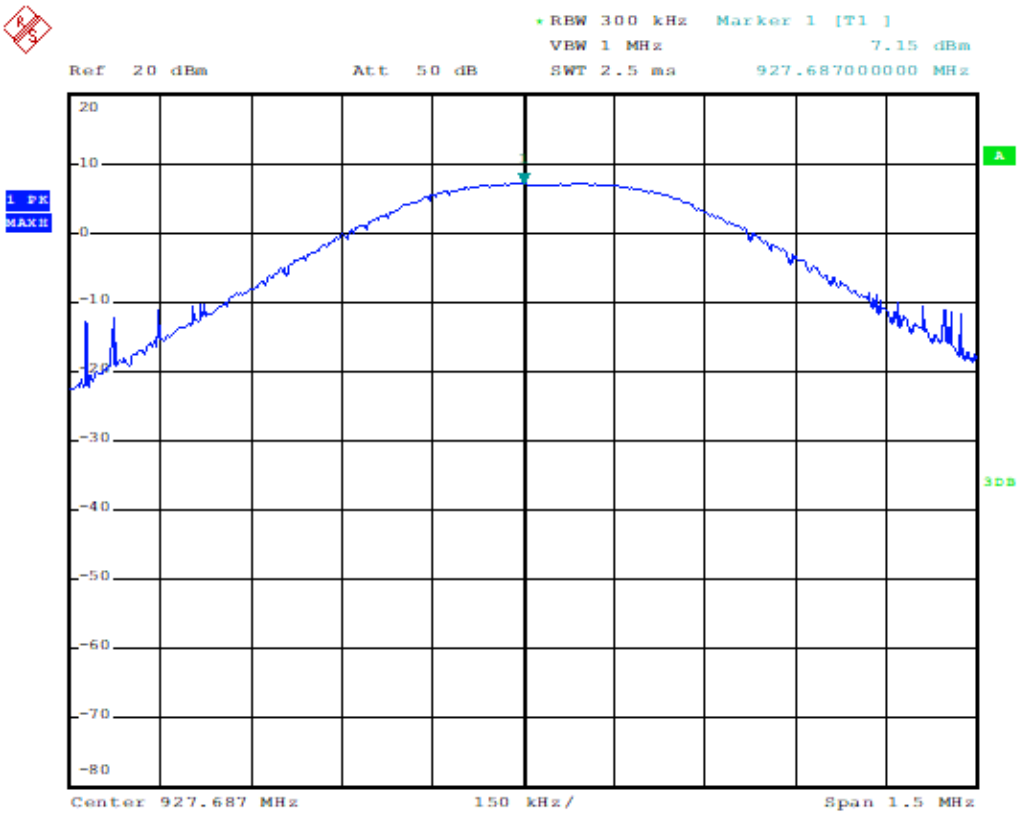
Channel	Freq. (MHz)	Raw Output Pwr (dBm)	Correction Factor (dB)	Corrected Output Pwr (dBm)	Limit (dBm)	Margin (dB)
Low	902.17	6.81	21.4	28.21	30	1.79
Middle	915.1	6.87	21.4	28.27	30	1.73
High	927.83	7.15	21.4	28.55	30	1.45



Plot 1: RF Peak Conducted Power Output (Low Channel ~902.2 MHz)



Plot 2: RF Peak Conducted Power Output (Mid Channel ~ 915.1 MHz)



Plot 3: RF Peak Conducted Power Output (High Channel ~ 927.7 MHz)

3.3 20dB Bandwidth

Date Performed: Jul 26, 2018

Test Standard: FCC Title 47 CFR Part 15: Subpart C - §15.247 (a)(1)(i)

Test Method: ANSI C63.10:2013

Test Requirement: For FHSs in the band 902-928 MHz: if the 20dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

Test Setup: The antenna port of EUT was directly connected to a spectrum analyzer.

Measurement Method: As called in ANSI C63.10-2013.

Modifications: No modification was required to comply for this test.

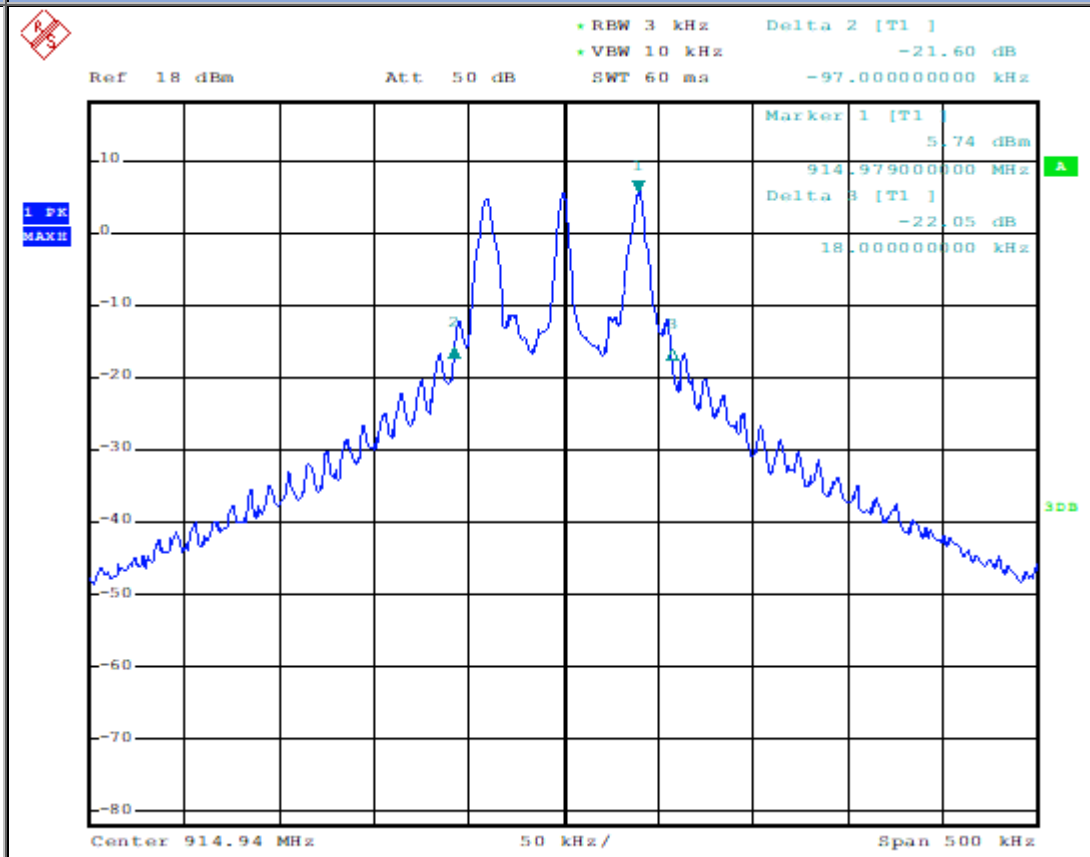
Result: The EUT complies with the applicable standard.

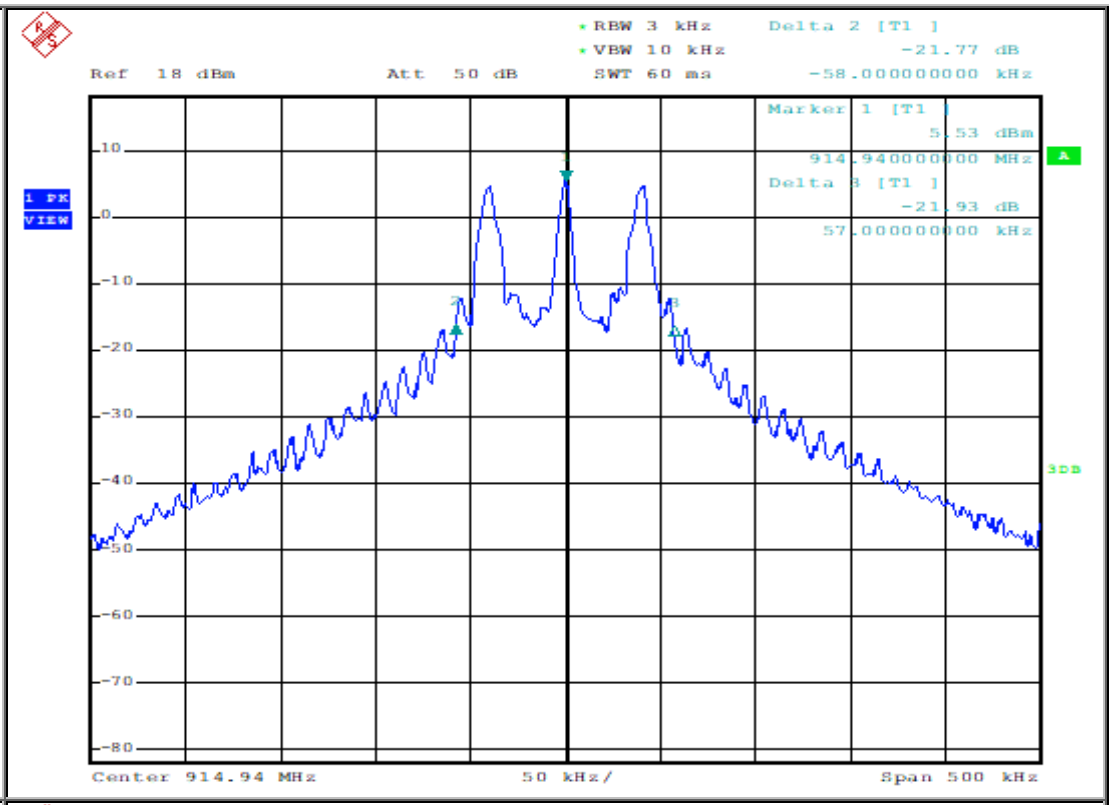
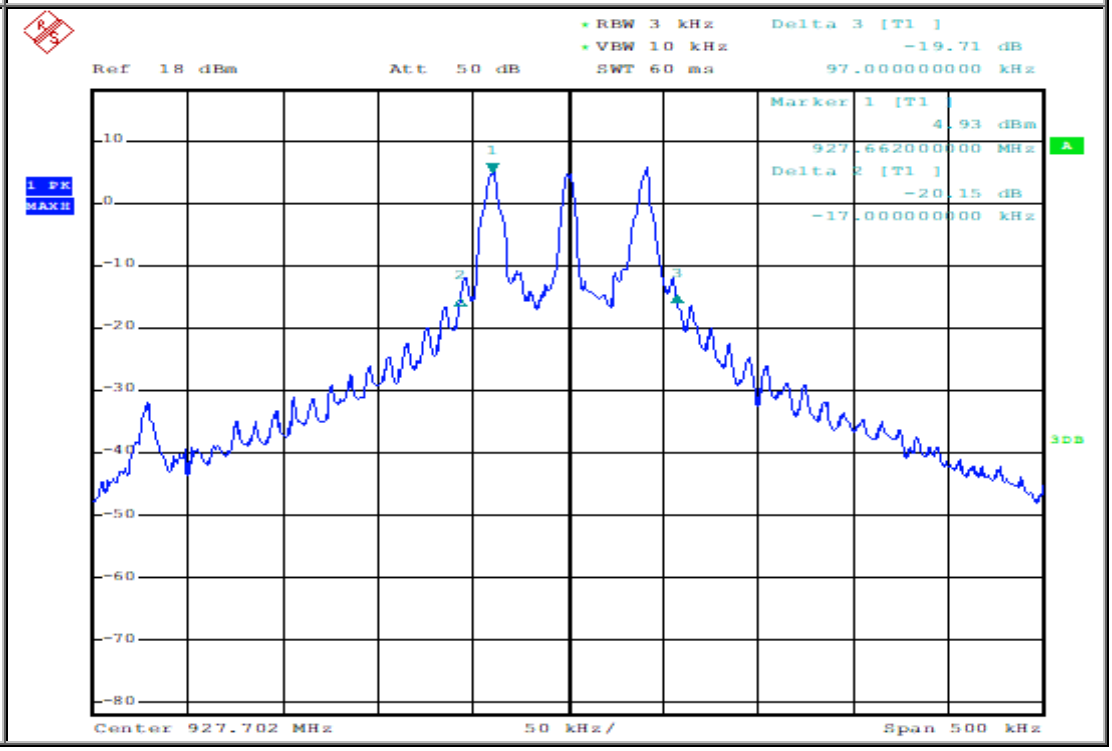
Measurement Data and Plot:

Low Data Rate

Table 3: 20dB Bandwidth Data on Low Data Rate

Channel	Frequency (MHz)	20dB Bandwidth (kHz)
Low	902.3	115.0
Middle	915.0	115.0
High	927.7	114.0

Channel	Plot
Low	

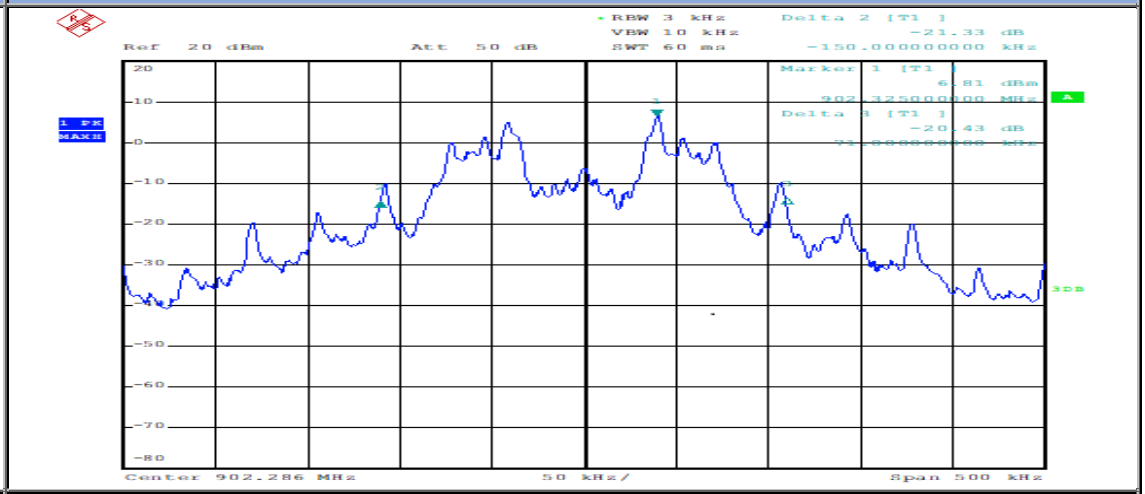
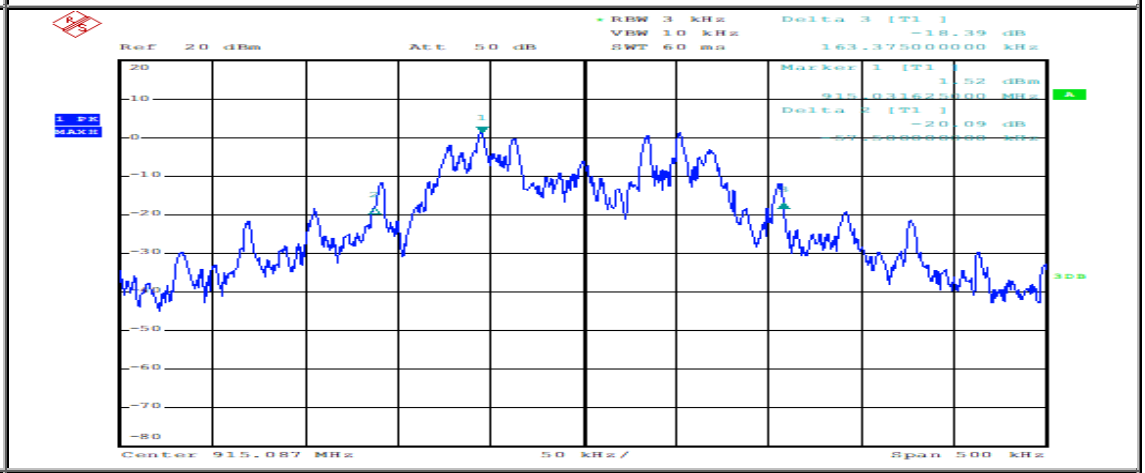
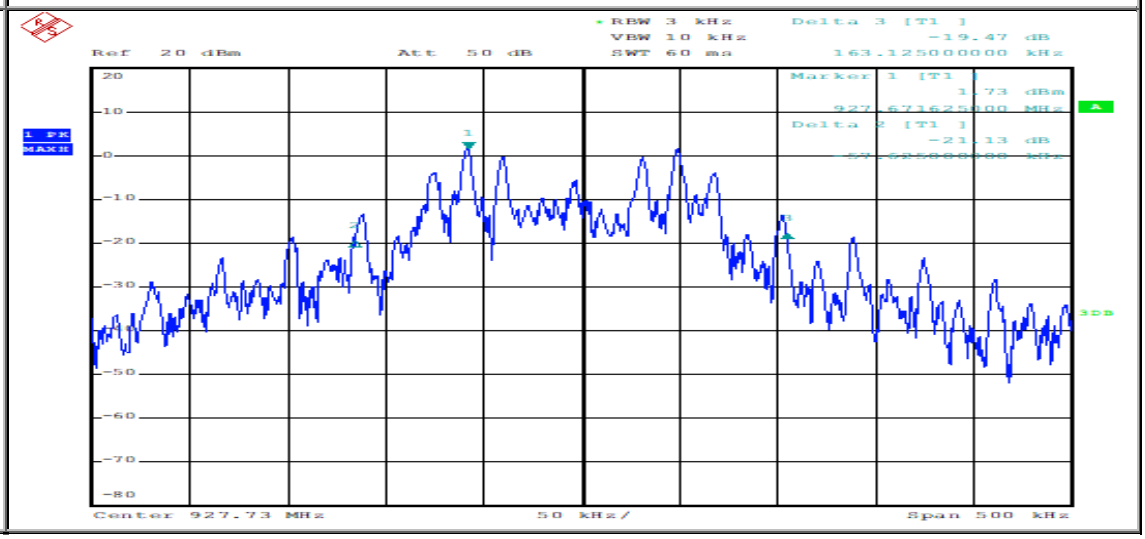
Middle	
High	

Plot 4: 20dB Bandwidth Plot (Low Data Rate)

High Data Rate

Table 4: 20dB Bandwidth Data on High Data Rate

Channel	Frequency (MHz)	20dB Bandwidth (kHz)
Low	902.2	221.0
Middle	915.0	220.9
High	927.7	220.8

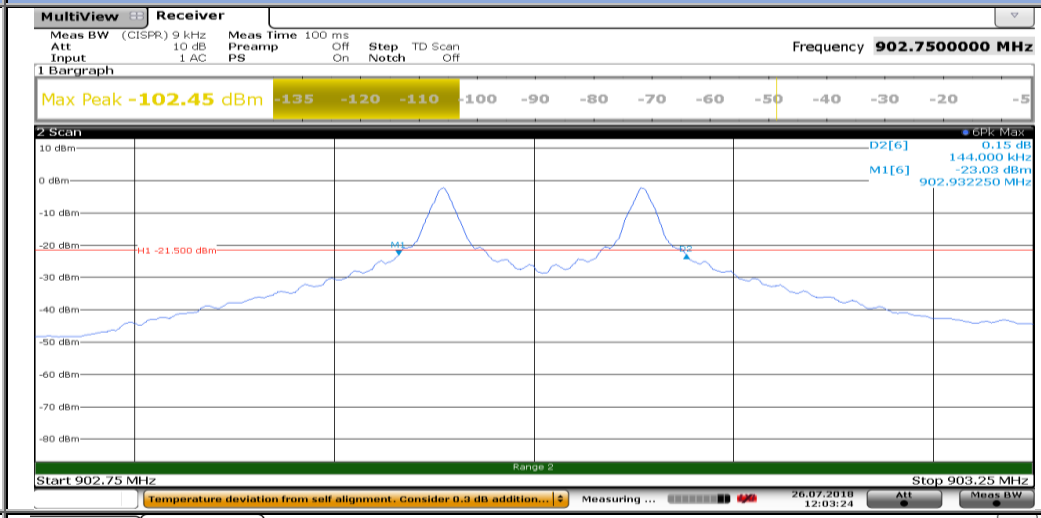
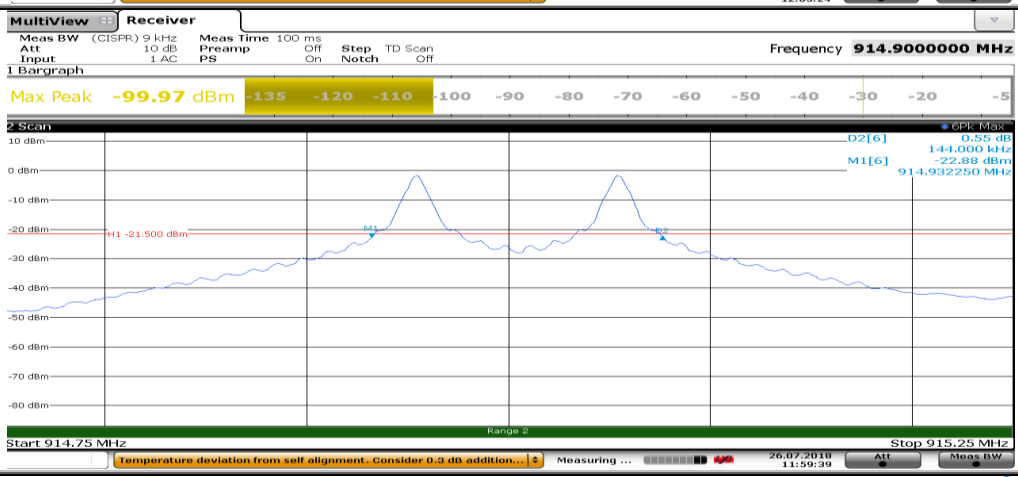
Channel	Plot
Low	
Middle	
High	

Plot 5: 20dB Bandwidth Plot (High Data Rate)

Data rate for communication to approved Part 15 device (3rd Party Mode)

Table 5: 20dB Bandwidth Data on communication to third party Part 15 approved device

Channel	Frequency (MHz)	20dB Bandwidth (kHz)
Low	903.1	144
Middle	915.0	144
High	926.8	144

Channel	Plot
Low	
Middle	
High	

Plot 6: 20dB Bandwidth Plot (Data rate for communication to approved Part 15 device)

3.4 Out of Band Emissions (Band Edge)

Date Performed:

Jul 25, 2018

Test Standard:

- FCC Title 47 CFR Part 15: Subpart C - §15.247 (d)

Test Method:

- ANSI C63.10:2013

Test Requirement: In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20dB.

Test Setup:

The antenna port of EUT was directly connected to a spectrum analyzer.

Measurement Method:

The measurement method used for both radios was Section 6.10.6.2 Marker-delta Method of ANSI C63.10-2013 standard.

Modifications:

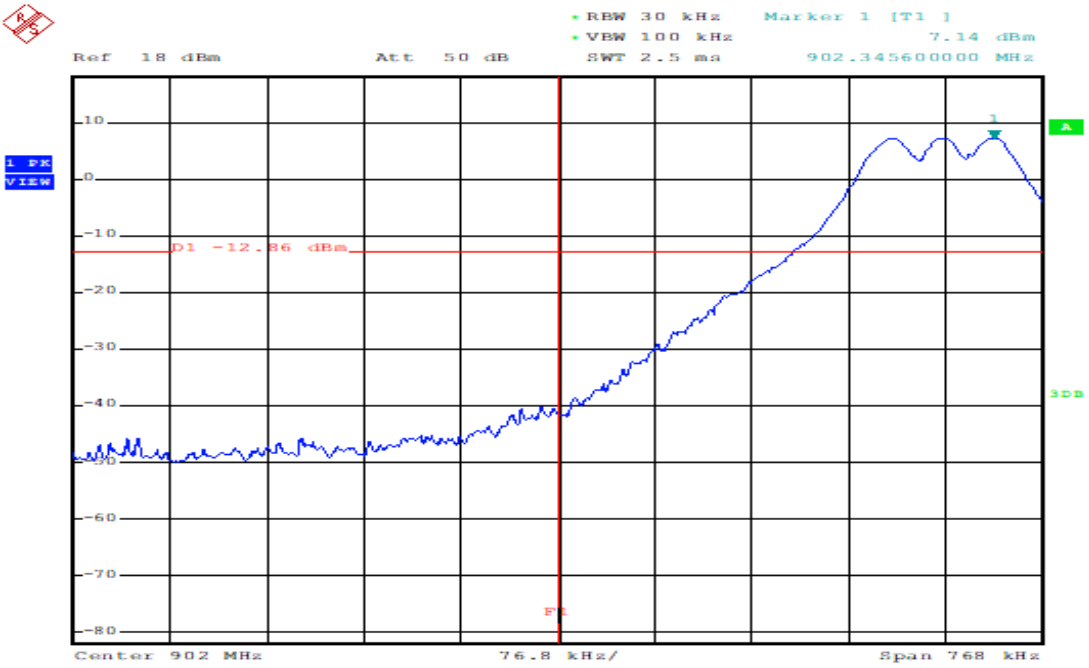
No modification was required to comply for this test.

Result:

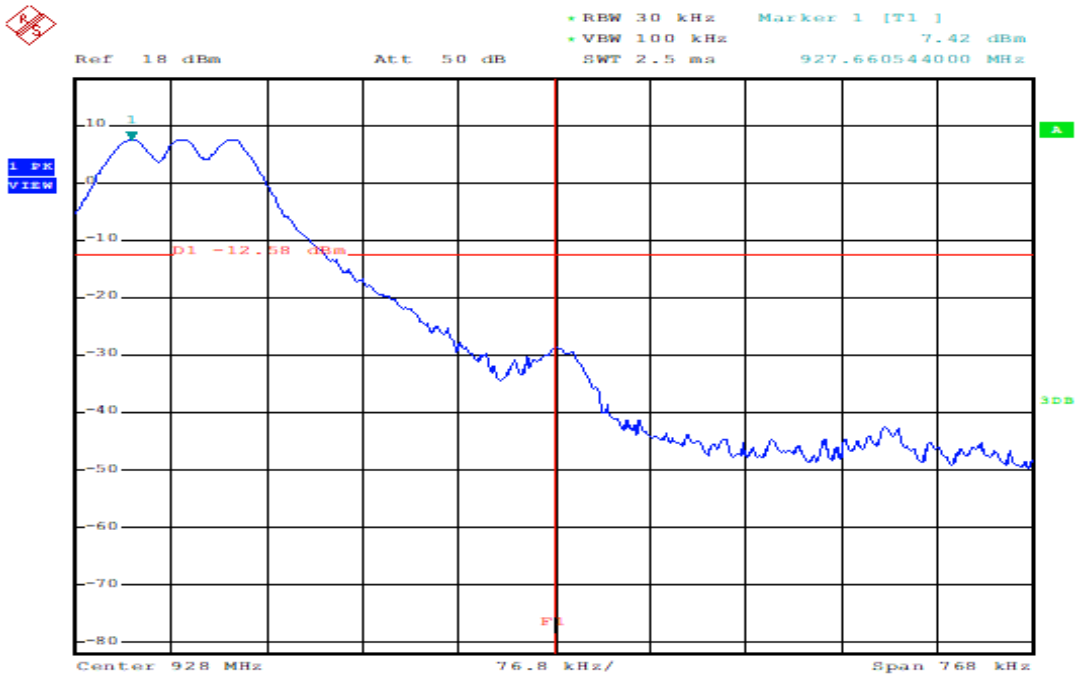
The EUT complies with the applicable standard.

Measurement Data and Plot:

Low Data Rate

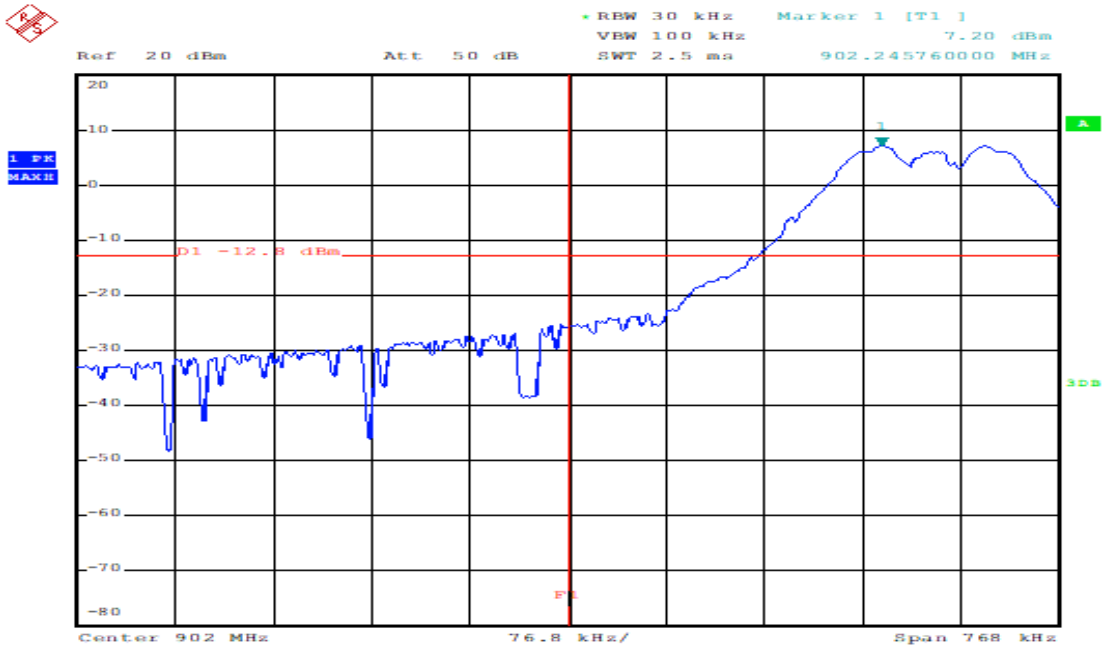


Plot 7: Band Edge Plot (Low Channel ~902.3MHz)

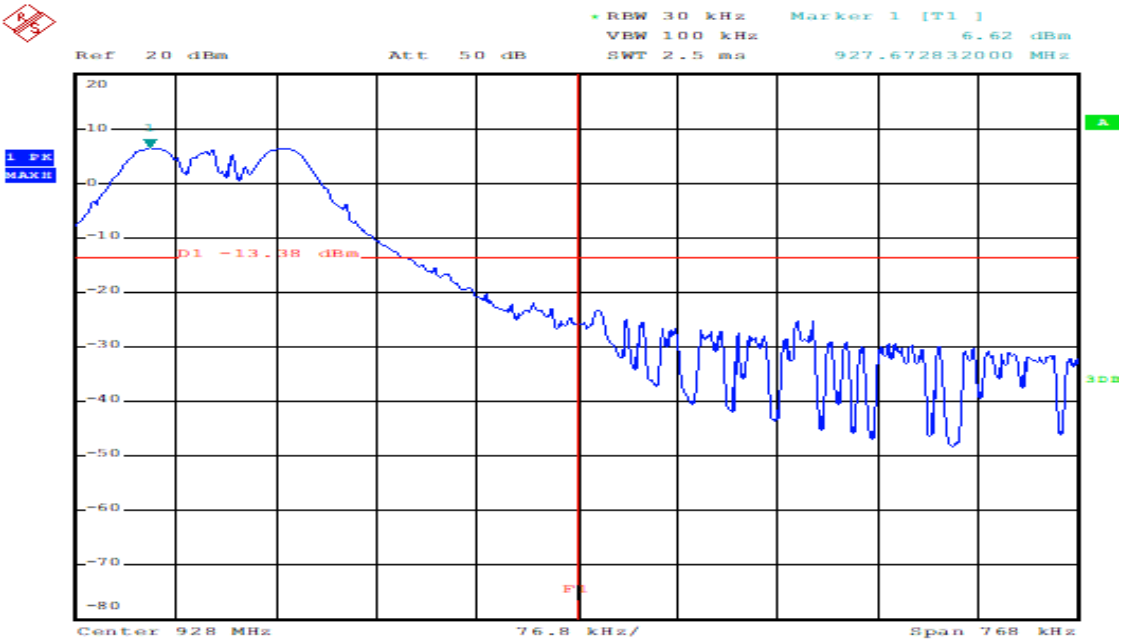


Plot 8: Band Edge Plot (High Channel ~927.7MHz)

High Data Rate

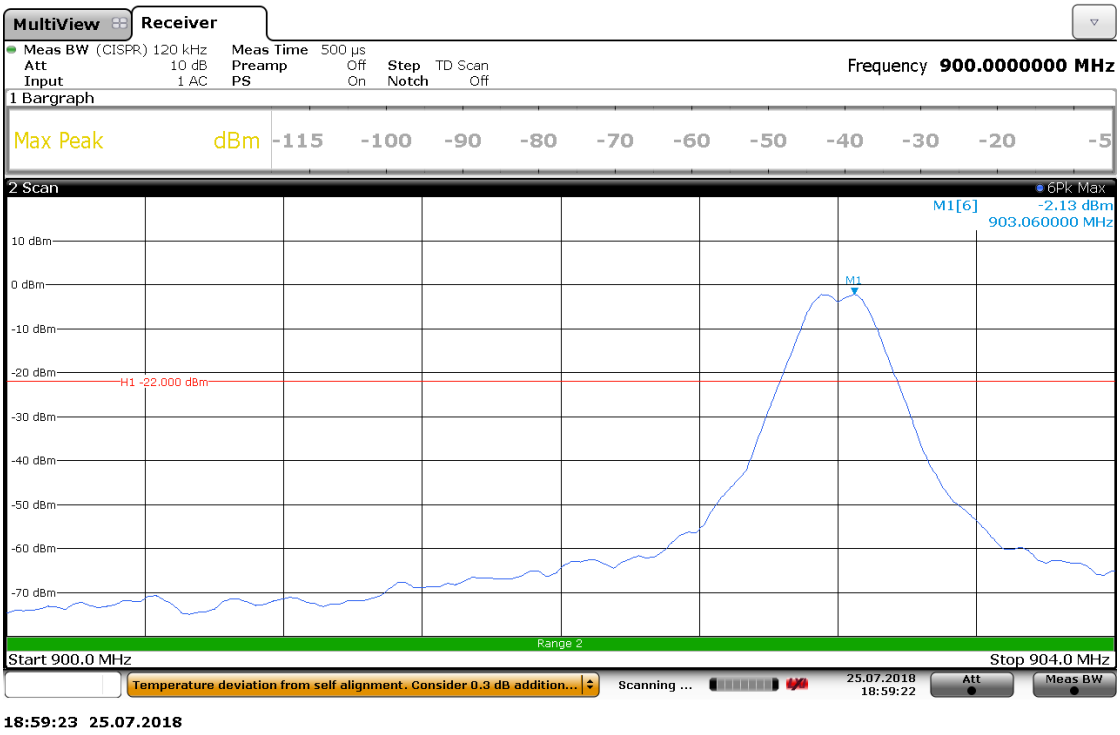


Plot 9: Band Edge Plot (Low Channel ~902.2MHz)



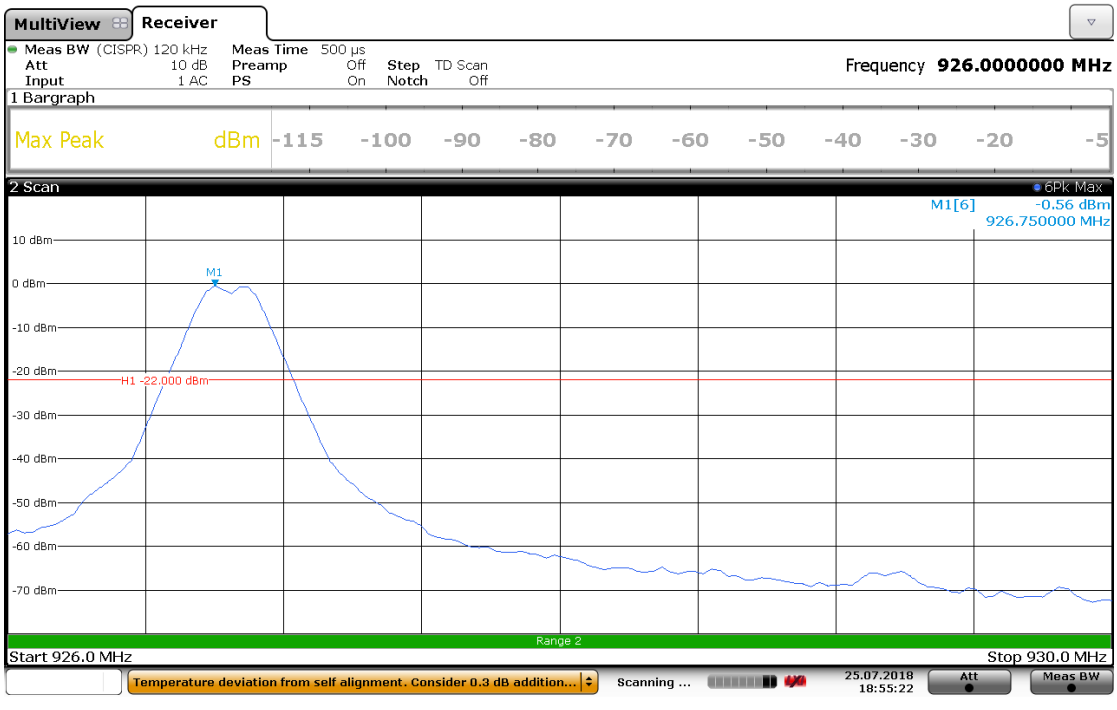
Plot 10: Band Edge Plot (High Channel ~927.7MHz)

Data rate for communication to approved Part 15 device (3rd Party Mode)



18:59:23 25.07.2018

Plot 11: Band Edge Plot (Low Channel ~903MHz)



18:55:22 25.07.2018

Plot 12: Band Edge Plot (High Channel ~926.8MHz)

3.5 Channel Separation

Date Performed: Jul 26, 2018

Test Standard: FCC Title 47 CFR Part 15: Subpart C - §15.247 (a)(1)(i)

Test Method: ANSI C63.10:2013

Test Requirement: For 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Setup: The antenna port of EUT was directly connected to a spectrum analyzer.

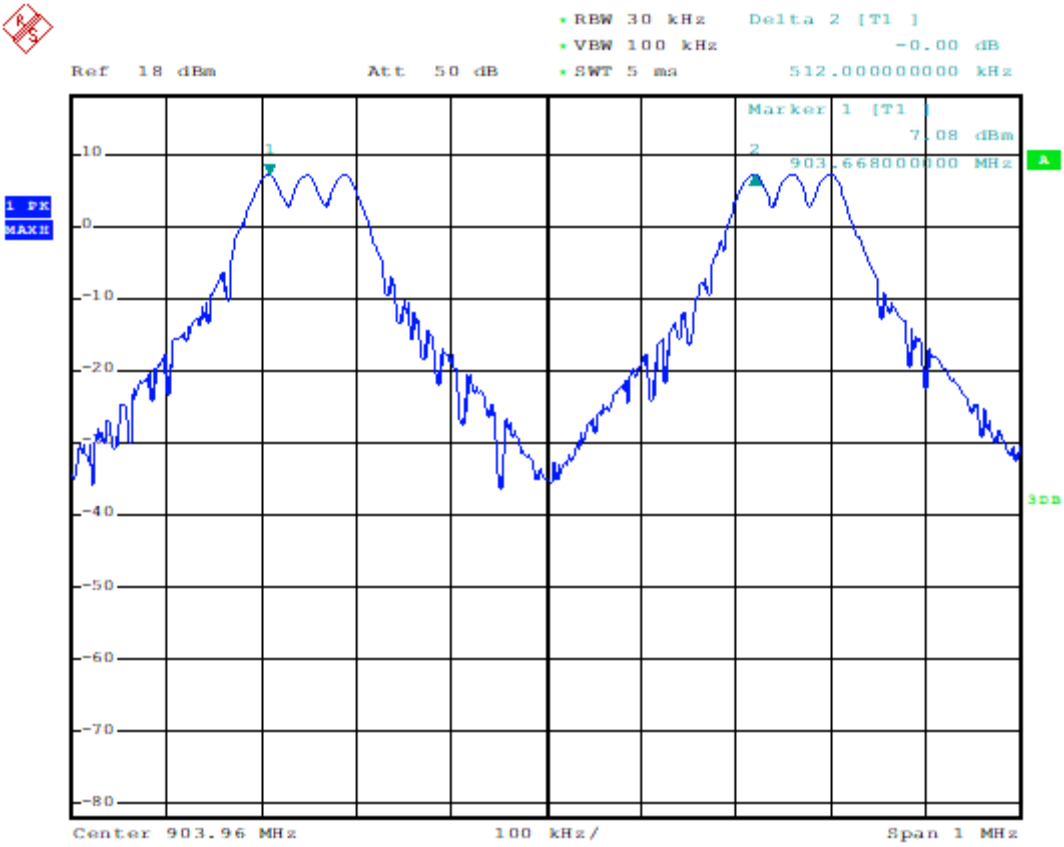
Measurement Method: As called in ANSI C63.10-2013.

Modifications: No modification was required to comply for this test.

Result: The EUT complies with the applicable standard.

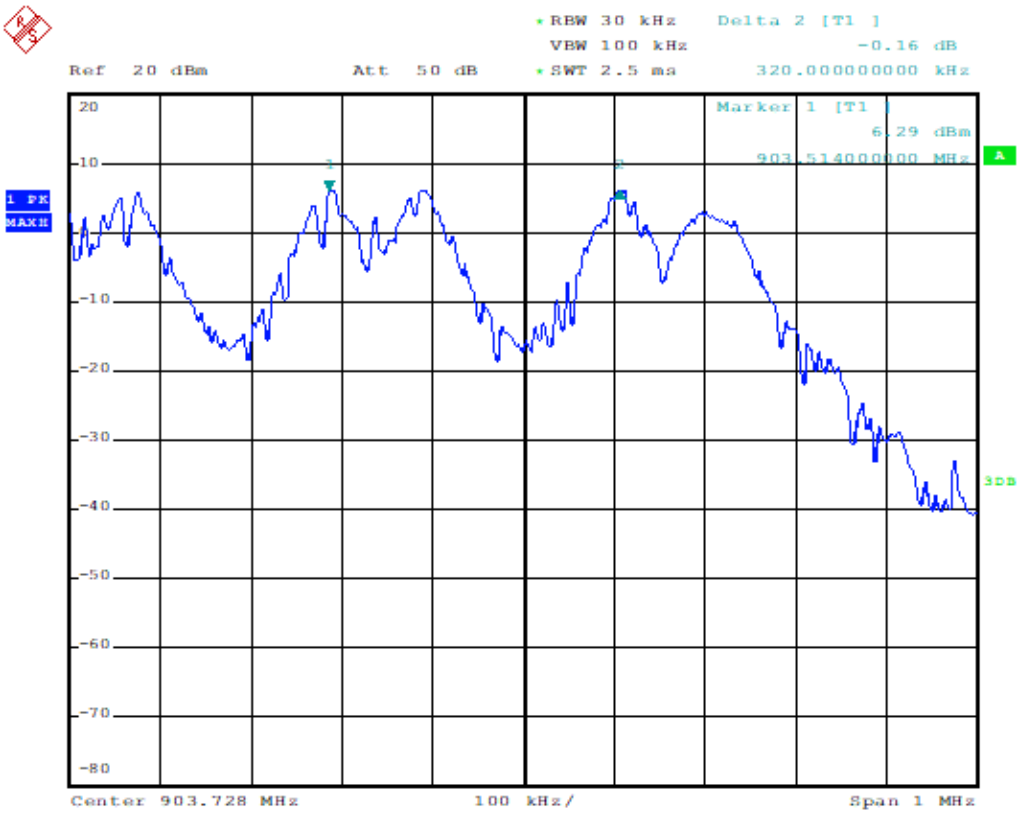
Measurement Data and Plot:

Low Data Rate



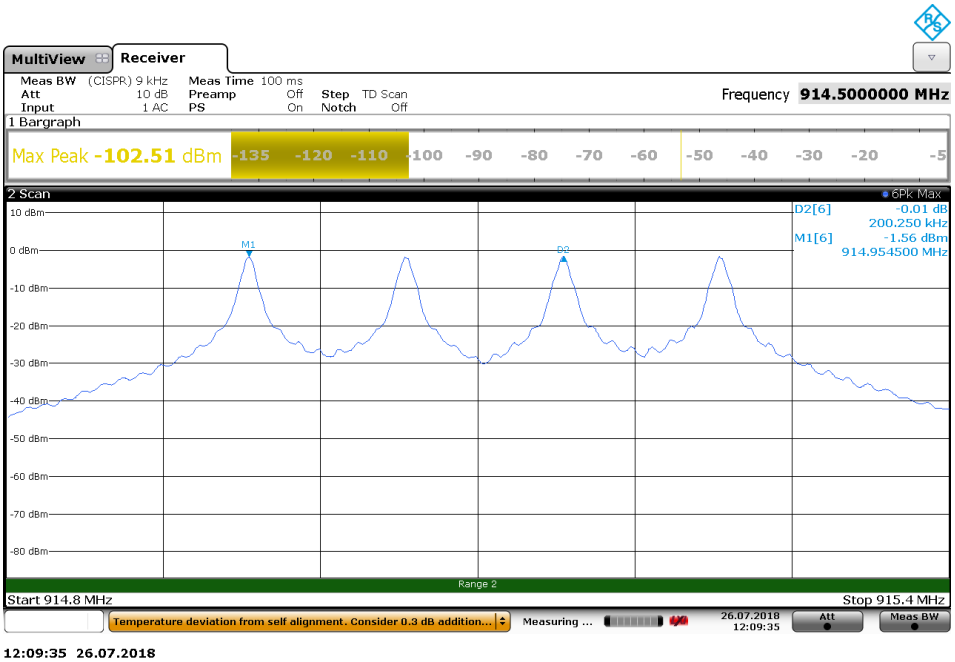
Plot 13: Channel Separation → 254.8 kHz

High Data Rate



Plot 14: Channel Separation → 321.2 kHz

Data rate for communication to approved Part 15 device (3rd Party Mode)



Plot 15: Channel Separation → 202.50 kHz

3.6 Number of Hopping Channels

Date Performed:

Jul 26, 2018

Test Standard:

- FCC Title 47 CFR Part 15: Subpart C - §15.247 (a)(1)(i)

Test Method:

- ANSI C63.10:2013

Test Requirement:

For FHSs in the band 902-928 MHz: if the 20dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

Test Setup:

The antenna port of EUT was directly connected to a spectrum analyzer.

Measurement Method:

As called in ANSI C63.10-2013.

Modifications:

No modification was required to comply for this test.

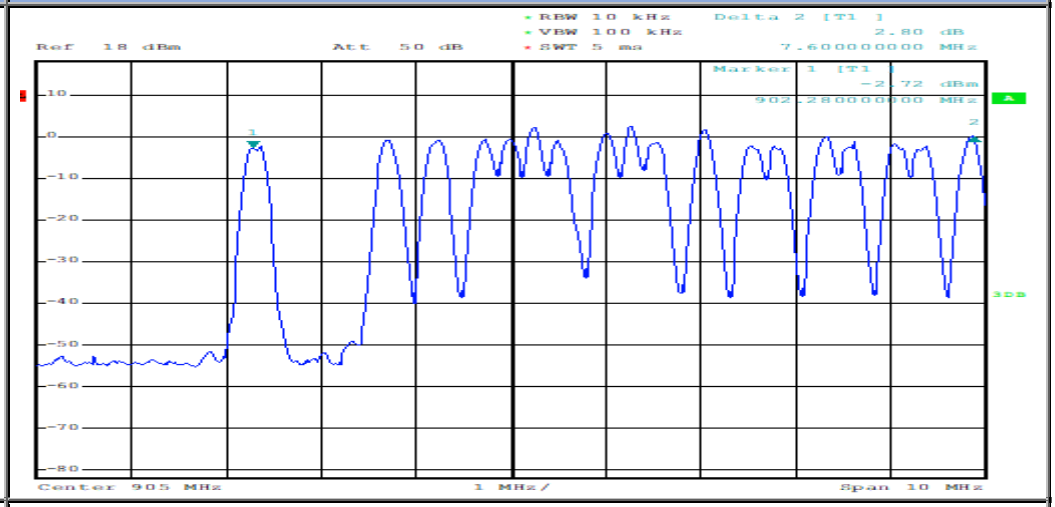
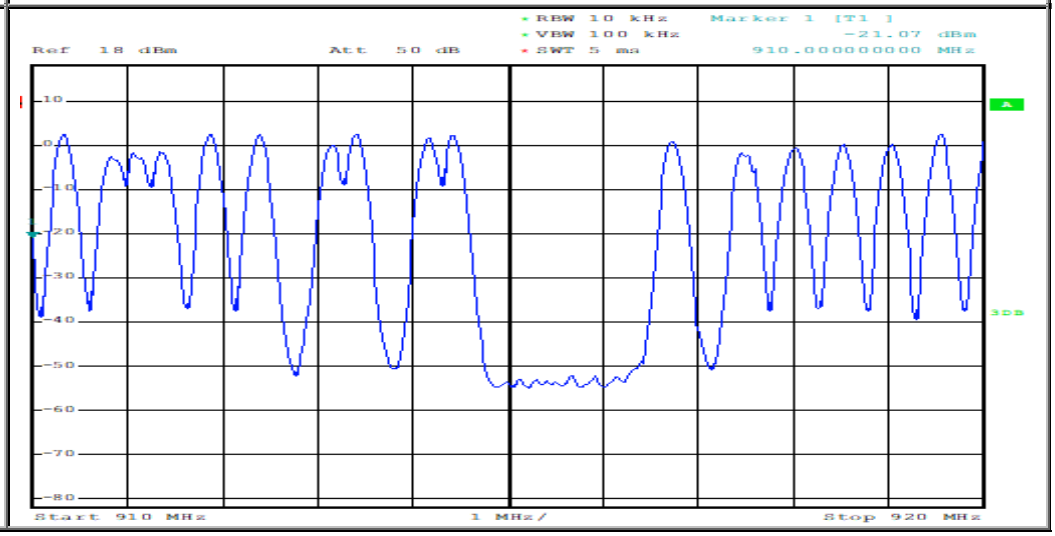
Result:

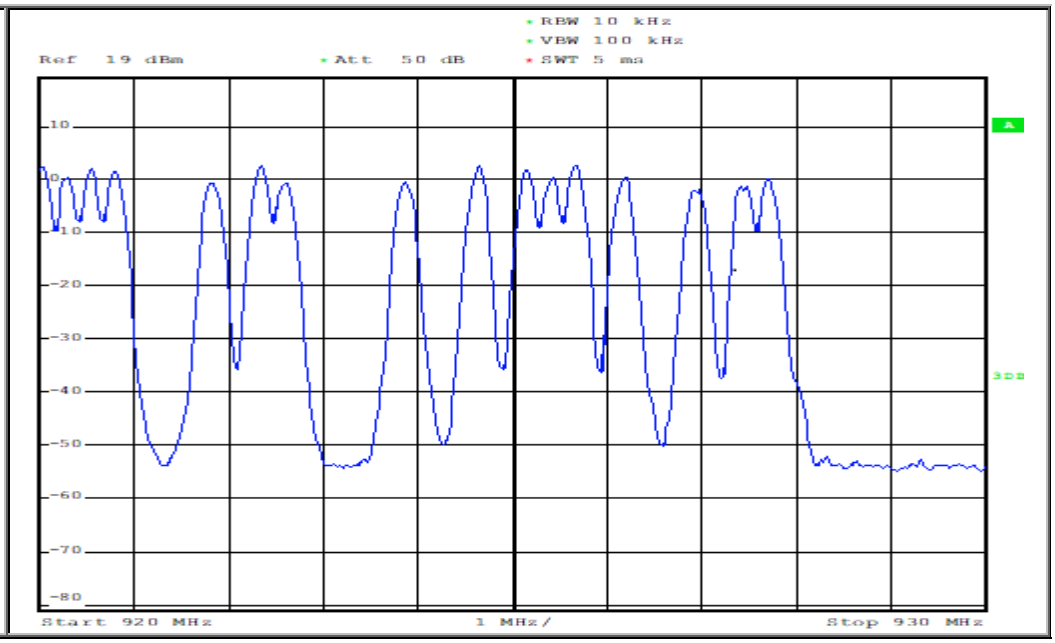
The EUT complies with the applicable standard.

Data Rate	Frequency Range	Number of Hopping Frequencies
Low Data Rate	902MHz to 910MHz	18
	910MHz to 920MHz	16
	920MHz to 930MHz	16
High Data Rate	902MHz to 910MHz	17
	910MHz to 920MHz	19
	920MHz to 930MHz	14
Data rate for communication to approved Part 15 device	902MHz to 905MHz	10
	905MHz to 908MHz	9
	908MHz to 911MHz	10
	911MHz to 914MHz	12
	914MHz to 917MHz	10
	917MHz to 920MHz	15
	920MHz to 923MHz	15
	923MHz to 926MHz	11
	926MHz to 928MHz	4

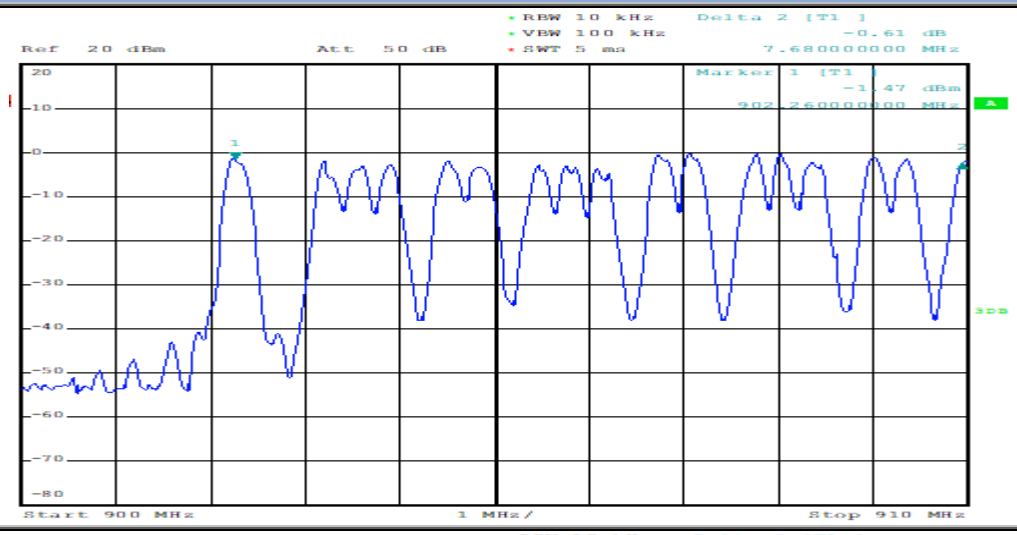
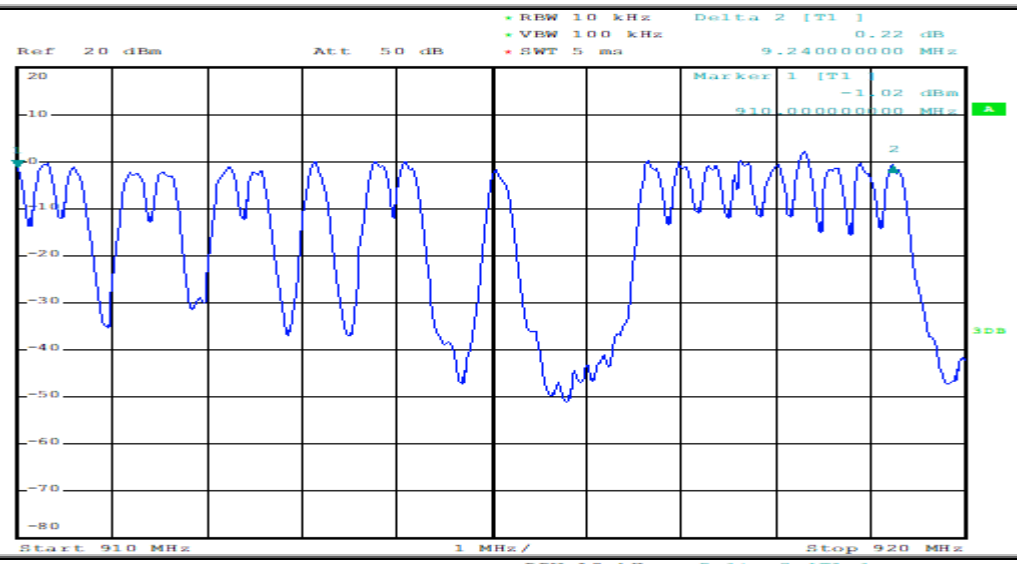
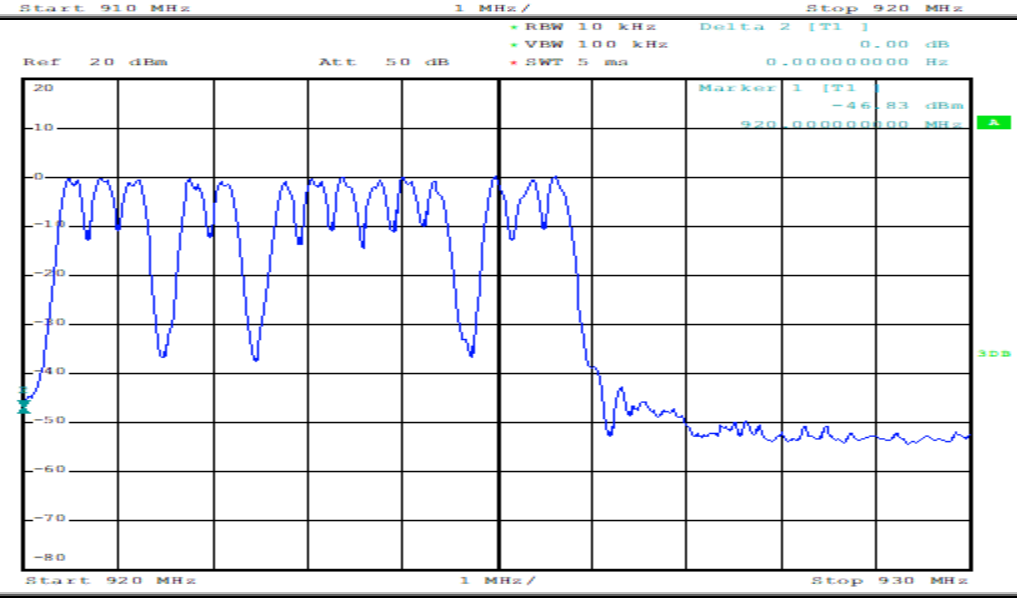
Measurement Data and Plot:

Low Data Rate

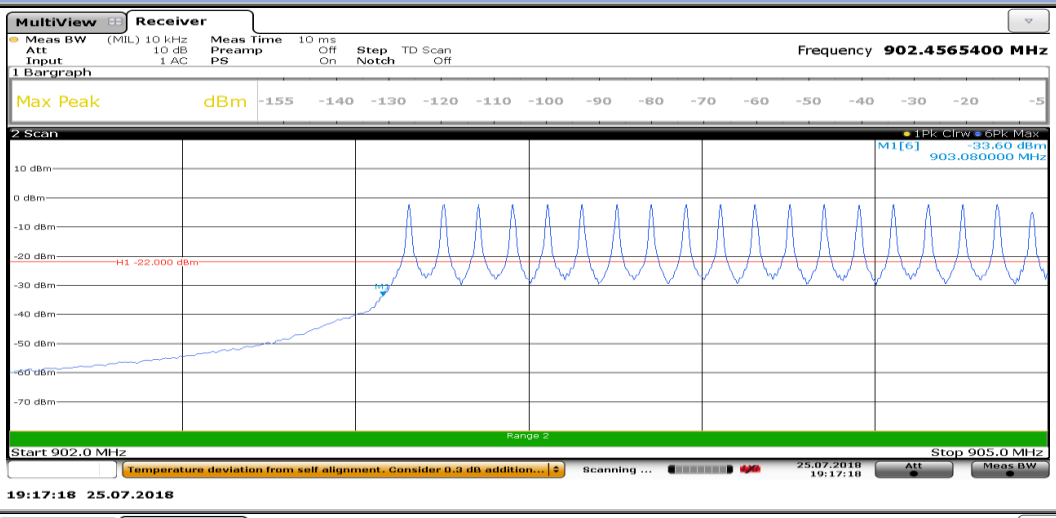
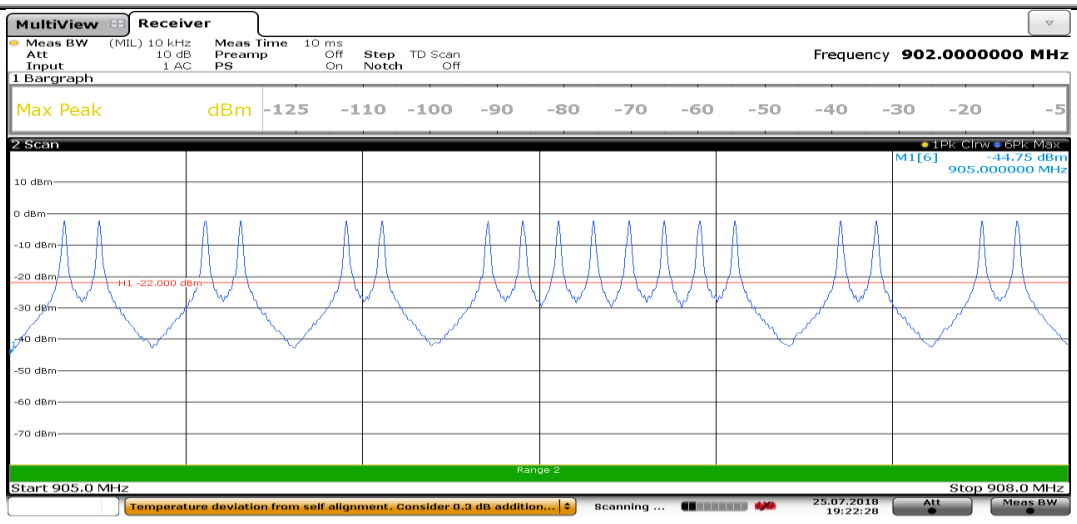
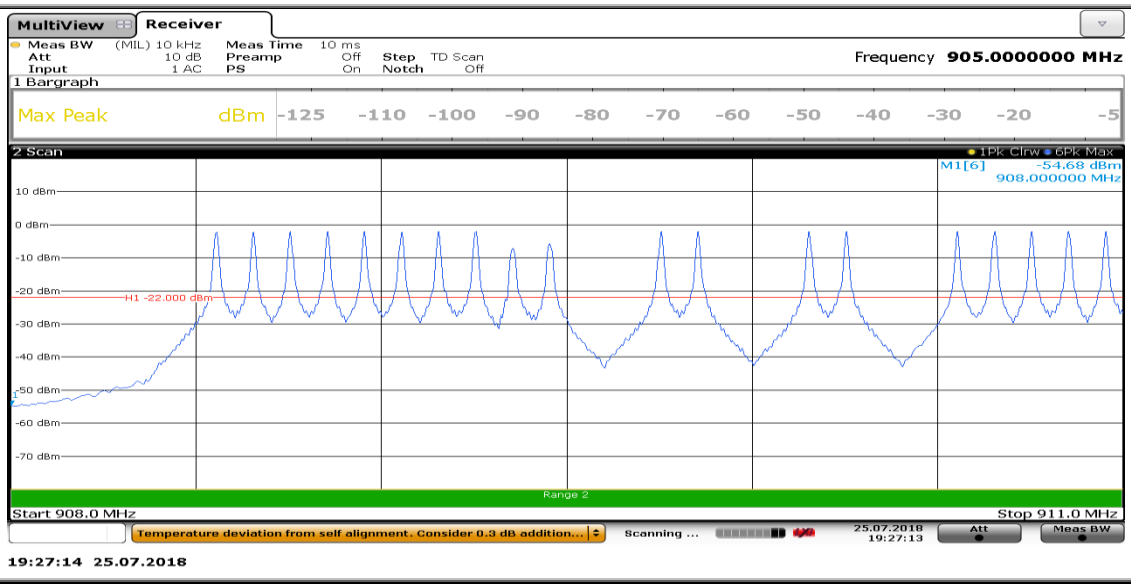
Number of Hopping Channels	Plot
902MHz to 908MHz ~18 frequencies	
908MHz to 915MHz ~16 frequencies	

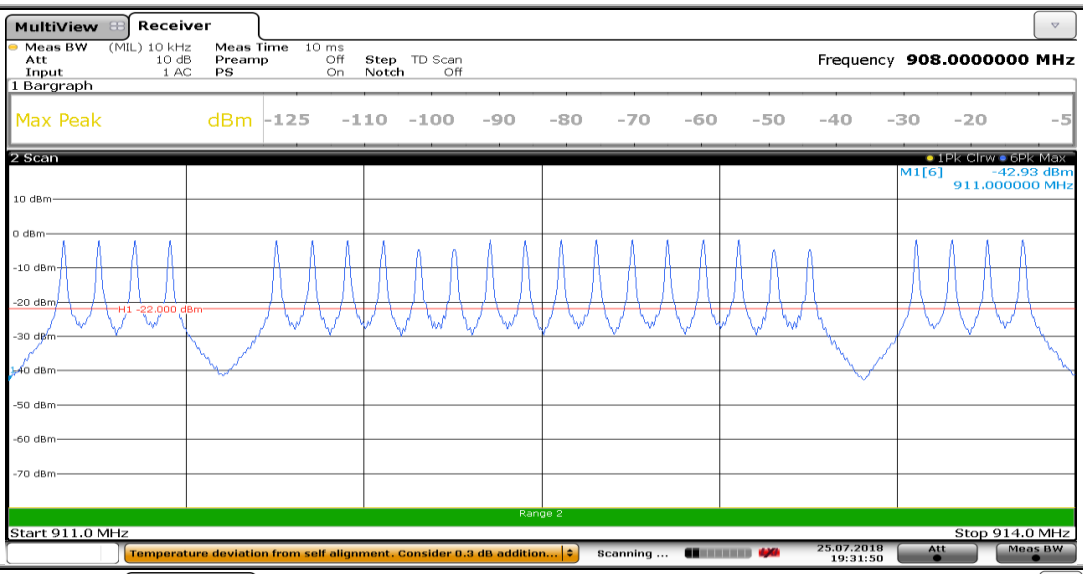
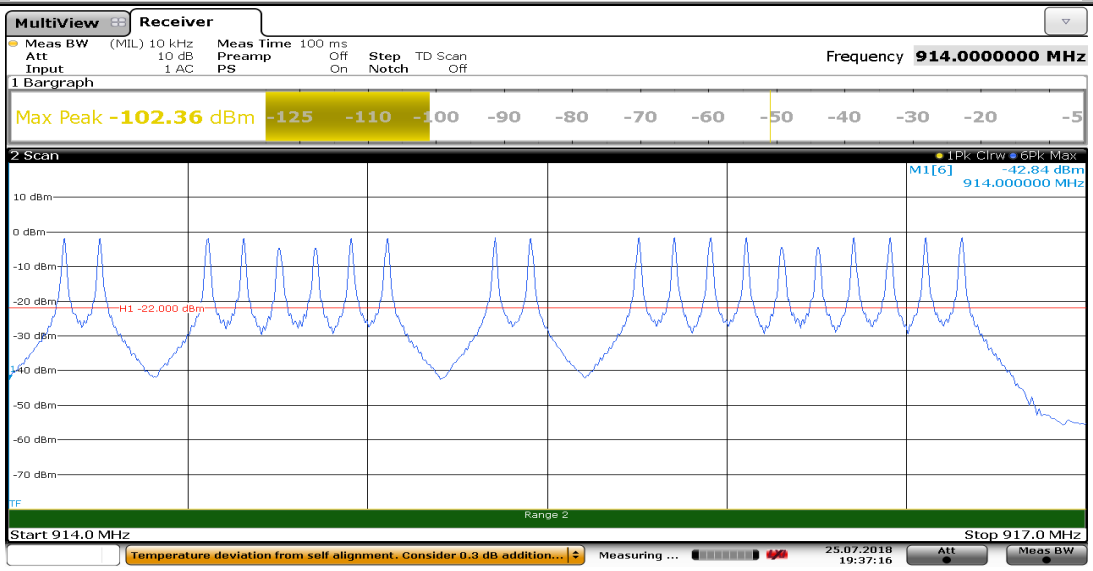
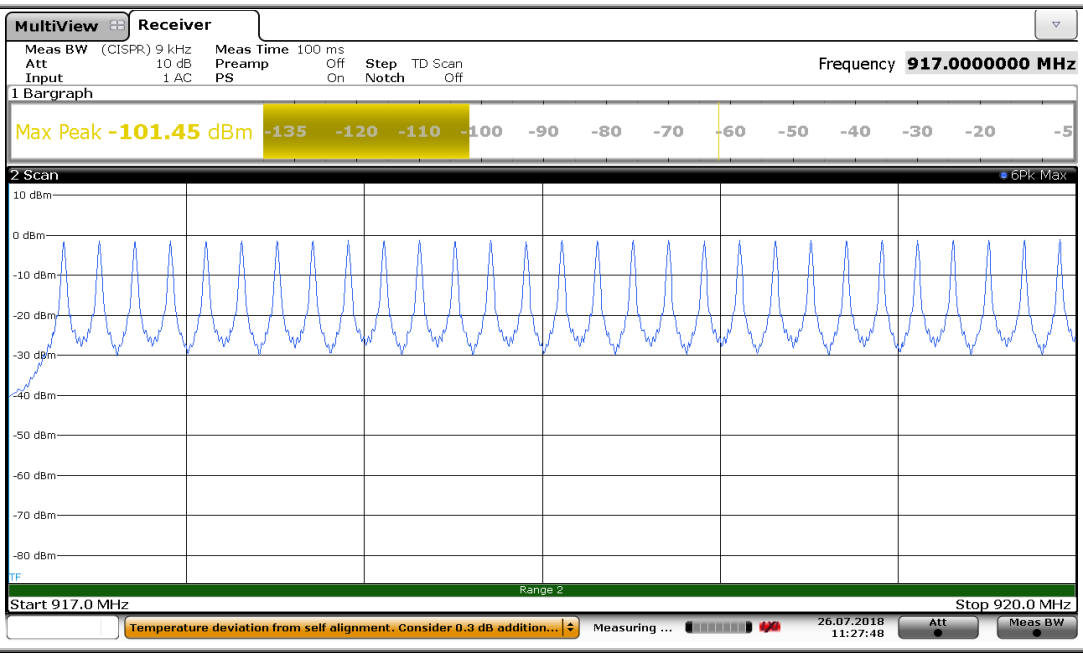
915MHz to 921MHz ~16 frequencies	

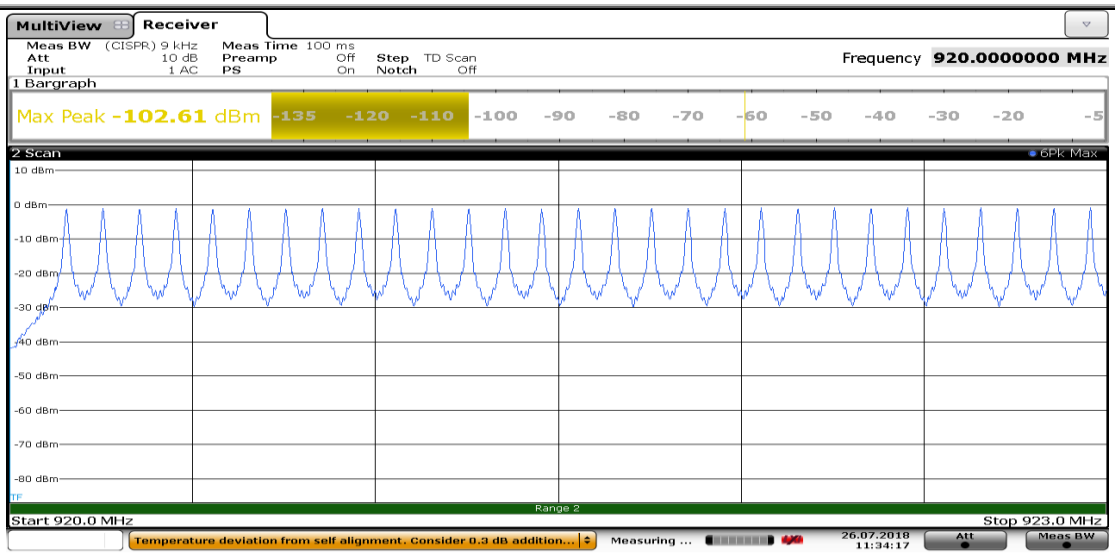
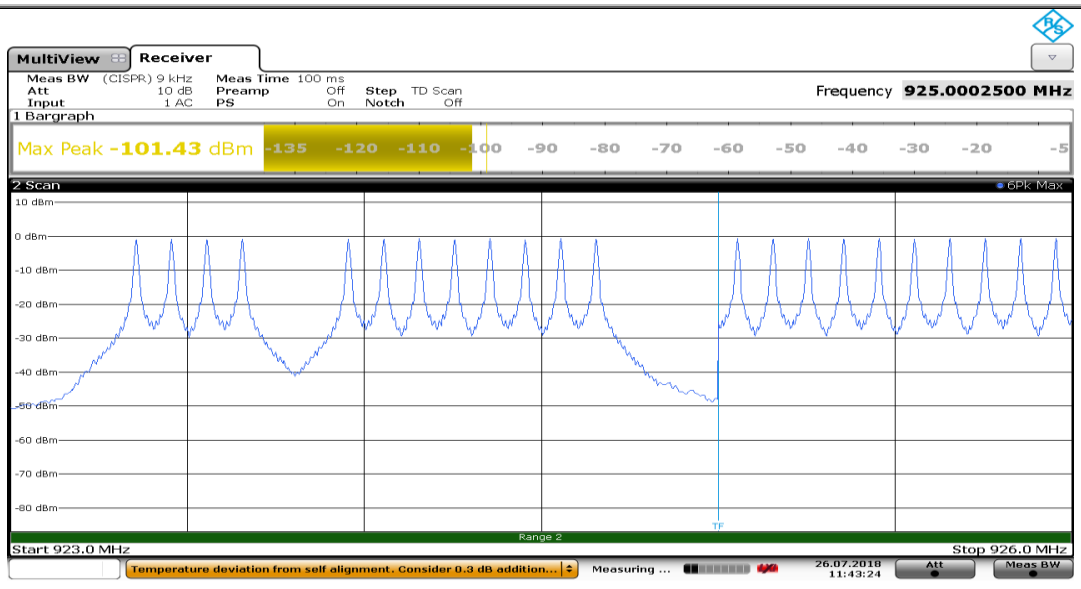
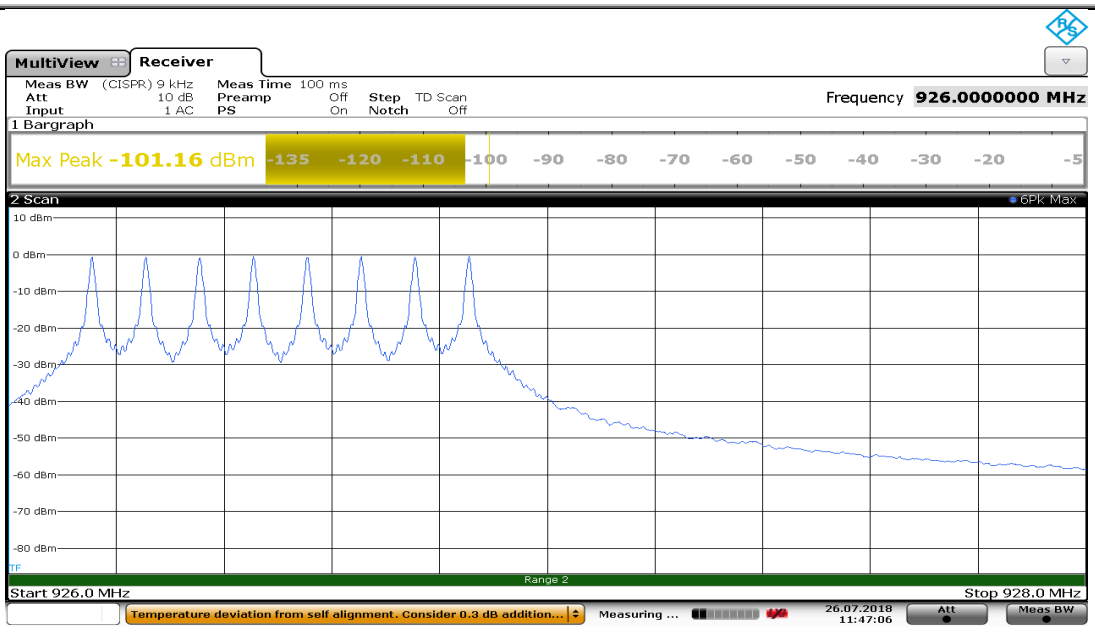
High Data Rate

Number of Hopping Channels	Plot
902MHz to 908MHz ~17 frequencies	
908MHz to 915MHz ~19 frequencies	
915MHz to 921MHz ~14 frequencies	

Data rate for communication to approved Part 15 device (3rd Party Mode)

Number of Hopping Channels	Plot
902MHz to 905MHz ~10 frequencies	
905MHz to 908MHz ~9 frequencies	
908MHz to 911MHz ~10 frequencies	

911MHz to 914MHz ~12 frequencies	
914MHz to 917MHz ~10 frequencies	
917MHz to 920MHz ~15 frequencies	

920MHz to 923MHz ~15 frequencies	
923MHz to 926MHz ~11 frequencies	
926MHz to 928MHz ~ 4 frequencies	

3.7 Dwell Time and Time Occupancy Per Frequency

Date Performed:

Jul 26, 2018

Test Standard:

- FCC Title 47 CFR Part 15: Subpart C - §15.247 (a)(1)(i)

Test Method:

- ANSI C63.10:2013

Test Requirement:

For FHSs in the band 902-928 MHz: if the 20dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

Test Setup:

The antenna port of EUT was directly connected to a spectrum analyzer.

Measurement Method:

As called in ANSI C63.10-2013.

Modifications:

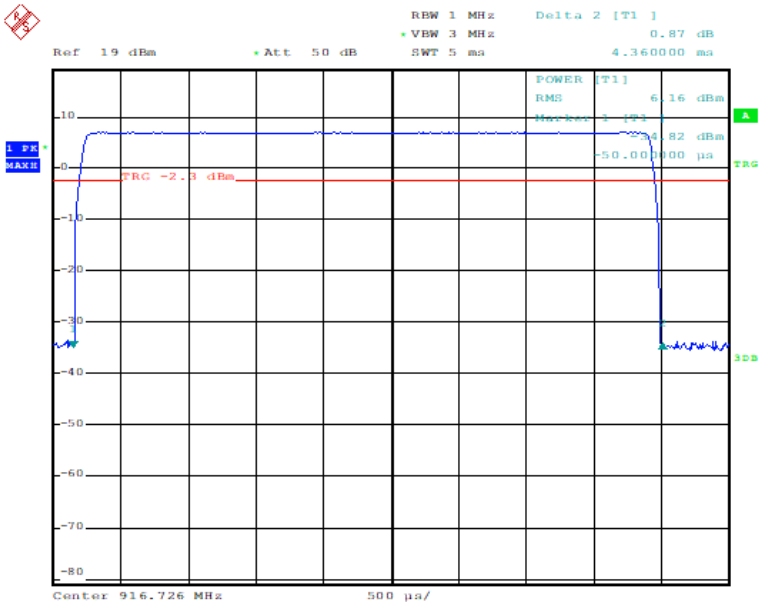
No modification was required to comply for this test.

Result:

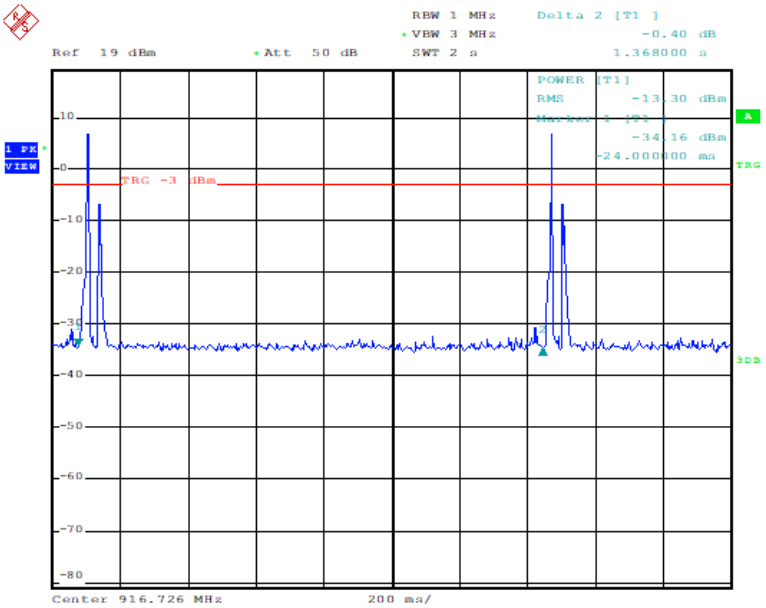
The EUT complies with the applicable standard.

Measurement Data and Plot:

Low Data Rate



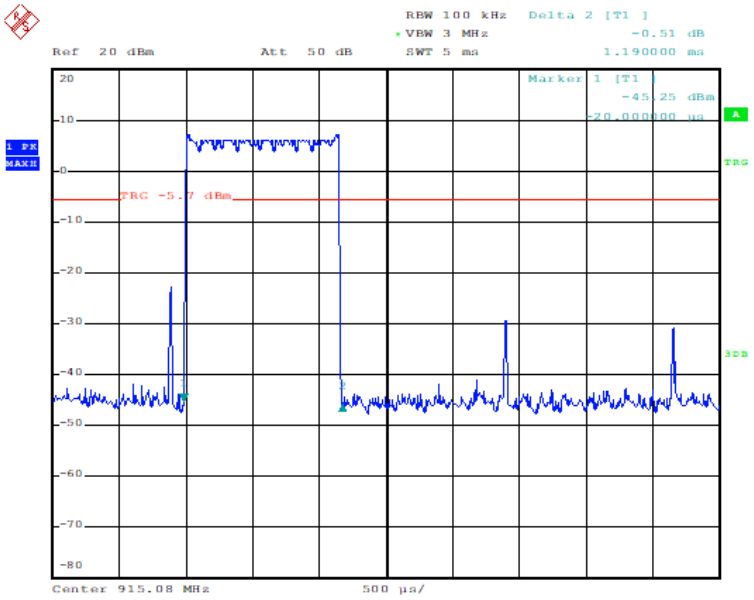
Plot 16: Dwell Time → 4.36ms



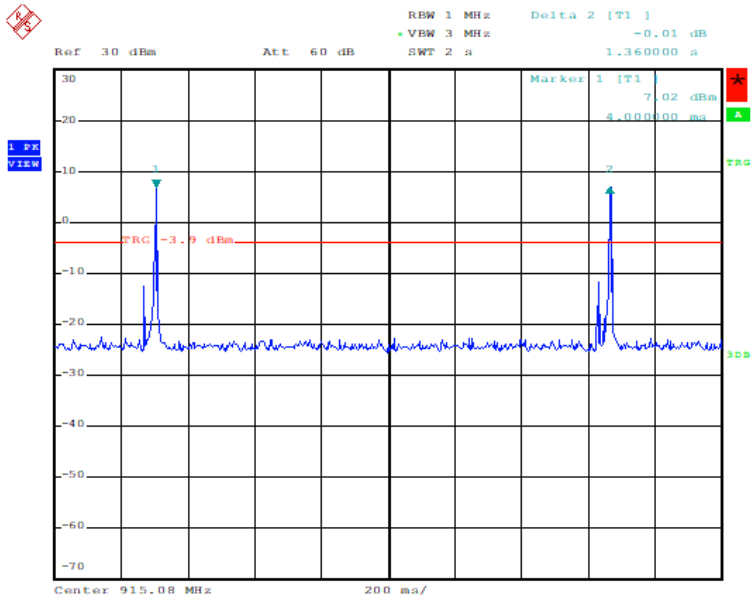
Plot 17: Time Between 2 Frequency → 1.368s

Time between 2 consecutive transmissions on the same frequency is 1.368s
Dwell time per frequency is 4.36ms
Therefore, **Time Occupancy per Frequency**, within 20 seconds' period, is $\frac{0.00436s \times 20s}{1.368s} = \mathbf{63.74}\boldsymbol{ms}$

High Data Rate



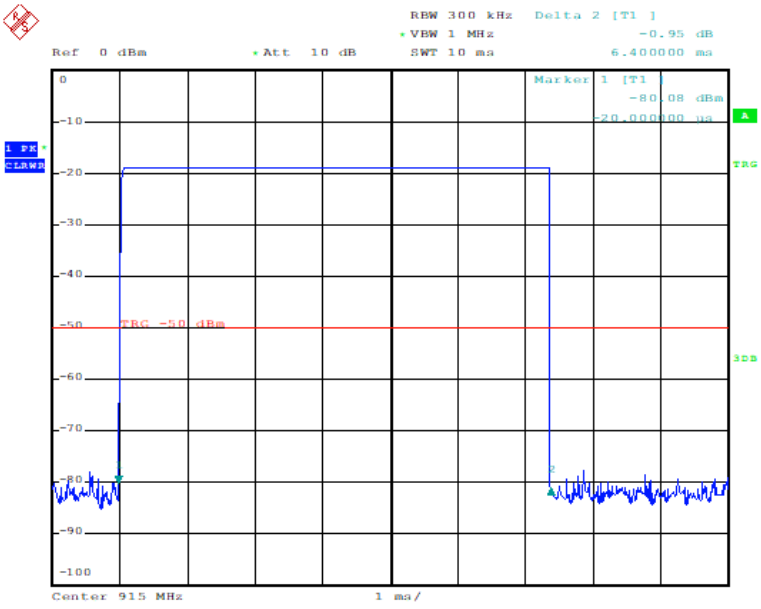
Plot 18: Dwell Time → 1.19ms



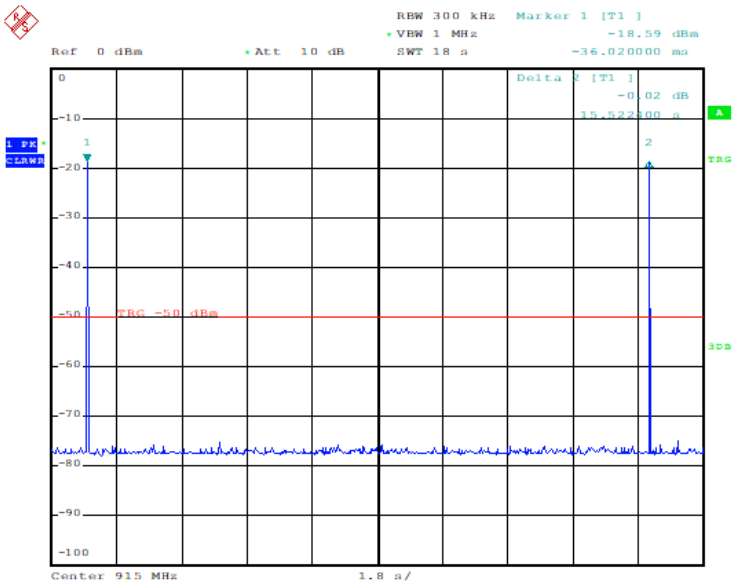
Plot 19: Time Between 2 Frequency → 1.36s

Time between 2 consecutive transmissions on the same frequency is 1.36s
Dwell time per frequency is 1.19ms
Therefore, **Time Occupancy per Frequency**, within 20 seconds period is $\frac{0.00119s \times 20s}{1.36s} = \mathbf{17.5}\boldsymbol{ms}$

Data rate for communication to approved Part 15 device (3rd Party Mode)



Plot 20: Dwell Time → 6.40ms



Plot 21: Time Between 2 Frequency → 36.02ms

There are 120 channels in the pseudo random sequence when EUT is communicating to OEM Part 15 approved device, therefore, next same channel will be used is in 120s
Dwell time per frequency is 6.40ms
Therefore, **Time Occupancy per Frequency**, within 20 seconds' period is $\frac{0.00640s \times 20s}{120s} = \mathbf{1.066}\boldsymbol{ms}$

3.8 Intentional Spurious Emissions

Date Performed: Jul 26, 2018

Test Standard: FCC Title 47 CFR Part 15: Subpart C - §15.209
- FCC Title 47 CFR Part 15: Subpart C - §15.205

Test Method: ANSI C63.10-2013

Required Limit(s): The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Frequency, *f* (MHz)	Field strength (dBµV/m)
0.009 – 0.490	(20*log(2400/*f* (kHz))) + 40 dB
0.490 – 1.705	(20*log(24000/*f* (kHz))) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0

Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
Note 2: The emissions limits shown in the above table are based on measurements employing a 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.

Unwanted emissions that fall into the restricted bands specified on the table below shall comply with the limits specified on the table limits above as per §15.209 and Clause 8.9 of RSS-Gen.

FCC Restricted Bands:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

Method of Measurement:

The EUT was tested in our 3 m SAC and was positioned on the center of the turntable. The transmitter was set for continuous transmission. The operating frequency of the device was measured for all radiated emissions 10 kHz to 4 GHz up to the 10th harmonic of the highest fundamental frequency. The EUT was pre-scanned in 3 different orthogonal orientations and was found to radiate highest when placed flat on the table top as indicated in the test photos.

Modifications: No modification was required to comply for this test.

Result: The EUT complies with the applicable standard.

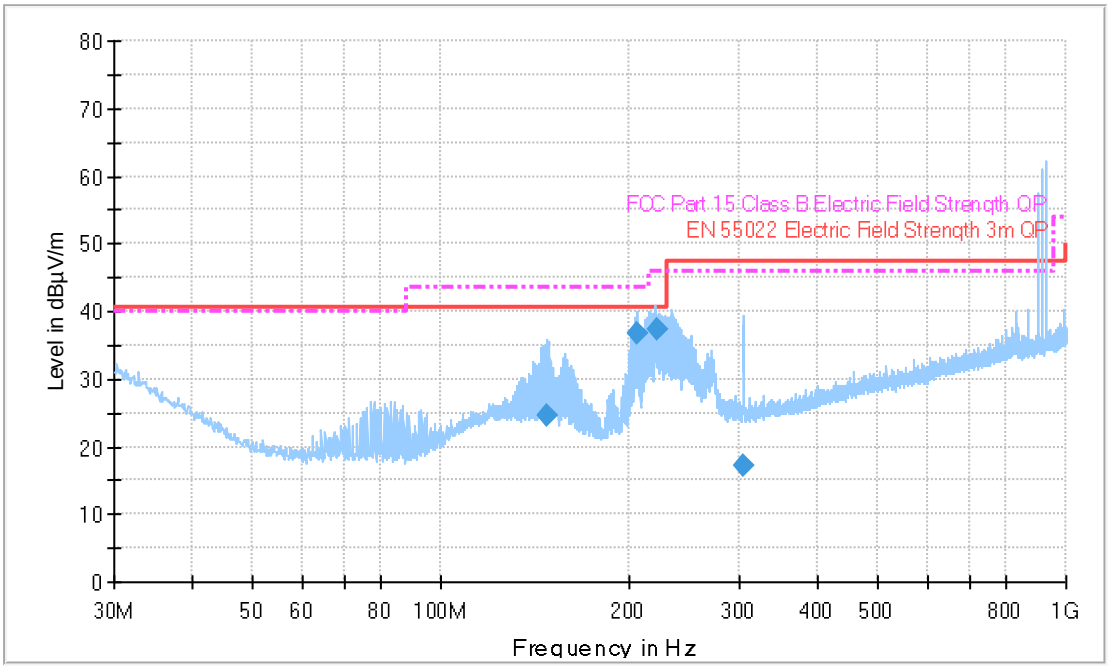
Data/Plot:

Test Mode/Configuration/Operation:

- TX Mode

Frequency Range:

- 30 MHz ↔ 1000 MHz



Plot 22: Radiated Emissions (below 1GHz) scanned at 3m SAC

Table 6: Intentional radiated spurious emissions measurement data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
150.712500	27.9	1000.000	120.000	100.0	V	360.0	19.7	15.6	43.5
205.303200	36.7	1000.000	120.000	100.0	V	26.6	19.1	6.8	43.5
220.203200	38.1	1000.000	120.000	100.0	V	1.0	18.4	7.9	46.0
304.150700	18.0	1000.000	120.000	100.0	V	319.4	20.9	28	46.0

Note: Frequencies around the 900 MHz band are fundamental frequencies of the radio device and the limits specified on this section do not apply. Only harmonics and spurious emissions while the device is on transmit mode are measured on this section.

Table 7: Fundamental frequency measurements data

Channel	Freq. (MHz)	Raw Peak (dBµV)	Pol (V/ H)	Turn Tbl. (deg)	Ant. Ht. (cm)	Ant. Fact. (dBµV)	Cable Loss (dB)	Atten. (dB)	Corr. Peak (dBµV)
Low	902.17	93.5	H	200	100	22.2	9.55	0	125.3
	902.17	85.8	V	0	100	22.35	9.55	0	117.7
Middle	915.01	96.8	H	210	100	22.5	9.55	0	128.9
	915.01	90.0	V	0	100	22.2	9.55	0	121.8
High	927.83	97.8	H	180	100	22.35	9.55	0	129.7
	927.83	89.8	V	0	100	22.5	9.55	0	121.9

Note: Corr. Peak Measurements above are used as limits that do not fall into the Restricted Bands on the measurements data below.

Table 8: Harmonics spurious emissions measurement data – Operating Frequency: 902 MHz

Freq.	Raw PK	Antenna Factor	System Gain	Corr. Peak	Duty Cycle Factor	Corr. Average	Peak Limit	Peak Margin	Average Limit	Average Margin	Polar
MHz	dBuv/m	dB/m	dB	dBuv/m	dB	dBuv/m	dBµV/m	dB	dBµV/m	dB	
1804.34	91.5	30	31.04	90.46	28	62.46	105.3	14.84	85.3	22.84	H
1804.34	88.7	30	31.04	87.66	28	59.66	105.3	17.64	85.3	25.64	V
2706.51	70.3	32.8	29.13	73.97	28	45.97	74	0.03	54	8.03	H
2706.51	68	32.8	29.13	71.67	28	43.67	74	2.33	54	10.33	V
3608.68	57	33.1	26.66	63.44	28	35.44	74	10.56	54	18.56	H
3608.68	59.3	33.1	26.66	65.74	28	37.74	74	8.26	54	16.26	V
4510.85	59.1	34	25.21	67.89	28	39.89	74	6.11	54	14.11	H
4510.85	60	34	25.21	68.79	28	40.79	74	5.21	54	13.21	V
5413.02	50.3	34.4	20.82	63.88	28	35.88	74	10.12	54	18.12	H
5413.02	50.5	34.4	20.82	64.08	28	36.08	74	9.92	54	17.92	V

Table 9: Harmonics spurious emissions measurement data – Operating Frequency: 915 MHz

Freq.	Raw PK	Antenna Factor	System Gain	Corr. Peak	Duty Cycle Factor	Corr. Average	Peak Limit	Peak Margin	Average Limit	Average Margin	Polar
MHz	dBuv/m	dB/m	dB	dBuv/m	dB	dBuv/m	dBµV/m	dB	dBµV/m	dB	
2745.042	69	32.8	29.13	72.67	28	44.67	74	1.33	54	9.33	H
2745.042	67.5	32.8	29.13	71.17	28	43.17	74	2.83	54	10.83	V
3660.056	61.7	33.1	26.66	68.14	28	40.14	74	5.86	54	13.86	H
3660.056	60.8	33.1	26.66	67.24	28	39.24	74	6.76	54	14.76	V
4575.07	54	34	25.21	62.79	28	34.79	74	11.21	54	19.21	H
4575.07	58	34	25.21	66.79	28	38.79	74	7.21	54	15.21	V
7320.112	58.6	35.5	20.31	73.79	28	45.79	74	0.21	54	8.21	H
7320.112	52.6	35.5	20.31	67.79	28	39.79	74	6.21	54	14.21	V

Table 10: Harmonics spurious emissions measurement data – Operating Frequency: 928 MHz

Freq.	Raw PK	Antenna Factor	System Gain	Corr. Peak	Duty Cycle Factor	Corr. Average	Peak Limit	Peak Margin	Average Limit	Average Margin	Polar
MHz	dBuv/m	dB/m	dB	dBuv/m	dB	dBuv/m	dBµV/m	dB	dBµV/m	dB	
2783.49	62.3	32.8	29.13	65.97	28	37.97	74	8.03	54	16.03	H
2783.49	61.5	32.8	29.13	65.17	28	37.17	74	8.83	54	16.83	V
3711.32	59	33.1	26.66	65.44	28	37.44	74	8.56	54	16.56	H
3711.32	58.5	33.1	26.66	64.94	28	36.94	74	9.06	54	17.06	V
4639.15	56	34	25.21	64.79	28	36.79	74	9.21	54	17.21	H
4639.15	58	34	25.21	66.79	28	38.79	74	7.21	54	15.21	V
7422.64	58.1	35.5	20.31	73.29	28	45.29	74	0.71	54	8.71	H
7422.64	54.5	35.5	20.31	69.69	28	41.69	74	4.31	54	12.31	V

Note: Data measured above 1 GHz were manually measured therefore no plots generated.

3.9 Unintentional Radiated Emissions

Date Performed:

Jul 19, 2018

Test Standard:

- FCC Title 47 CFR Part 15: Subpart B - §15.109

Test Method:

- ANSI C63.4-2014

Test Requirement:

The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency, *f* (MHz)	Field strength (dBµV/m)
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.	
Note 2: The emissions limits shown in the above table are based on measurements employing a 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.	

Method of Measurement:

The EUT was positioned in the center of the turntable in the SAC. The EUT was then measured for all the radiated emissions in the frequency range of 30MHz – 1GHz. Measurements were made using the spectrum analyzer and receiver using the appropriate antennas, amplifiers, attenuators, and filters.

The required Quasi-Peak CISPR bandwidth shall be 120 kHz for the range 30 – 1000 MHz. A 1 MHz Resolution Bandwidth (RBW, CISPR Band E) shall be used and a 10 Hz Video Bandwidth (VBW). The ANSI C63.4:2014 requirement for the placement of RF Absorber on the turntable Ground Plane shall be satisfied.

Emissions in both horizontal and vertical polarizations were measured while rotating the Equipment Under Test (EUT) on the turntable to maximize signal strength. In the case of high ambient noises, the measurements are performed at a closer distance and the limit is adjusted per the equation below. The result is added or subtracted to the required emission level to ensure compliance at the new distance.

$$20 \log\left(\frac{D1}{D2}\right);$$ Where D1 = Current Distance, D2 = Required Distance

Modifications:

No modification was required to comply for this test.

Result:

The EUT complies with the applicable standard.

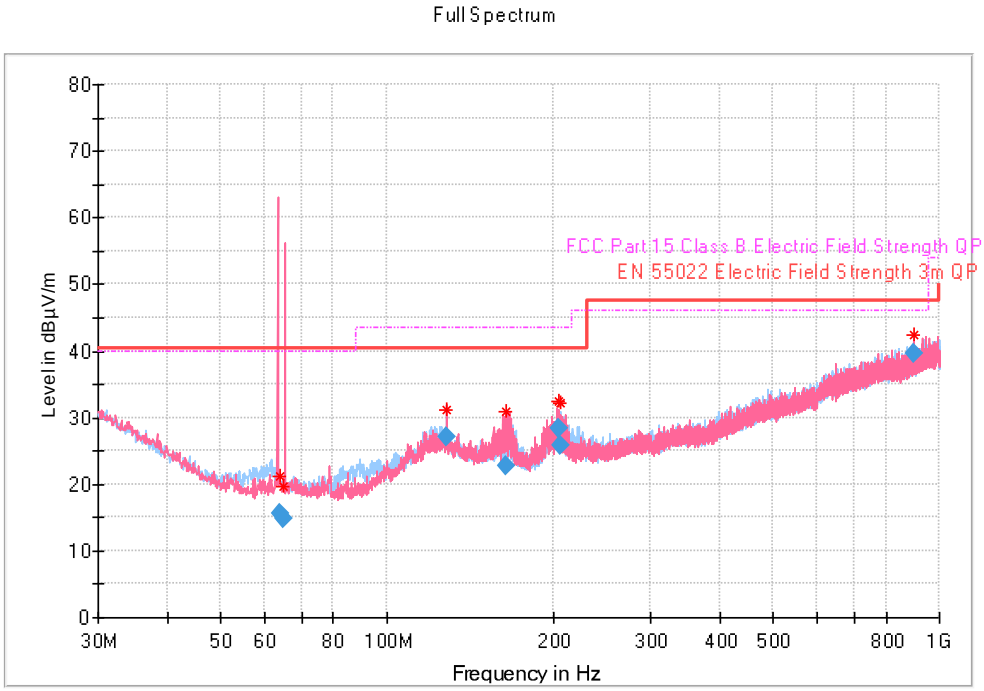
Measurement Data and Plot:

EUT Test Mode:

- Run Mode, No TX

Frequency Range:

- 30 MHz ↔ 1000 MHz



Plot 23: Radiated Emissions scanned at 3m SAC, Form 1s

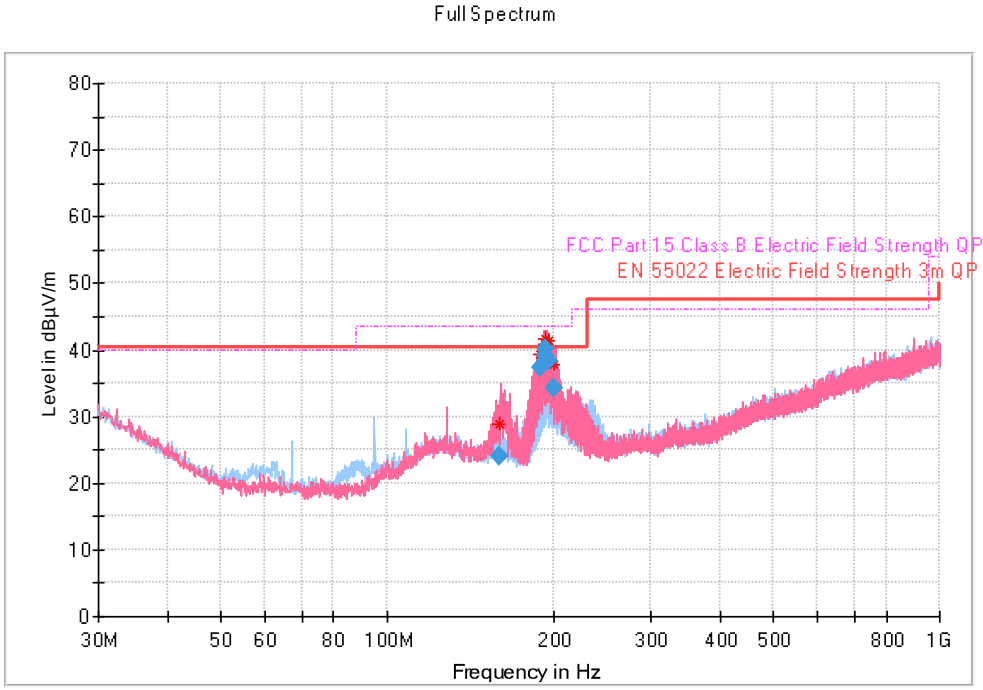
The data above the limit were erroneous pulses from an adjacent test system in the lab – they are not real artefacts of the DUT

Table 11: Unintentional radiated spurious emissions measurement data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
63.965840	15.49	1000.000	120.000	373.0	V	96.0	15.7	24.51	40
64.955720	14.94	1000.000	120.000	402.0	V	285.0	15.8	25.06	40
128.035280	27.14	1000.000	120.000	234.0	H	0.0	22.3	12.86	40
164.700560	22.71	1000.000	120.000	153.0	V	240.0	20.9	17.29	40
203.901920	28.42	1000.000	120.000	164.0	V	121.0	21.0	11.58	40
206.664120	25.92	1000.000	120.000	155.0	H	0.0	20.9	14.08	40
896.021800	39.74	1000.000	120.000	278.0	H	341.0	32.9	6.26	46

Frequency Range:

- 30 MHz ↔ 1000 MHz



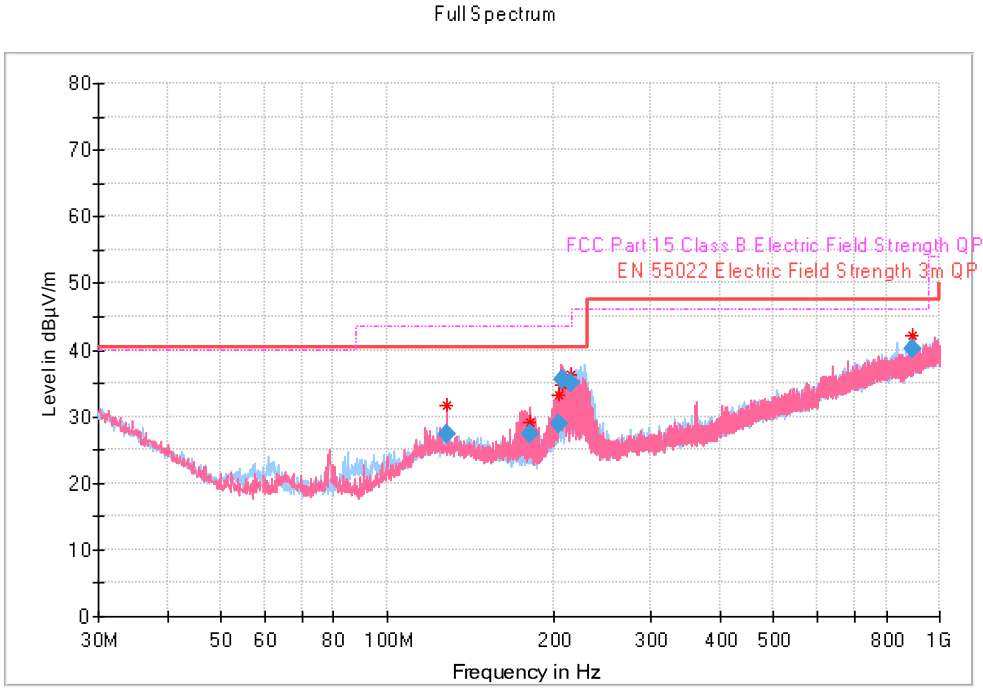
Plot 24: Radiated Emissions scanned at 3m SAC, Form 2s

Table 12: Unintentional radiated spurious emissions measurement data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
159.130280	24.06	1000.000	120.000	111.0	V	187.0	21.2	19.44	43.5
189.864800	37.42	1000.000	120.000	110.0	V	161.0	20.3	6.08	43.5
192.788280	39.21	1000.000	120.000	128.0	V	141.0	20.5	4.29	43.5
193.960200	40.15	1000.000	120.000	111.0	V	170.0	20.7	3.35	43.5
195.860600	38.37	1000.000	120.000	117.0	V	183.0	20.8	5.13	43.5
200.614560	34.21	1000.000	120.000	144.0	V	181.0	21.2	9.29	43.5

Frequency Range:

- 30 MHz ↔ 1000 MHz



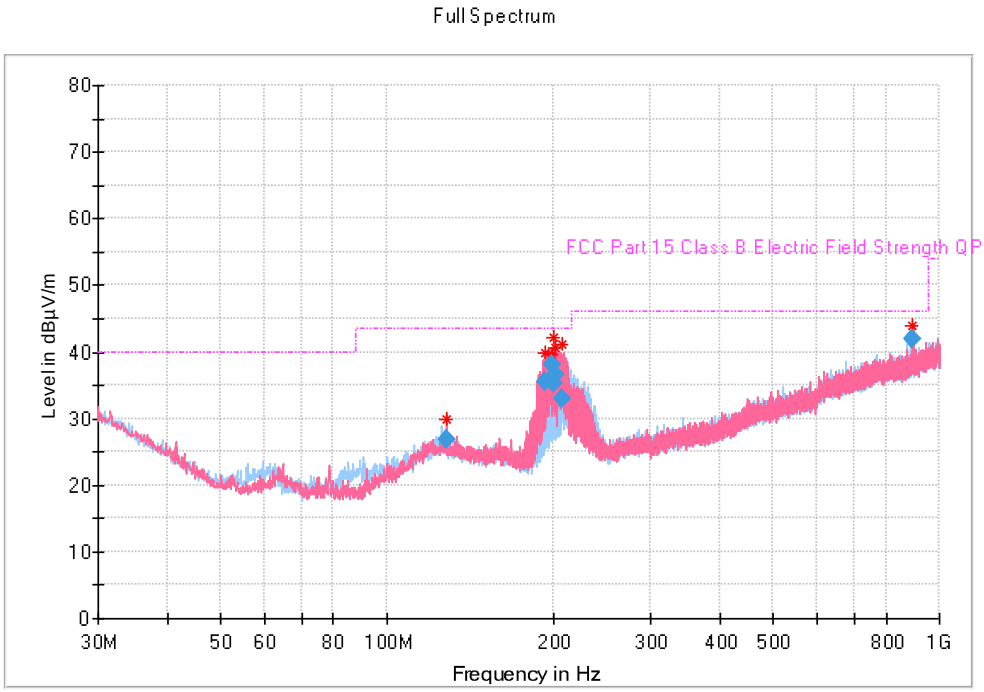
Plot 25: Radiated Emissions scanned at 3m SAC, Form 3s

Table 13: Unintentional radiated spurious emissions measurement data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
127.986560	27.48	1000.000	120.000	402.0	V	313.0	22.3	16.02	43.5
181.396560	27.46	1000.000	120.000	112.0	V	5.0	19.9	16.04	43.5
204.552680	28.98	1000.000	120.000	111.0	V	332.0	21.0	14.52	43.5
206.886440	35.47	1000.000	120.000	111.0	V	170.0	20.9	8.03	43.5
214.489640	35.13	1000.000	120.000	120.0	V	142.0	20.5	8.37	43.5
896.001360	40.12	1000.000	120.000	172.0	V	153.0	32.9	5.88	46

Frequency Range:

- 30 MHz ↔ 1000 MHz



Plot 26: Radiated Emissions scanned at 3m SAC, Form 4s

Table 14: Unintentional radiated spurious emissions measurement data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
127.981760	28.5	1000.000	120.000	250.0	H	104.0	22.3	15	43.5
193.058400	37.3	1000.000	120.000	119.0	V	158.0	20.6	6.2	43.5
198.241880	40.0	1000.000	120.000	111.0	V	181.0	21.0	3.5	43.5
199.934640	37.1	1000.000	120.000	124.0	V	351.0	21.2	6.4	43.5
202.286360	38.1	1000.000	120.000	110.0	V	161.0	21.1	5.4	43.5
207.412960	34.7	1000.000	120.000	113.0	V	0.0	20.8	8.8	43.5
896.004480	42.3	1000.000	120.000	316.0	V	61.0	32.9	3.7	46

3.10 AC Mains Conducted Emissions

Date Performed:

Jul 19, 2018

Test Standard:

- FCC Title 47 CFR Part 15: Subpart B - §15.107
- FCC Title 47 CFR Part 15: Subpart C - §15.207

Test Method:

- ANSI C63.4-2014

Required Limit:

The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the following limits

Frequency (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 – 0.50	66 to 56	56 to 46
0.50 – 5	56	46
5.0 – 30.0	60	50
Note 1: *The lower limit shall apply at the transition frequencies.*		

Method of Measurement:

Measurements were made using a test receiver with 9kHz bandwidth, CISPR Quasi-Peak and Average detector.

Modifications:

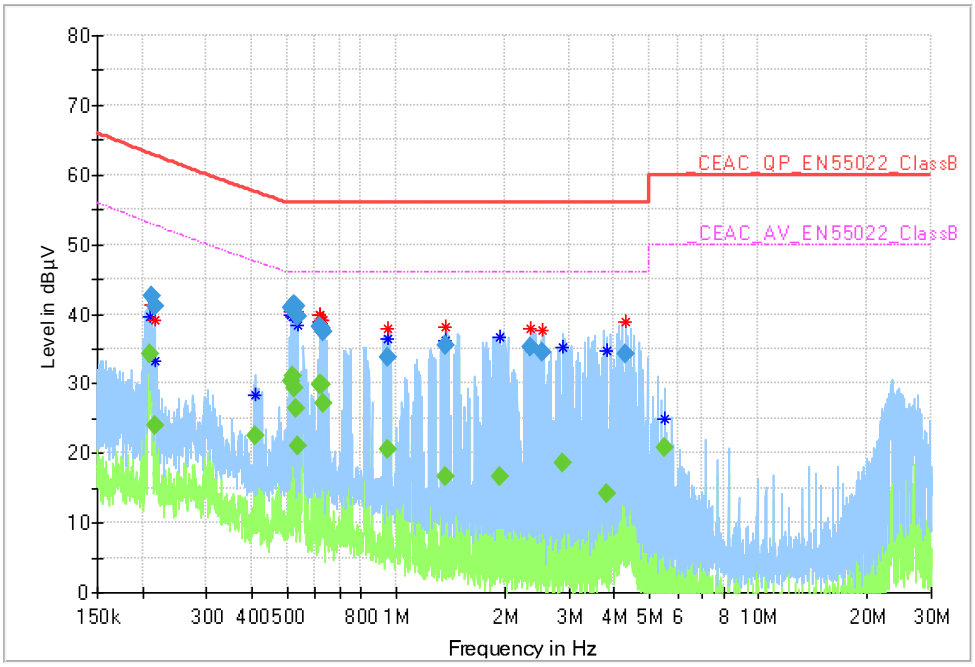
No modification was required to comply for this test.

Result:

The EUT complies with the applicable standard.

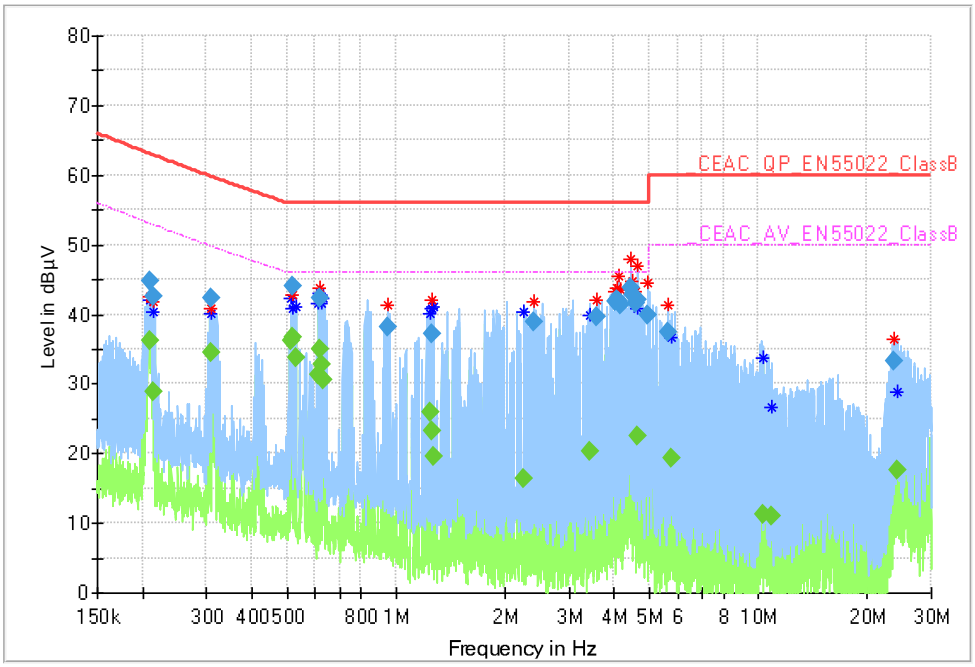
Measurement Data and Plot:

Conducted Emissions – Line 1, 120Vac/60Hz, Form 1s



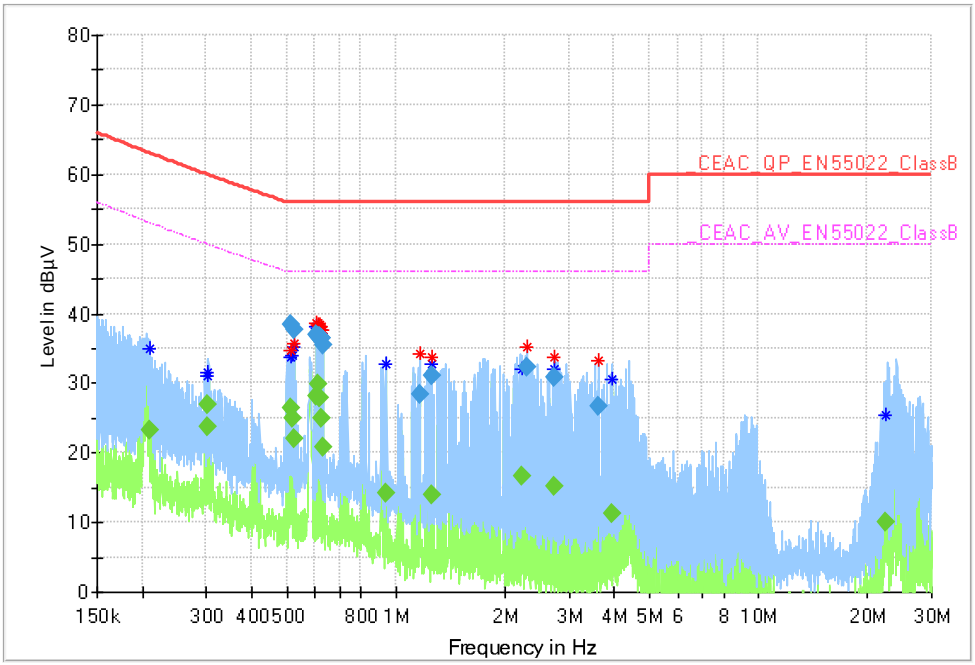
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.208611	---	34.35	53.06	18.72	1000.0	9.000	11.0
0.212823	42.47	---	62.92	20.46	1000.0	9.000	11.0
0.215606	41.05	---	62.81	21.76	1000.0	9.000	11.0
0.216038	---	23.98	52.76	28.78	1000.0	9.000	11.0
0.408762	---	22.59	47.54	24.95	1000.0	9.000	10.9
0.512869	---	30.31	46.00	15.69	1000.0	9.000	10.9
0.512869	40.92	---	56.00	15.08	1000.0	9.000	10.9
0.518021	41.21	---	56.00	14.79	1000.0	9.000	10.9
0.518021	---	31.09	46.00	14.91	1000.0	9.000	10.9
0.520096	41.07	---	56.00	14.93	1000.0	9.000	10.9
0.522702	41.35	---	56.00	14.65	1000.0	9.000	10.9
0.522702	---	29.28	46.00	16.72	1000.0	9.000	10.9
0.526898	40.82	---	56.00	15.18	1000.0	9.000	10.9
0.528480	---	26.40	46.00	19.60	1000.0	9.000	10.9
0.528480	41.08	---	56.00	14.92	1000.0	9.000	10.9
0.534857	39.53	---	56.00	16.47	1000.0	9.000	10.9
0.534857	---	21.16	46.00	24.84	1000.0	9.000	10.9
0.615804	38.16	---	56.00	17.84	1000.0	9.000	10.9
0.616420	38.07	---	56.00	17.93	1000.0	9.000	10.9
0.616420	---	29.95	46.00	16.05	1000.0	9.000	10.9
0.621990	37.84	---	56.00	18.16	1000.0	9.000	10.9
0.621990	---	29.86	46.00	16.14	1000.0	9.000	10.9
0.628866	37.34	---	56.00	18.66	1000.0	9.000	10.9
0.628866	---	27.10	46.00	18.90	1000.0	9.000	10.9
0.951188	33.86	---	56.00	22.14	1000.0	9.000	10.9
0.951188	---	20.50	46.00	25.50	1000.0	9.000	10.9
1.368581	35.40	---	56.00	20.60	1000.0	9.000	11.1
1.368581	---	16.73	46.00	29.27	1000.0	9.000	11.1
1.943712	---	16.55	46.00	29.45	1000.0	9.000	11.2
2.358592	35.33	---	56.00	20.67	1000.0	9.000	11.2
2.534582	34.51	---	56.00	21.49	1000.0	9.000	11.2
2.877625	---	18.70	46.00	27.30	1000.0	9.000	11.2
3.803136	---	14.26	46.00	31.74	1000.0	9.000	11.3
4.292054	34.15	---	56.00	21.85	1000.0	9.000	11.3
5.515929	---	20.90	50.00	29.10	1000.0	9.000	11.3

Conducted Emissions – Line 2, 120Vac/60Hz, Form 1s



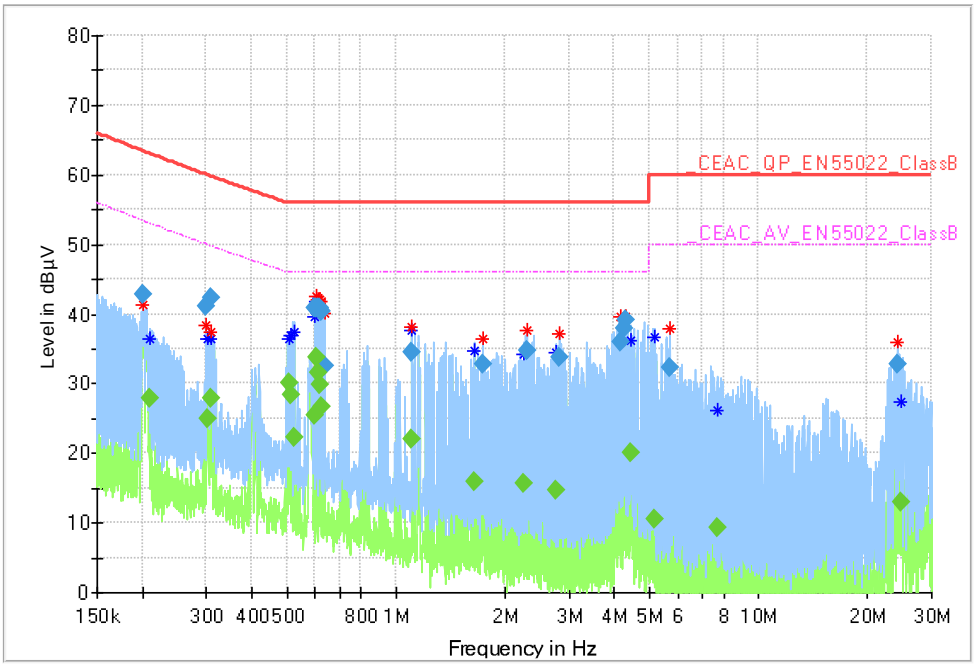
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth	Corr. (dB)
0.209656	---	36.11	53.02	16.91	1000.0	9.000	11.0
0.209656	44.67	---	63.05	18.38	1000.0	9.000	11.0
0.214317	42.62	---	62.86	20.25	1000.0	9.000	11.0
0.214532	---	28.99	52.82	23.83	1000.0	9.000	11.0
0.310217	---	34.58	49.73	15.15	1000.0	9.000	10.9
0.310217	42.32	---	59.77	17.45	1000.0	9.000	10.9
0.514409	---	36.31	46.00	9.69	1000.0	9.000	10.9
0.517504	43.95	---	56.00	12.05	1000.0	9.000	10.9
0.520616	---	36.69	46.00	9.31	1000.0	9.000	10.9
0.529538	---	33.82	46.00	12.18	1000.0	9.000	10.9
0.612735	---	31.37	46.00	14.63	1000.0	9.000	10.9
0.619508	42.22	---	56.00	13.78	1000.0	9.000	10.9
0.619508	---	35.01	46.00	10.99	1000.0	9.000	10.9
0.625106	---	32.69	46.00	13.31	1000.0	9.000	10.9
0.632017	---	30.63	46.00	15.37	1000.0	9.000	10.9
0.945501	38.20	---	56.00	17.80	1000.0	9.000	10.9
1.237168	---	26.01	46.00	19.99	1000.0	9.000	11.0
1.253348	37.09	---	56.00	18.91	1000.0	9.000	11.0
1.253348	---	23.13	46.00	22.87	1000.0	9.000	11.0
1.269740	---	19.61	46.00	26.39	1000.0	9.000	11.0
2.248108	---	16.47	46.00	29.53	1000.0	9.000	11.2
2.408621	38.88	---	56.00	17.12	1000.0	9.000	11.2
3.417398	---	20.28	46.00	25.72	1000.0	9.000	11.3
3.585348	39.59	---	56.00	16.41	1000.0	9.000	11.3
4.038188	41.93	---	56.00	14.07	1000.0	9.000	11.3
4.062477	42.07	---	56.00	13.93	1000.0	9.000	11.3
4.123843	41.74	---	56.00	14.26	1000.0	9.000	11.3
4.169433	41.43	---	56.00	14.57	1000.0	9.000	11.3
4.427123	43.80	---	56.00	12.20	1000.0	9.000	11.3
4.512000	42.84	---	56.00	13.16	1000.0	9.000	11.3
4.571009	41.58	---	56.00	14.42	1000.0	9.000	11.3
4.616926	42.01	---	56.00	13.99	1000.0	9.000	11.3
4.616926	---	22.42	46.00	23.58	1000.0	9.000	11.3
4.956469	39.82	---	56.00	16.18	1000.0	9.000	11.3

Conducted Emissions – Line 1, 120Vac/60Hz, Form 3s



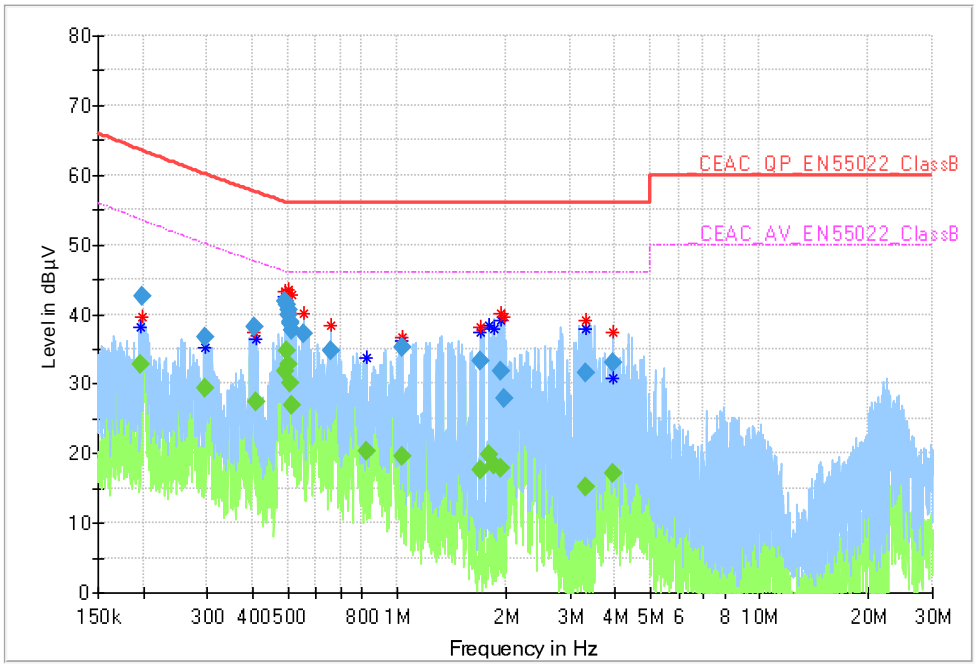
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.210076	---	23.35	53.00	29.65	1000.0	9.000	11.0
0.301354	---	23.74	49.97	26.23	1000.0	9.000	10.9
0.304077	---	26.83	49.89	23.06	1000.0	9.000	10.9
0.511334	---	26.31	46.00	19.69	1000.0	9.000	10.9
0.511334	38.33	---	56.00	17.67	1000.0	9.000	10.9
0.517504	---	24.85	46.00	21.15	1000.0	9.000	10.9
0.522702	37.78	---	56.00	18.22	1000.0	9.000	10.9
0.522702	---	22.09	46.00	23.91	1000.0	9.000	10.9
0.602411	---	28.02	46.00	17.98	1000.0	9.000	10.9
0.602411	36.97	---	56.00	19.03	1000.0	9.000	10.9
0.608463	36.63	---	56.00	19.37	1000.0	9.000	10.9
0.608463	---	29.78	46.00	16.22	1000.0	9.000	10.9
0.611511	36.72	---	56.00	19.28	1000.0	9.000	10.9
0.615189	36.75	---	56.00	19.25	1000.0	9.000	10.9
0.615189	---	27.97	46.00	18.03	1000.0	9.000	10.9
0.620748	36.51	---	56.00	19.49	1000.0	9.000	10.9
0.622612	---	25.05	46.00	20.95	1000.0	9.000	10.9
0.622612	36.47	---	56.00	19.53	1000.0	9.000	10.9
0.630125	---	20.69	46.00	25.31	1000.0	9.000	10.9
0.630125	35.54	---	56.00	20.46	1000.0	9.000	10.9
0.942670	---	14.08	46.00	31.92	1000.0	9.000	10.9
1.161668	28.27	---	56.00	27.73	1000.0	9.000	11.0
1.258369	---	13.88	46.00	32.12	1000.0	9.000	11.0
1.258369	31.14	---	56.00	24.86	1000.0	9.000	11.0
2.216869	---	16.68	46.00	29.32	1000.0	9.000	11.2
2.293499	32.26	---	56.00	23.74	1000.0	9.000	11.2
2.726428	---	15.22	46.00	30.78	1000.0	9.000	11.2
2.726428	30.89	---	56.00	25.11	1000.0	9.000	11.2
3.614131	26.73	---	56.00	29.27	1000.0	9.000	11.3
3.938534	---	11.37	46.00	34.63	1000.0	9.000	11.3
22.503556	---	9.96	50.00	40.04	1000.0	9.000	12.1

Conducted Emissions – Line 2, 120Vac/60Hz, Form 3s



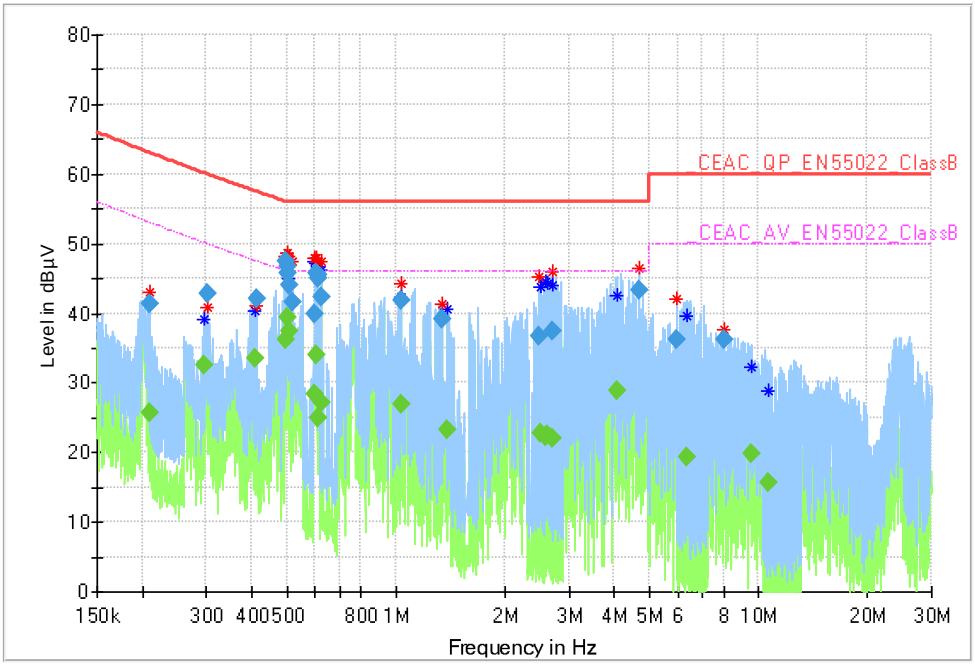
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.200035	42.76	---	63.46	20.70	1000.0	9.000	11.0
0.210076	---	27.84	53.00	25.16	1000.0	9.000	11.0
0.298954	41.05	---	60.07	19.03	1000.0	9.000	10.9
0.302259	---	25.04	49.94	24.91	1000.0	9.000	10.9
0.309907	42.35	---	59.78	17.42	1000.0	9.000	10.9
0.309907	---	27.83	49.74	21.91	1000.0	9.000	10.9
0.507261	---	30.01	46.00	15.99	1000.0	9.000	10.9
0.513382	---	28.35	46.00	17.65	1000.0	9.000	10.9
0.525321	---	22.16	46.00	23.84	1000.0	9.000	10.9
0.598211	---	25.55	46.00	20.45	1000.0	9.000	10.9
0.598211	40.86	---	56.00	15.14	1000.0	9.000	10.9
0.605429	---	33.73	46.00	12.27	1000.0	9.000	10.9
0.605429	40.97	---	56.00	15.03	1000.0	9.000	10.9
0.612122	40.93	---	56.00	15.07	1000.0	9.000	10.9
0.612122	---	31.52	46.00	14.48	1000.0	9.000	10.9
0.616420	40.73	---	56.00	15.27	1000.0	9.000	10.9
0.619508	40.75	---	56.00	15.25	1000.0	9.000	10.9
0.619508	---	29.97	46.00	16.03	1000.0	9.000	10.9
0.625731	40.32	---	56.00	15.68	1000.0	9.000	10.9
0.626357	---	26.56	46.00	19.44	1000.0	9.000	10.9
0.635183	32.45	---	56.00	23.55	1000.0	9.000	10.9
1.108359	---	21.96	46.00	24.04	1000.0	9.000	10.9
1.108359	34.39	---	56.00	21.61	1000.0	9.000	10.9
1.638342	---	15.79	46.00	30.21	1000.0	9.000	11.2
1.743080	32.88	---	56.00	23.12	1000.0	9.000	11.2
2.245862	---	15.63	46.00	30.37	1000.0	9.000	11.2
2.302687	34.81	---	56.00	21.19	1000.0	9.000	11.2
2.773150	---	14.73	46.00	31.27	1000.0	9.000	11.2
2.837639	33.68	---	56.00	22.32	1000.0	9.000	11.2
4.152797	36.08	---	56.00	19.93	1000.0	9.000	11.3
4.245124	37.81	---	56.00	18.19	1000.0	9.000	11.3
4.304943	39.15	---	56.00	16.85	1000.0	9.000	11.3

Conducted Emissions – Line 1, 240Vac/60Hz, Form 2s



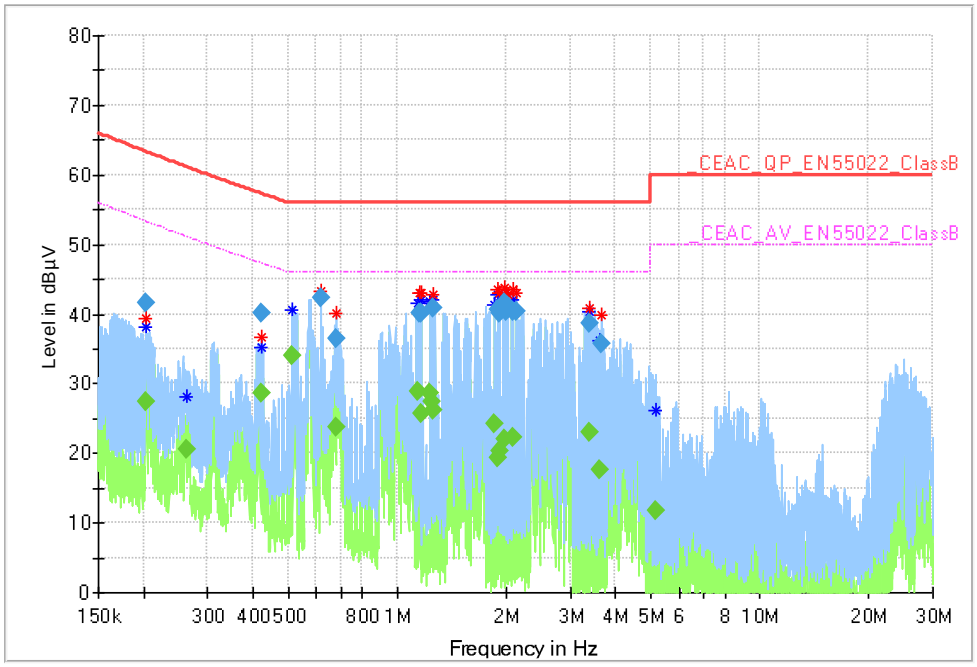
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.197453	---	32.75	53.54	20.79	1000.0	9.000	11.0
0.197650	42.55	---	63.56	21.01	1000.0	9.000	11.0
0.296277	---	29.47	50.11	20.64	1000.0	9.000	10.9
0.296277	36.73	---	60.15	23.41	1000.0	9.000	10.9
0.404697	38.15	---	57.64	19.49	1000.0	9.000	10.9
0.409580	---	27.40	47.52	20.12	1000.0	9.000	10.9
0.492769	---	31.77	46.11	14.34	1000.0	9.000	10.9
0.492769	41.87	---	56.11	14.24	1000.0	9.000	10.9
0.497719	41.28	---	56.04	14.76	1000.0	9.000	10.9
0.497719	---	34.63	46.03	11.41	1000.0	9.000	10.9
0.500713	40.66	---	56.00	15.34	1000.0	9.000	10.9
0.503725	39.91	---	56.00	16.09	1000.0	9.000	10.9
0.503725	---	32.76	46.00	13.24	1000.0	9.000	10.9
0.507769	38.99	---	56.00	17.01	1000.0	9.000	10.9
0.509293	---	30.05	46.00	15.95	1000.0	9.000	10.9
0.509293	38.73	---	56.00	17.27	1000.0	9.000	10.9
0.515439	37.65	---	56.00	18.35	1000.0	9.000	10.9
0.515954	---	27.01	46.00	18.99	1000.0	9.000	10.9
0.555562	37.12	---	56.00	18.88	1000.0	9.000	10.9
0.656483	34.62	---	56.00	21.38	1000.0	9.000	10.9
0.825330	---	20.41	46.00	25.59	1000.0	9.000	11.0
1.031399	---	19.57	46.00	26.43	1000.0	9.000	10.9
1.031399	35.33	---	56.00	20.67	1000.0	9.000	10.9
1.693281	---	17.60	46.00	28.40	1000.0	9.000	11.2
1.693281	33.19	---	56.00	22.81	1000.0	9.000	11.2
1.796138	---	19.79	46.00	26.21	1000.0	9.000	11.2
1.858225	---	18.37	46.00	27.63	1000.0	9.000	11.2
1.941770	31.90	---	56.00	24.10	1000.0	9.000	11.2

Conducted Emissions – Line 2, 240Vac/60Hz, Form 2s



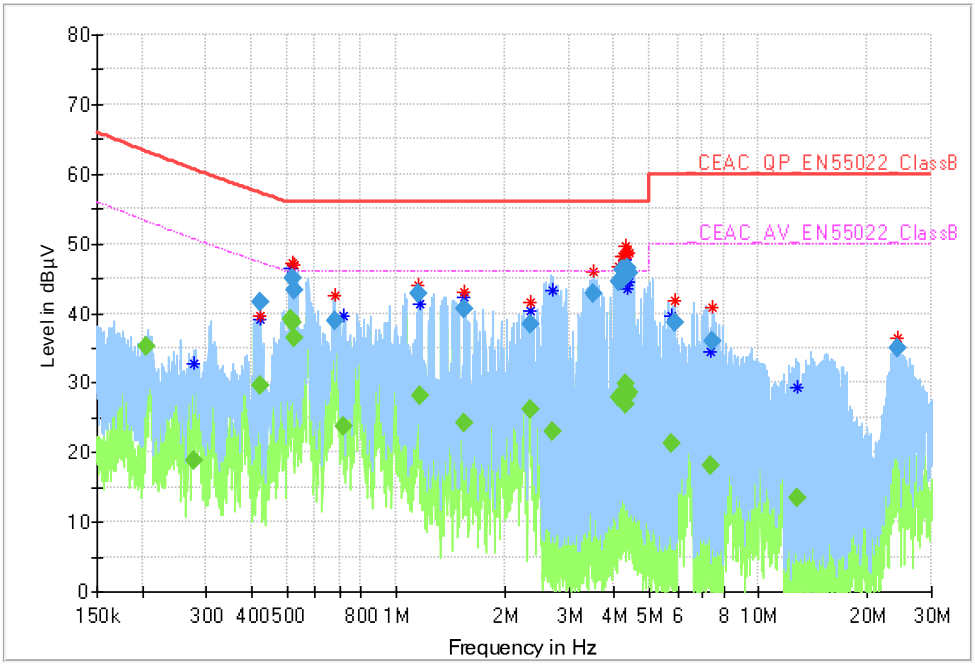
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.209447	---	25.78	53.03	27.25	1000.0	9.000	11.0
0.209447	41.43	---	63.06	21.63	1000.0	9.000	11.0
0.296277	---	32.60	50.11	17.50	1000.0	9.000	10.9
0.301053	42.81	---	60.01	17.20	1000.0	9.000	10.9
0.408762	---	33.43	47.54	14.11	1000.0	9.000	10.9
0.414108	42.04	---	57.46	15.42	1000.0	9.000	10.9
0.494249	---	36.15	46.09	9.94	1000.0	9.000	10.9
0.494249	47.45	---	56.09	8.63	1000.0	9.000	10.9
0.499713	---	39.44	46.00	6.57	1000.0	9.000	10.9
0.499713	46.68	---	56.00	9.32	1000.0	9.000	10.9
0.502719	45.87	---	56.00	10.13	1000.0	9.000	10.9
0.505237	---	37.35	46.00	8.65	1000.0	9.000	10.9
0.510313	44.11	---	56.00	11.89	1000.0	9.000	10.9
0.518021	41.51	---	56.00	14.49	1000.0	9.000	10.9
0.596420	39.76	---	56.00	16.24	1000.0	9.000	10.9
0.596420	---	28.27	46.00	17.73	1000.0	9.000	10.9
0.603617	---	33.91	46.00	12.09	1000.0	9.000	10.9
0.603617	45.81	---	56.00	10.19	1000.0	9.000	10.9
0.608463	45.57	---	56.00	10.43	1000.0	9.000	10.9
0.611511	44.90	---	56.00	11.10	1000.0	9.000	10.9
0.611511	---	24.85	46.00	21.15	1000.0	9.000	10.9
0.620128	42.33	---	56.00	13.67	1000.0	9.000	10.9
0.620128	---	27.14	46.00	18.86	1000.0	9.000	10.9
1.030369	41.78	---	56.00	14.22	1000.0	9.000	10.9
1.030369	---	27.00	46.00	19.00	1000.0	9.000	10.9
1.338816	39.24	---	56.00	16.76	1000.0	9.000	11.1
1.386480	---	23.14	46.00	22.86	1000.0	9.000	11.1
2.489390	36.60	---	56.00	19.40	1000.0	9.000	11.2
2.519428	---	22.68	46.00	23.32	1000.0	9.000	11.2
2.585758	---	22.34	46.00	23.66	1000.0	9.000	11.2
2.616959	---	22.39	46.00	23.61	1000.0	9.000	11.2
2.715550	37.33	---	56.00	18.67	1000.0	9.000	11.2
2.715550	---	21.93	46.00	24.07	1000.0	9.000	11.2
4.082830	---	28.97	46.00	17.03	1000.0	9.000	11.3
4.667966	43.18	---	56.00	12.82	1000.0	9.000	11.3

Conducted Emissions – Line 1, 240Vac/60Hz, Form 4s



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.203260	---	27.39	53.29	25.90	1000.0	9.000	11.0
0.203260	41.49	---	63.32	21.83	1000.0	9.000	11.0
0.263843	---	20.61	51.06	30.45	1000.0	9.000	10.9
0.422892	40.01	---	57.30	17.29	1000.0	9.000	10.9
0.422892	---	28.62	47.28	18.66	1000.0	9.000	10.9
0.512869	---	34.06	46.00	11.94	1000.0	9.000	10.9
0.615189	42.33	---	56.00	13.67	1000.0	9.000	10.9
0.680535	36.40	---	56.00	19.60	1000.0	9.000	10.9
0.680535	---	23.64	46.00	22.36	1000.0	9.000	10.9
1.138677	---	28.89	46.00	17.11	1000.0	9.000	10.9
1.151265	40.22	---	56.00	15.78	1000.0	9.000	10.9
1.166321	---	25.60	46.00	20.40	1000.0	9.000	11.0
1.166321	40.04	---	56.00	15.96	1000.0	9.000	11.0
1.234698	---	28.53	46.00	17.47	1000.0	9.000	11.0
1.248348	---	27.46	46.00	18.54	1000.0	9.000	11.0
1.260887	40.95	---	56.00	15.05	1000.0	9.000	11.0
1.260887	---	26.07	46.00	19.93	1000.0	9.000	11.0
1.858225	---	24.13	46.00	21.87	1000.0	9.000	11.2
1.895745	40.49	---	56.00	15.51	1000.0	9.000	11.2
1.895745	---	19.21	46.00	26.79	1000.0	9.000	11.2
1.918619	---	20.28	46.00	25.72	1000.0	9.000	11.2
1.918619	40.04	---	56.00	15.96	1000.0	9.000	11.2
1.982957	---	22.04	46.00	23.96	1000.0	9.000	11.2
1.982957	41.64	---	56.00	14.36	1000.0	9.000	11.2
2.008012	40.40	---	56.00	15.60	1000.0	9.000	11.2
2.012030	41.21	---	56.00	14.79	1000.0	9.000	11.2
2.094101	---	22.16	46.00	23.84	1000.0	9.000	11.2
2.094101	40.45	---	56.00	15.55	1000.0	9.000	11.2
2.121488	40.45	---	56.00	15.55	1000.0	9.000	11.2
3.403762	---	22.90	46.00	23.10	1000.0	9.000	11.3
3.403762	38.74	---	56.00	17.26	1000.0	9.000	11.3
3.632238	---	17.70	46.00	28.30	1000.0	9.000	11.3
3.668724	35.82	---	56.00	20.18	1000.0	9.000	11.3
5.148341	---	11.86	50.00	38.14	1000.0	9.000	11.3

Conducted Emissions – Line 2, 240Vac/60Hz, Form 4s



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
0.205507	---	35.20	53.19	17.99	1000.0	9.000	11.0
0.277918	---	18.76	50.63	31.87	1000.0	9.000	10.9
0.424162	41.70	---	57.27	15.57	1000.0	9.000	10.9
0.424162	---	29.57	47.25	17.68	1000.0	9.000	10.9
0.511845	---	39.13	46.00	6.87	1000.0	9.000	10.9
0.516987	---	38.72	46.00	7.28	1000.0	9.000	10.9
0.519058	44.97	---	56.00	11.03	1000.0	9.000	10.9
0.521658	---	36.46	46.00	9.54	1000.0	9.000	10.9
0.526372	43.36	---	56.00	12.64	1000.0	9.000	10.9
0.681897	38.97	---	56.00	17.03	1000.0	9.000	10.9
0.714694	---	23.80	46.00	22.20	1000.0	9.000	11.0
1.148966	42.69	---	56.00	13.31	1000.0	9.000	10.9
1.160507	---	28.19	46.00	17.81	1000.0	9.000	11.0
1.536822	---	24.25	46.00	21.75	1000.0	9.000	11.2
1.536822	40.70	---	56.00	15.30	1000.0	9.000	11.2
2.353882	---	26.23	46.00	19.77	1000.0	9.000	11.2
2.353882	38.33	---	56.00	17.67	1000.0	9.000	11.2
2.693923	---	23.11	46.00	22.89	1000.0	9.000	11.2
3.503866	42.73	---	56.00	13.27	1000.0	9.000	11.3
4.107389	---	27.78	46.00	18.22	1000.0	9.000	11.3
4.107389	44.58	---	56.00	11.42	1000.0	9.000	11.3
4.190322	44.83	---	56.00	11.17	1000.0	9.000	11.3
4.207108	46.13	---	56.00	9.87	1000.0	9.000	11.3
4.232414	---	28.63	46.00	17.37	1000.0	9.000	11.3
4.232414	46.32	---	56.00	9.68	1000.0	9.000	11.3
4.283483	---	26.88	46.00	19.12	1000.0	9.000	11.3
4.283483	45.75	---	56.00	10.25	1000.0	9.000	11.3
4.313558	---	29.74	46.00	16.26	1000.0	9.000	11.3
4.339504	46.44	---	56.00	9.56	1000.0	9.000	11.3
4.361245	---	28.11	46.00	17.89	1000.0	9.000	11.3
4.361245	46.11	---	56.00	9.89	1000.0	9.000	11.3
4.418282	---	28.53	46.00	17.47	1000.0	9.000	11.3
4.418282	45.77	---	56.00	10.23	1000.0	9.000	11.3
5.752411	---	21.30	50.00	28.70	1000.0	9.000	11.3
5.886182	38.57	---	60.00	21.43	1000.0	9.000	11.3

Appendix A: TEST SETUP PHOTOS

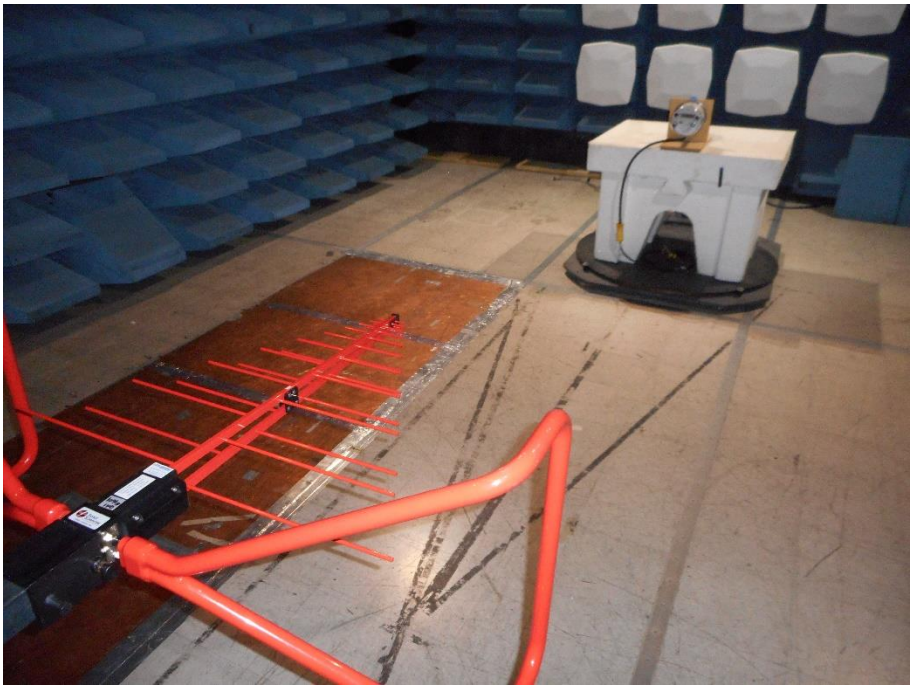


Figure 1: Unintentional Radiated Emissions performed at the 3m SAC, 30MHz – 1GHz: 4 Models

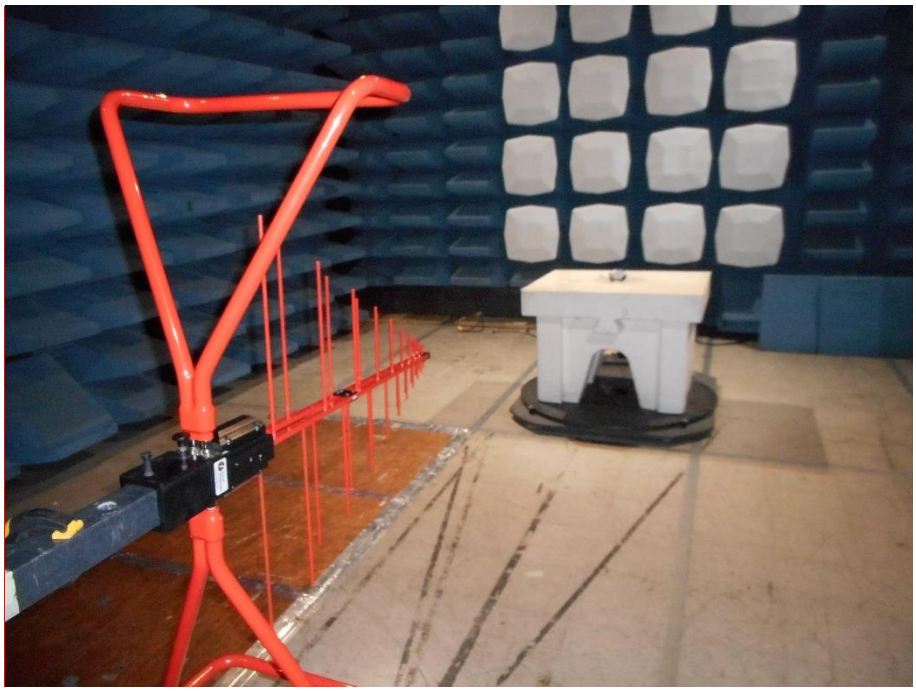


Figure 2: Intentional Radiated Emissions performed at the 3m SAC, 30MHz – 1GHz

Figure3: Intentional Radiated Emissions performed at the 3m SAC, 30MHz – 1GHz, the EUT setup

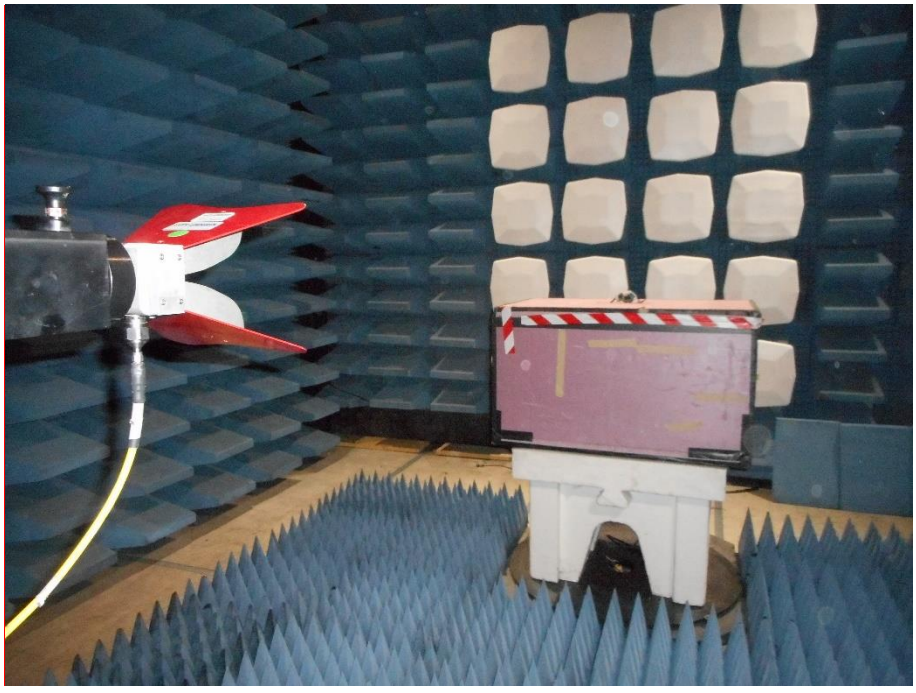


Figure 4: Intentional Radiated Emissions performed at the 3m SAC, above 1GHz

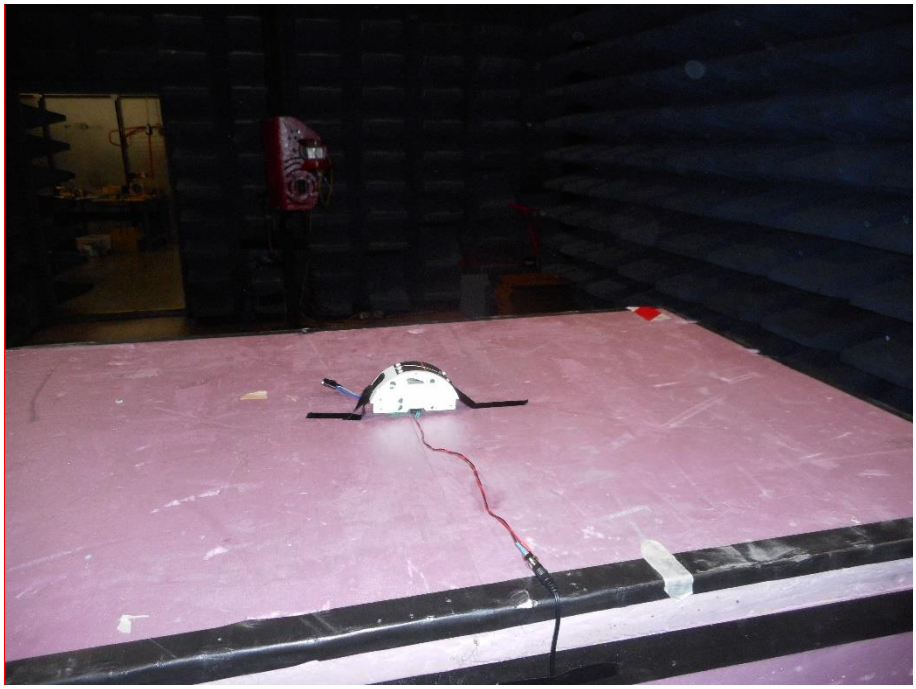


Figure 5: Radiated Emissions performed at the 3m SAC, above 1GHz, the EUT setup

Figure 6: Unintentional Radiated Emissions performed at the 3m SAC, 150kHz – 30MHz

***Figure 7*: Unintentional Radiated Emissions performed at the SAC (close-up view) Test Setup: 4 models**

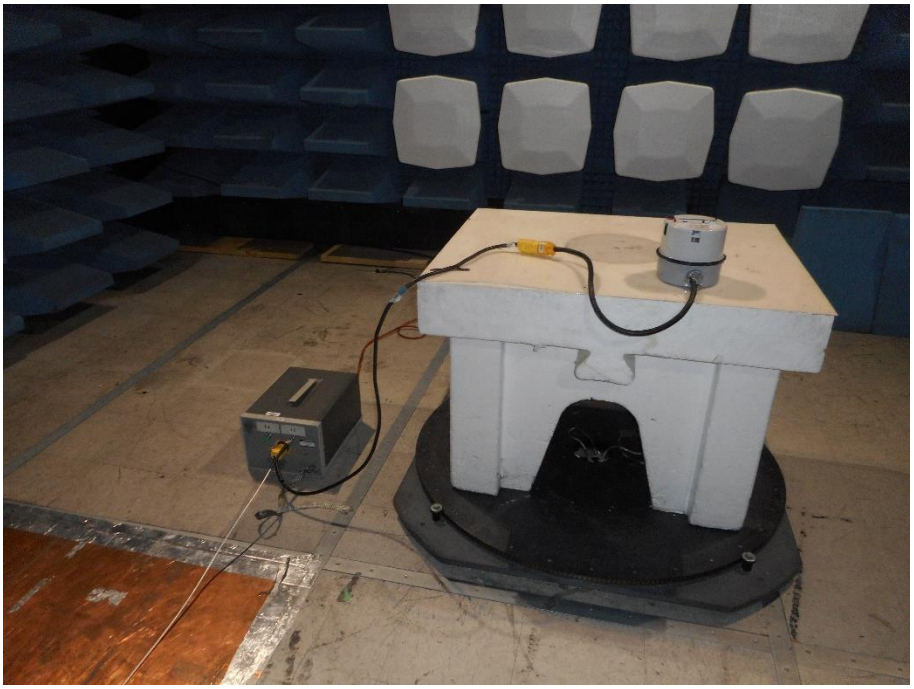


Figure 8: Conducted Emissions Test Setup: 4 models

Appendix B: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
CISPR	Comité International Spécial des Perturbations Radioélectriques
DC	Direct Current
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EUT	Equipment Under Test
FCC	Federal Communications Commission
IC	Industry Canada
ICES	Interference Causing Equipment Standard
IEC	International Electrotechnical Commission
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber

END OF REPORT