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Test report

341229-6TRFWL

Date of issue: December 8, 2017

Applicant:

Panasonic Corporation of North America

Product:

Bluetooth Transceiver in DECT Base Station

Model:

KX-TGE660

Model variant:

KX-TGE680C

FCC ID:

ACJ96NKX-TGE660

IC Reg. Number:

216A-KXTGE680

Specifications:

- FCC 47 CFR Part 15, Subpart C

  Frequency Hopping Transmitters / Digital Transmission Systems

- RSS-247, Issue 2, February 2017

  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: CA2040; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Frode Sveinsen, Senior Wireless Engineer
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Date	December 8, 2017
Signature of reviewer	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

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1 INFORMATION

1.1 Applicant information

Name :	Panasonic Corporation of North America
Address:	Panasonic System Networks Co., Ltd. 1-62, 4-chome, Minoshima, Hakata-ku Fukuoka 812-8531, Japan

1.2 Tested Item

Name:	DECT Base Station with Bluetooth
Additional information:	DECT 6.0
Model name:	KX-TGE660 (USA Model)
Model variant:	KX-TGE680C (Canada Model)
FCC ID:	ACJ96NKX-TGE660
Industry Canada Registration Number:	216A-KXTGE680
Serial number:	/
Trademark:	PANASONIC
Hardware identity and/or version:	PNLB2728xx
Software identity and/or version:	SW200
Tested to ISED Radio Standard (RSS):	RSS-247 Issue 2; RSS-Gen Issue 4
Frequency Band:	2400–2483.5 MHz
Frequency Range:	2402–2480 MHz
Number of Channels:	79 Channels
Type of Modulation:	Digital (Gaussian Frequency Shift Keying)
Conducted Output Power:	6.43 mW (Peak)
Antenna Connector:	None
Number of Antennas:	1
Antenna Diversity Supported:	No
Power Supply:	AC Adaptor: PNLV226 (ZZ)
Interface:	PSTN

1.3 Testing dates

Tested in period:	November 6, 2017 to November 9, 2017

1.4 Description of Tested Device

The EUT is a Bluetooth Transceiver in a DECT Base Station.

The models KX-TGE660 and KX-TGE680C for USA and Canada respectively, are identical.

1.5 Test Conditions

Temperature:	**15–30 °C**
Relative humidity	**20–75 %**
Air pressure	**860–1060 mbar**
Normal test voltage	**120 V_{AC}**

All tests were performed with the EUT powered from the mains.

The values are the limit registered during the test period.

1.6 Test Engineer(s)

Frode Sveinsen

1.7 Antenna Requirement

Does the EUT have detachable antenna(s)?	**☐ YES**	**☒ NO**
If detachable, is the antenna connector(s) non-standard?	**☐ YES**	**☐ NO**
The tested equipment has only integral antennas. The conducted tests were performed on a sample with a temporary antenna connector.		

Requirement: FCC 15.203, 15.204, 15.317.

1.8 Other Comments

The measurements were done with the EUT powered by 120 V AC. It was checked that power variations between 85% and 115% did not have any influence on the measurements.

All ports were populated during Spurious Emission and Power Line Conducted measurements.

2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15, paragraph 15.247 and Industry Canada RSS-247 Issue 2 / RSS-Gen Issue 4 / RSP-100 Issue 11.

All tests were conducted is accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

A description of the test facility is on file with the FCC and Industry Canada.

☒ New Submission	☒ Production Unit
☐ Class II Permissive Change	☐ Pre-production Unit
DSS Equipment Code	☐ Family Listing

THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in “Summary of Test Data”.

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 1, RSS-GEN Issue 4 reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	Complies
Number of Operating Frequencies	15.31(m)	5.1 (6)	Complies
Antenna Requirement	15.203	8.3 (RSS-GEN)	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	8.8 (RSS-GEN)	Complies
Channel Separation	15.247(a)(1)	5.1 (4)	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	5.1 (3)	Complies
Time of Occupancy	15.247(a)(1)(iii)	5.1 (5)	Complies
Occupied Bandwidth	15.247(a)(1)	5.1 (7)	Complies
Minimum 6 dB Bandwidth	15.247(a)(2)	5.2 (1)	N/A[1]
Peak Power Output	15.247(b)	5.4 (5)	Complies
Power Spectral Density	15.247(d)	5.2 (2)	N/A[1]
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5	Complies[2]
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	6.13 (RSS-GEN) 8.9 (RSS-GEN)	Complies

[1] Not applicable for FHSS equipment

[2] The tested equipment has integrated antennas only

3 TEST RESULTS

3.1 Power Line Conducted Emissions

FCC Part 15.207(a)

RSS-213 Clause 6.3, RSS-GEN Clause 8.8

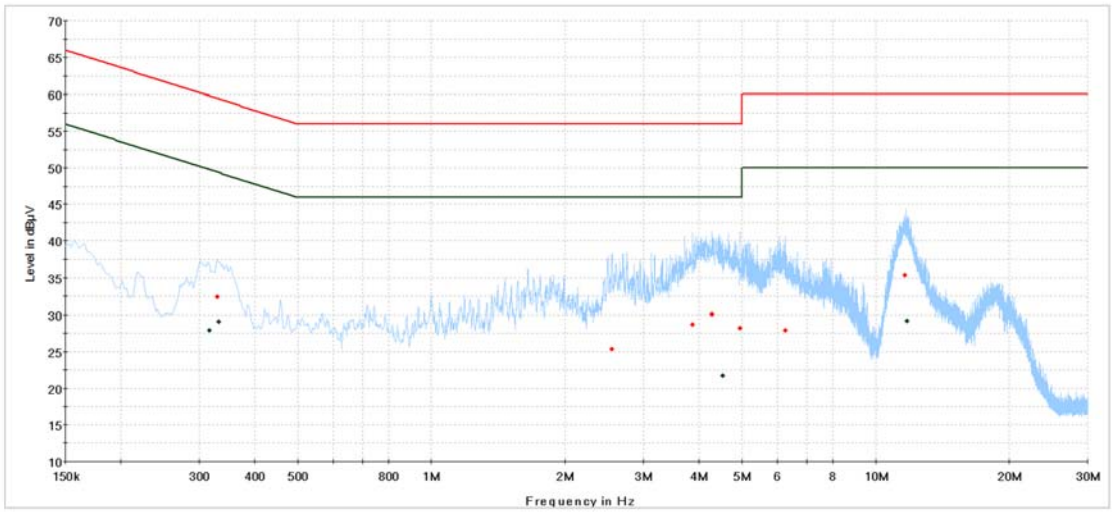
Measurement procedure: **ANSI C63.4-2014 using 50 µH/50 ohms LISN.**

Test Results: **Complies**

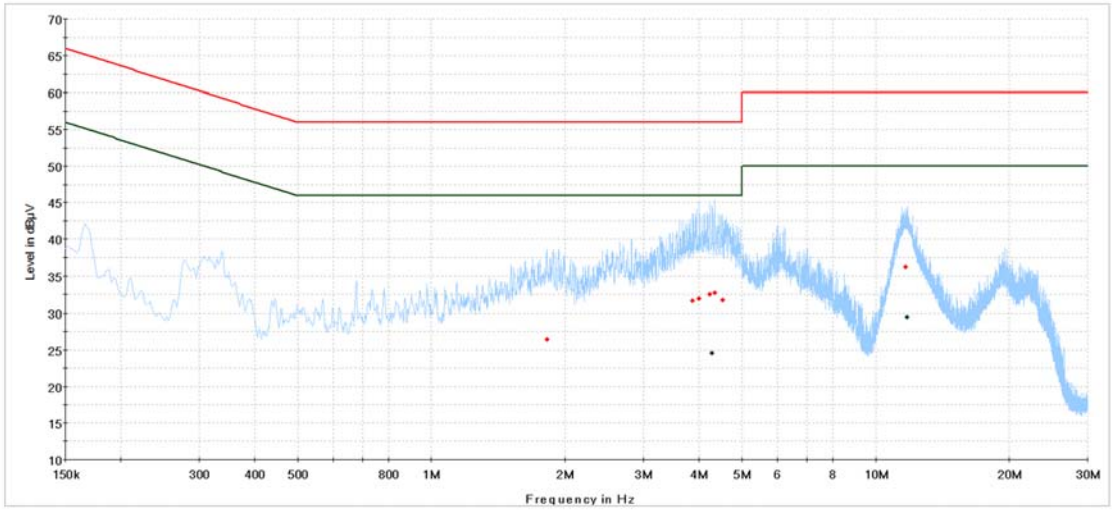
Measurement Data: **See attached graph, (Peak detector).**

ON-Hook, BT Active

Frequency (MHz)	Measured Value (dBµV)	Detector	Line	Limit (dBµV)	Margin (dB)
0.316500	27.89	Av	N	49.80	21.91
0.332250	29.06	Av	N	49.40	20.33
4.524000	21.71	Av	N	46.00	24.29
11.766250	29.22	Av	N	50.00	20.78
0.330000	32.43	QP	N	59.45	27.02
2.550750	25.36	QP	N	56.00	30.64
3.871500	28.72	QP	N	56.00	27.28
4.278750	30.04	QP	N	56.00	25.96
4.951500	28.23	QP	N	56.00	27.77
6.252000	27.92	QP	N	60.00	32.08
11.613250	35.34	QP	N	60.00	24.66
4.278750	24.62	Av	L1	46.00	21.38
11.757250	29.48	Av	L1	50.00	20.52
1.817250	26.43	QP	L1	56.00	29.57
3.873750	31.61	QP	L1	56.00	24.39
4.004250	31.90	QP	L1	56.00	24.10
4.231500	32.47	QP	L1	56.00	23.53
4.341750	32.72	QP	L1	56.00	23.28
4.528500	31.74	QP	L1	56.00	24.26
11.658250	36.27	QP	L1	60.00	23.73



ON-Hook, BT Active, 120V 60Hz, Phase N



ON-Hook, BT Active, 120V 60Hz, Phase L1

3.2 Channel Separation

Para. No.: 15.247 (a)(1)

Test Results: **Complies**

Measurement Data:

Channel Separation:	1.0 MHz
Nominal value for Channel Separation	1.0 MHz
20 dB BW of hopping channel, 2402MHz:	932 kHz
20 dB BW of hopping channel, 2441MHz:	928 kHz
20 dB BW of hopping channel, 2480MHz:	936 kHz

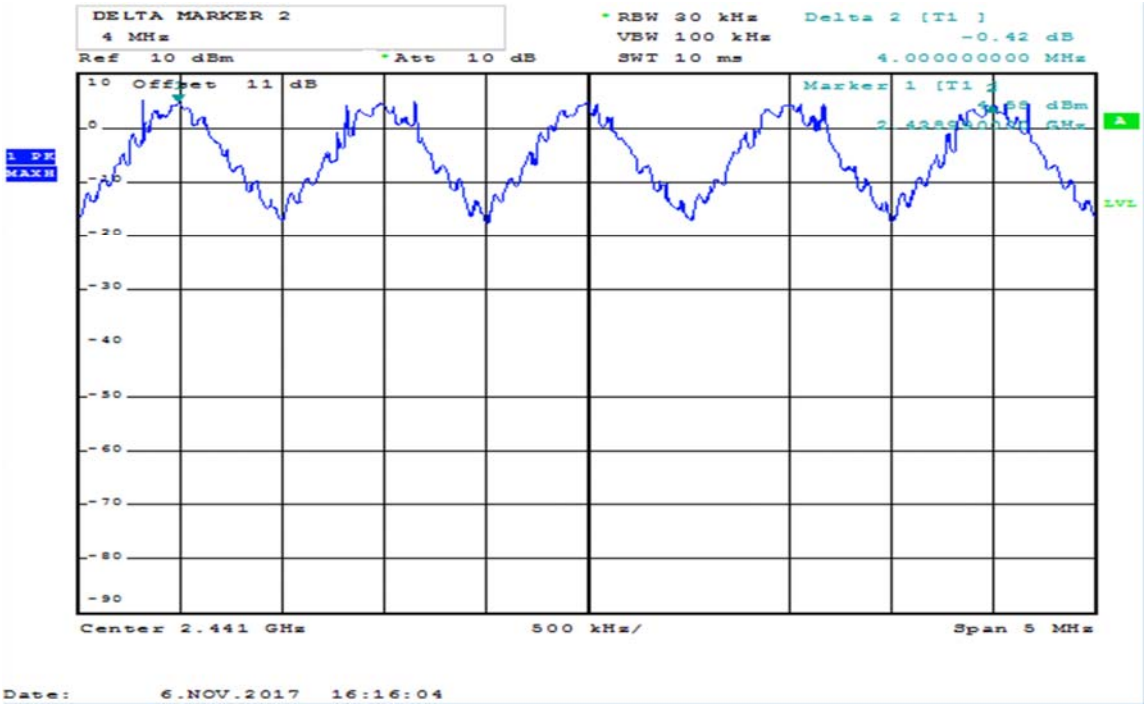
See attached plots

Requirement:

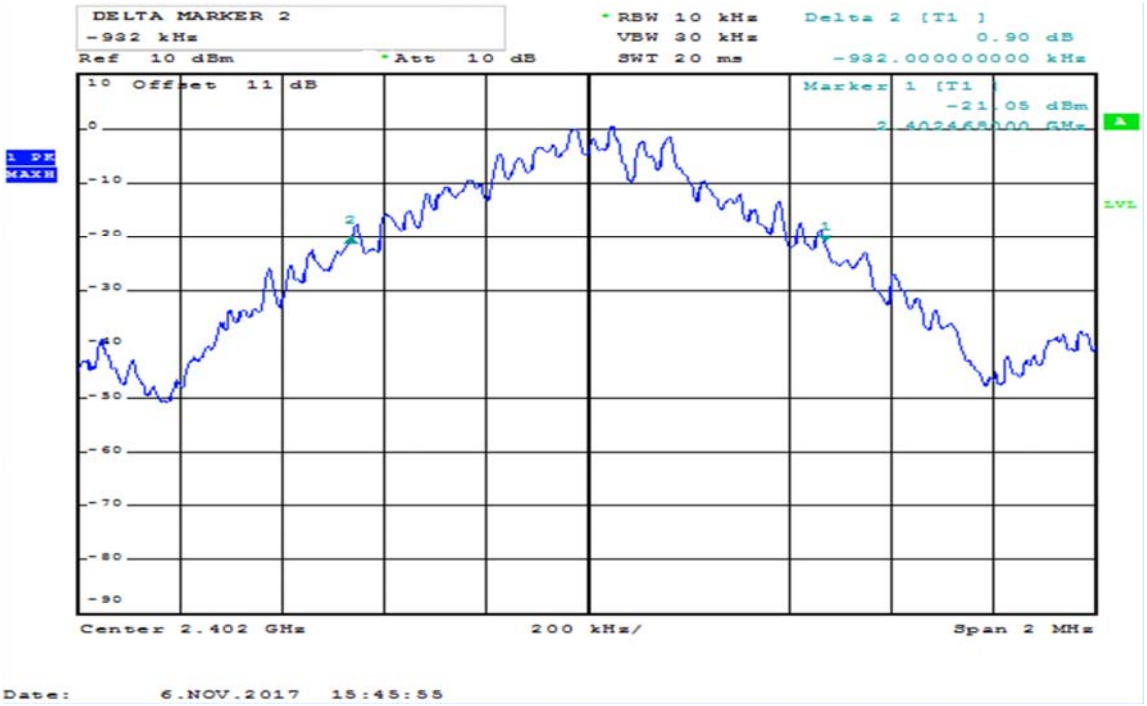
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

or:

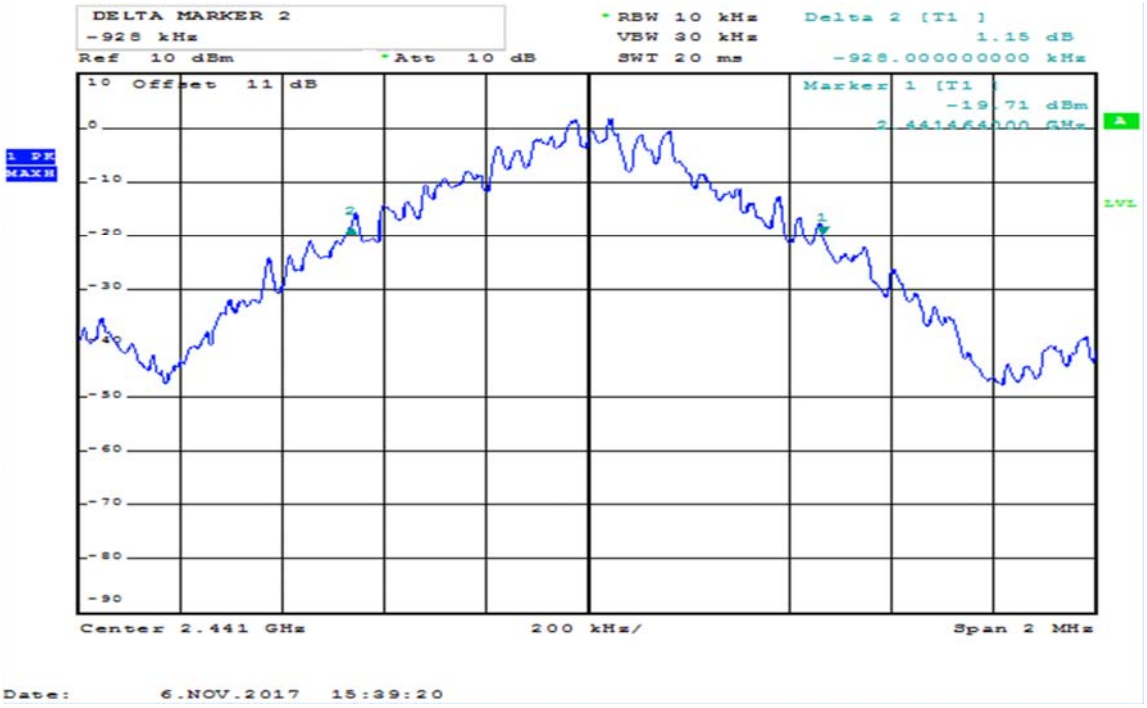
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.



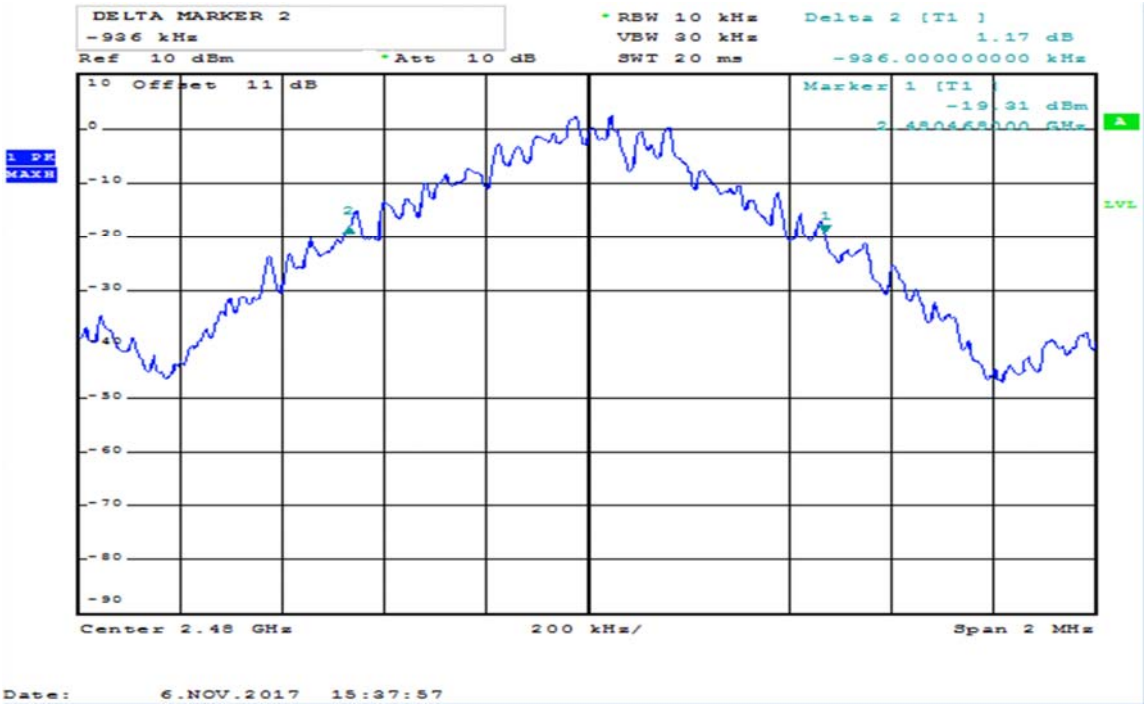
Channel Separation



20dB Bandwidth, 2402 MHz



20dB Bandwidth, 2441 MHz



20dB Bandwidth, 2480 MHz

3.3 Pseudorandom Hopping Algorithm

Para. No.: 15.247 (a)(1)

Test Results: Complies

Measurement Data: The EUT follows the Bluetooth standard.

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

No requirements for Digital Transmission Systems.

3.4 Occupancy Time

Para. No.: 15.247 (a)(1)(iii)

Test Results: Complies

Measurement Data:

Minimum Number of RF Channels:	20
Maximum Number of RF Channels:	79
Maximum Length of RF Burst pr. channel	2.90 ms
Time between RF Burst on same RF Channel	75.2 ms (20 ch)
	297.04 ms (79 ch)
Time of Occupancy (20 and 79 ch mode)	309.6 ms

20 Ch Mode:

Time between RF burst on same channel: 3.76 x 20 ms = 75.2 ms

Time of occupancy: (2.91 x 400 x 20) / 75.2 = 309.6 ms

79 Ch Mode:

Time between RF burst on same channel: 3.76 x 79 ms = 297.04 ms

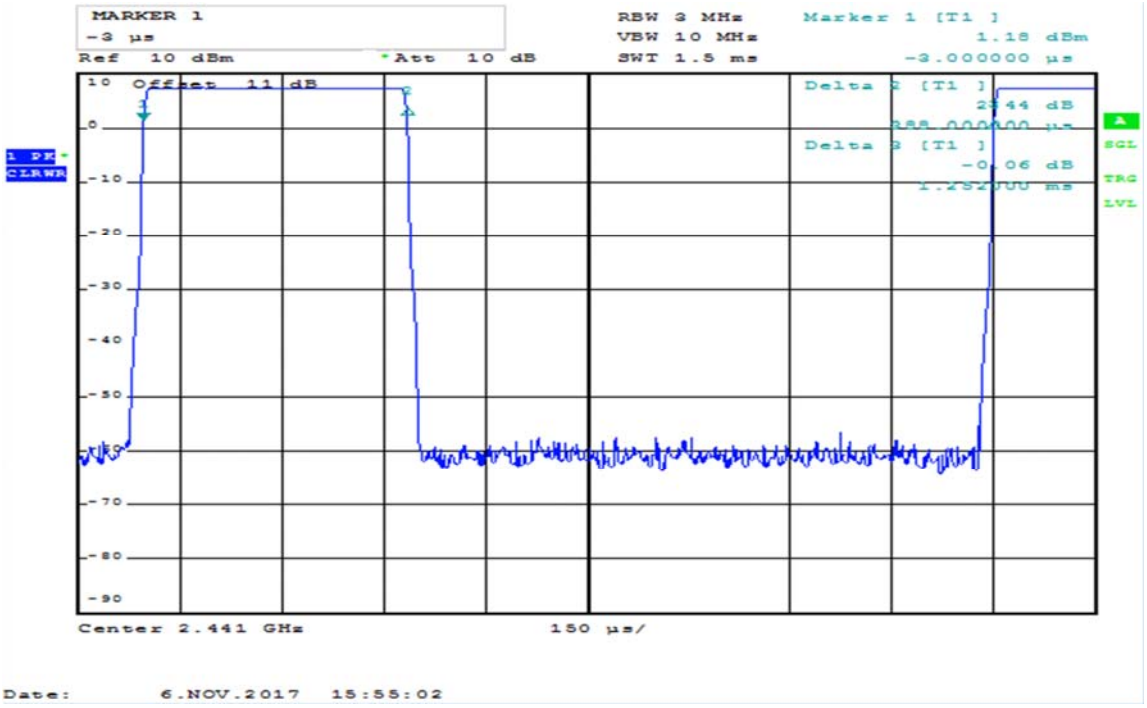
Time of occupancy: (2.91 x 400 x 79) / 297.04 = 309.6 ms

See attached graph.

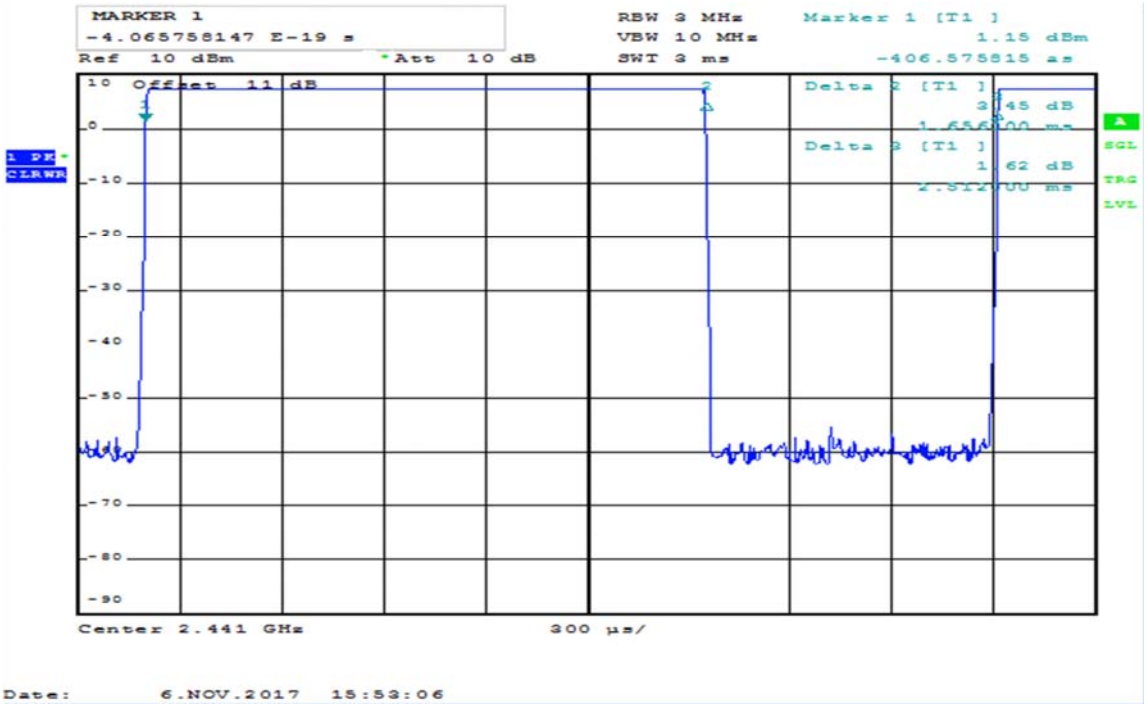
Requirements:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

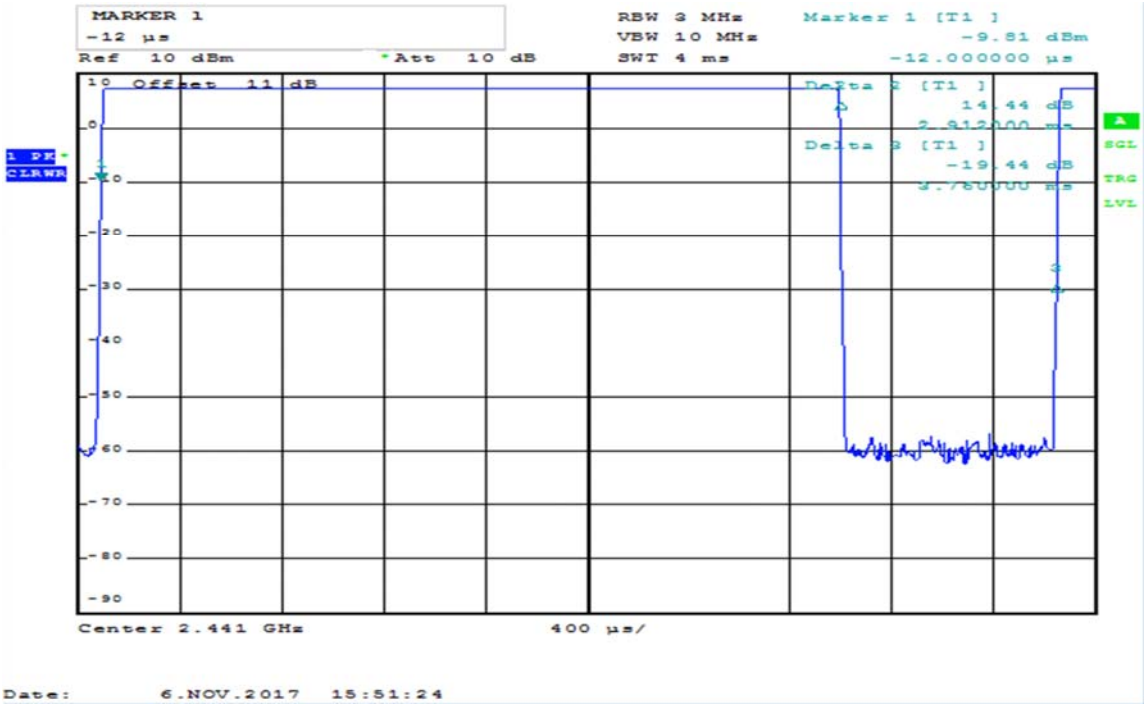
No requirements for Digital Transmission Systems.



Burst Length DH1



Burst Length DH3



Burst Length DH5

3.5 Occupied Bandwidth

Para. No.: 15.247 (a)(1)(iii)

Test Results: Complies

Measurement Data:

Number of RF Channels in use:	20 or 79 RF channels in use
Channel Centre Frequencies:	The channels are centred at each full MHz from 2402 to 2480 MHz

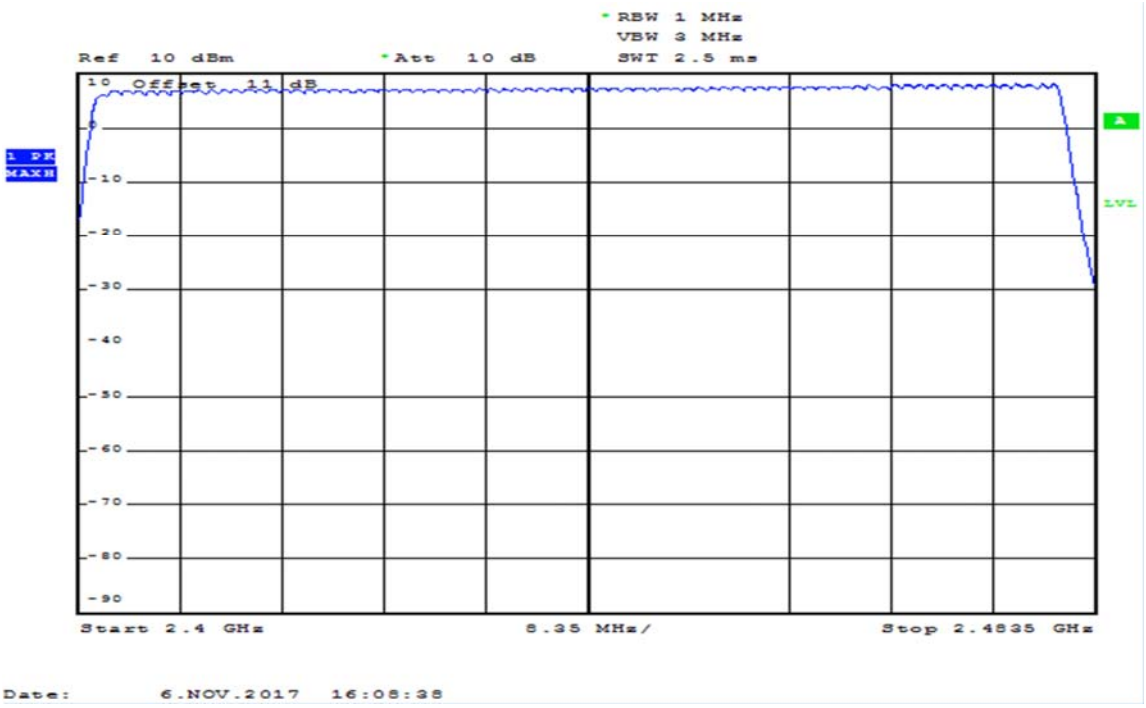
See attached plots.

Requirements:

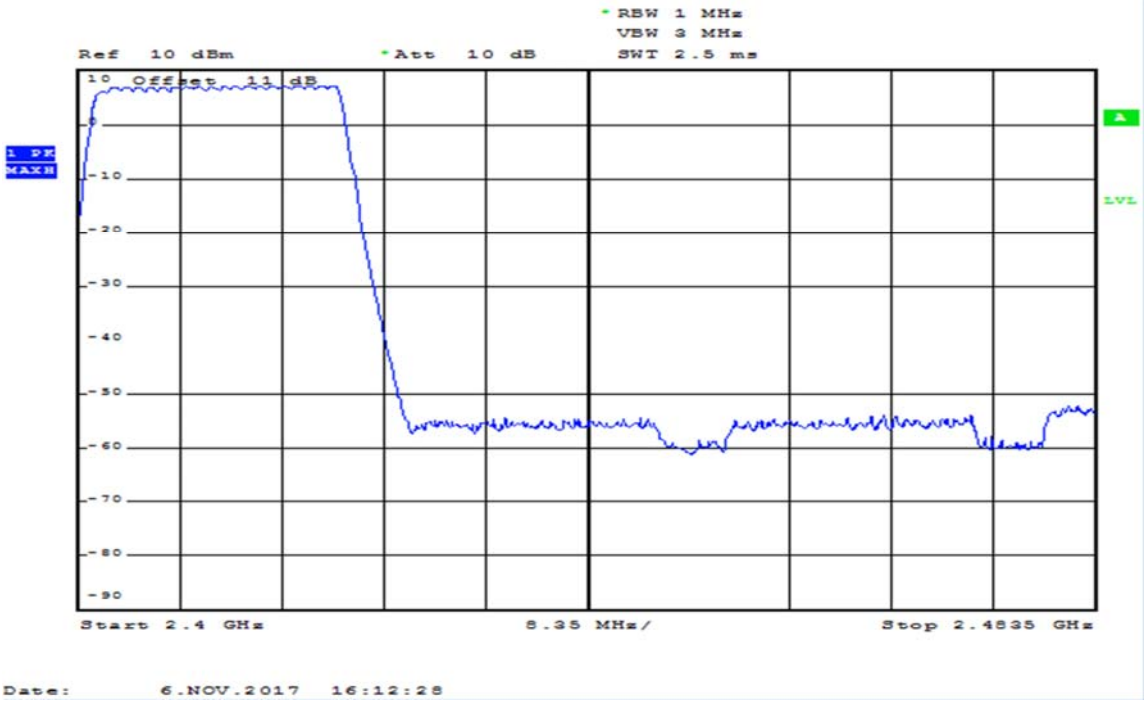
Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

No requirements for Digital Transmission Systems.

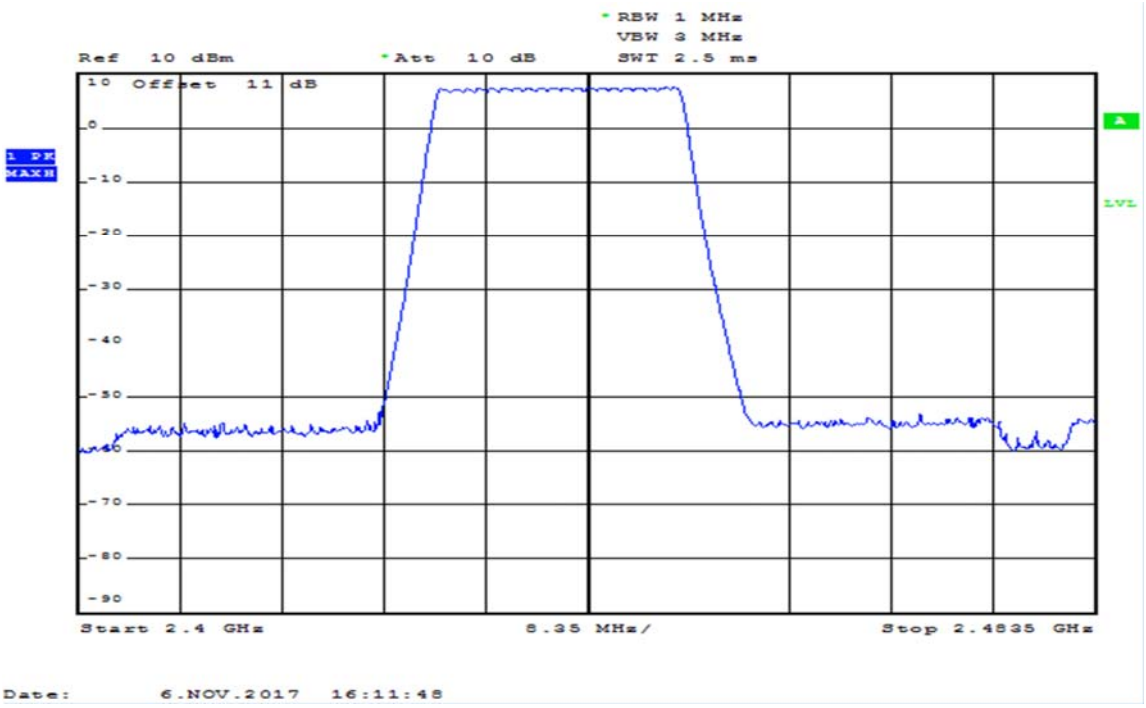
No requirement for 99% BW, reported for information only.



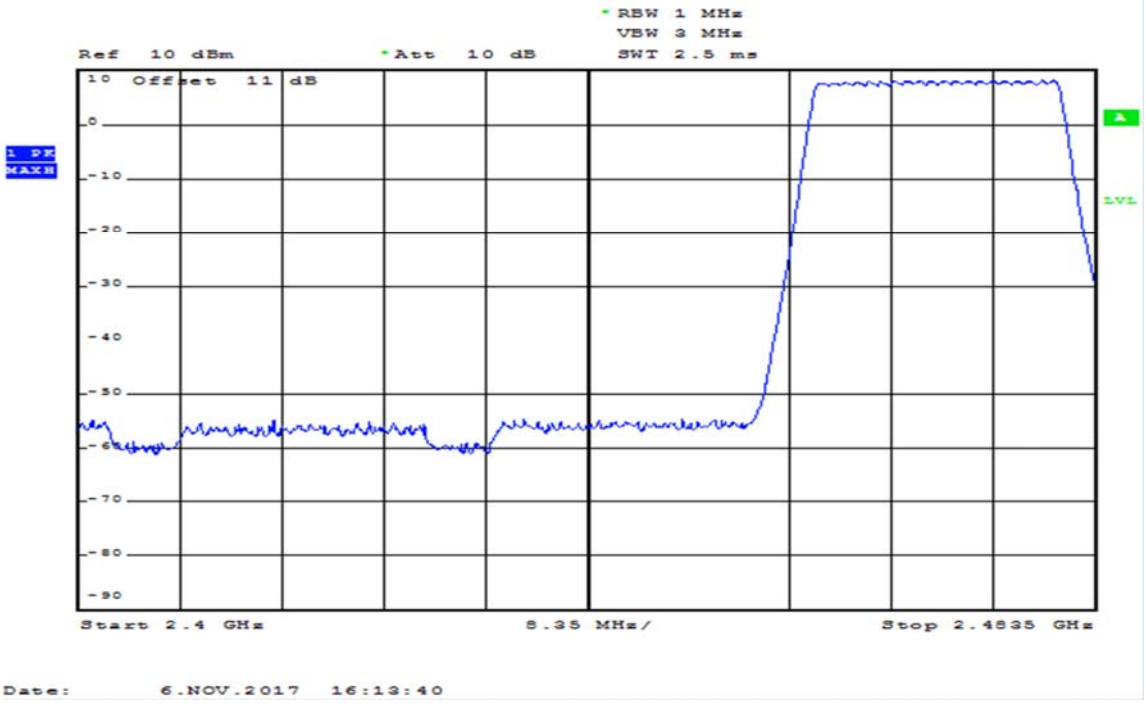
RF Channels in Use, 79 Ch



RF Channels in Use, 20 Ch, Low



RF Channels in Use, 20 Ch, Mid



RF Channels in Use, 20 Ch, High

3.6 Peak Power Output

Para. No.: 15.247 (b)

Test Results: Complies

Measurement Data:

	2402 MHz	2441 MHz	2480 MHz
Peak Power (dBm)	6.18	7.44	8.08
Peak Power (Watts)	4.15	5.55	6.43
Declared Antenna Gain (dBi)	0	0	0
Calculated Field Strength (dBµV/m, @3m)	101.4	102.7	103.3

Field strength is calculated from measured power and declared antenna gain by the formulas in KDB 412172 D01 Determining ERP and EIRP v01r01.

See attached plots.

Requirements:

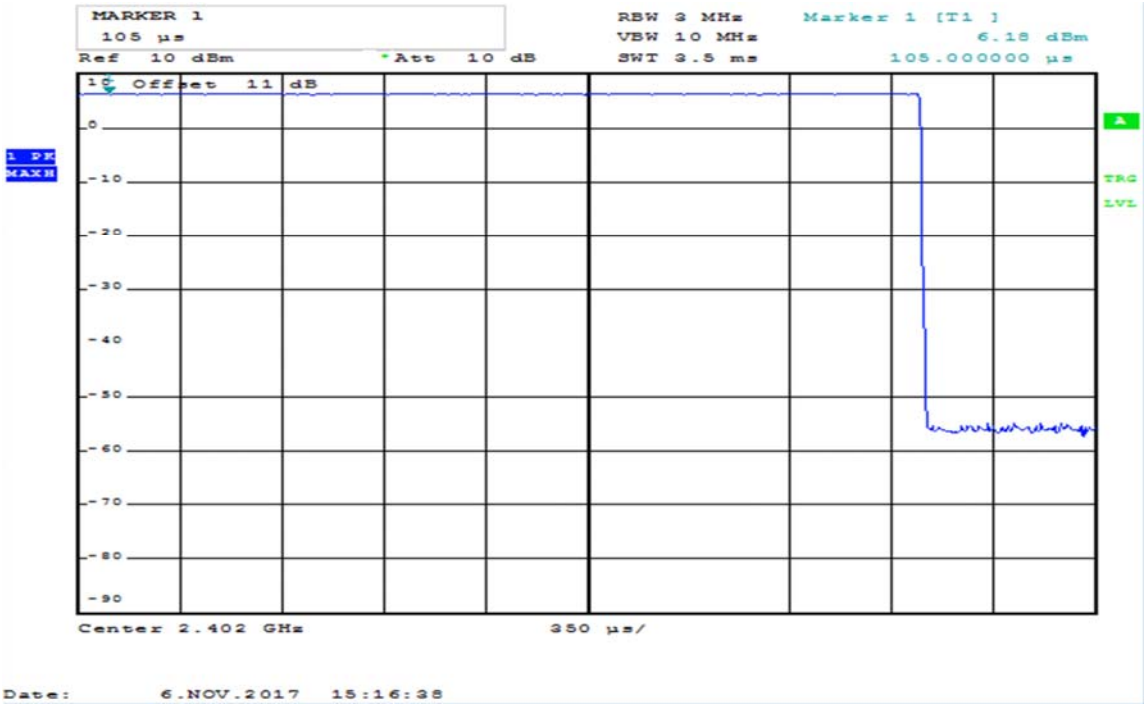
The maximum peak output power shall not exceed the following limits:

For frequency hopping systems employing at least 75 hopping channels: 1 Watt

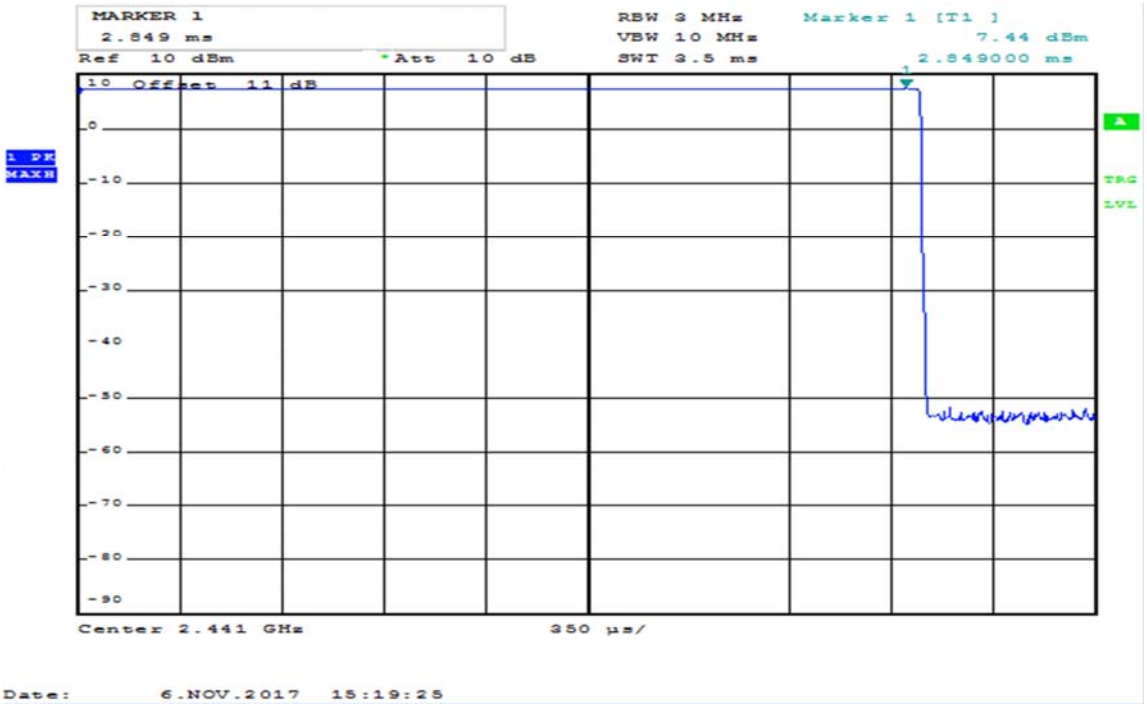
For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

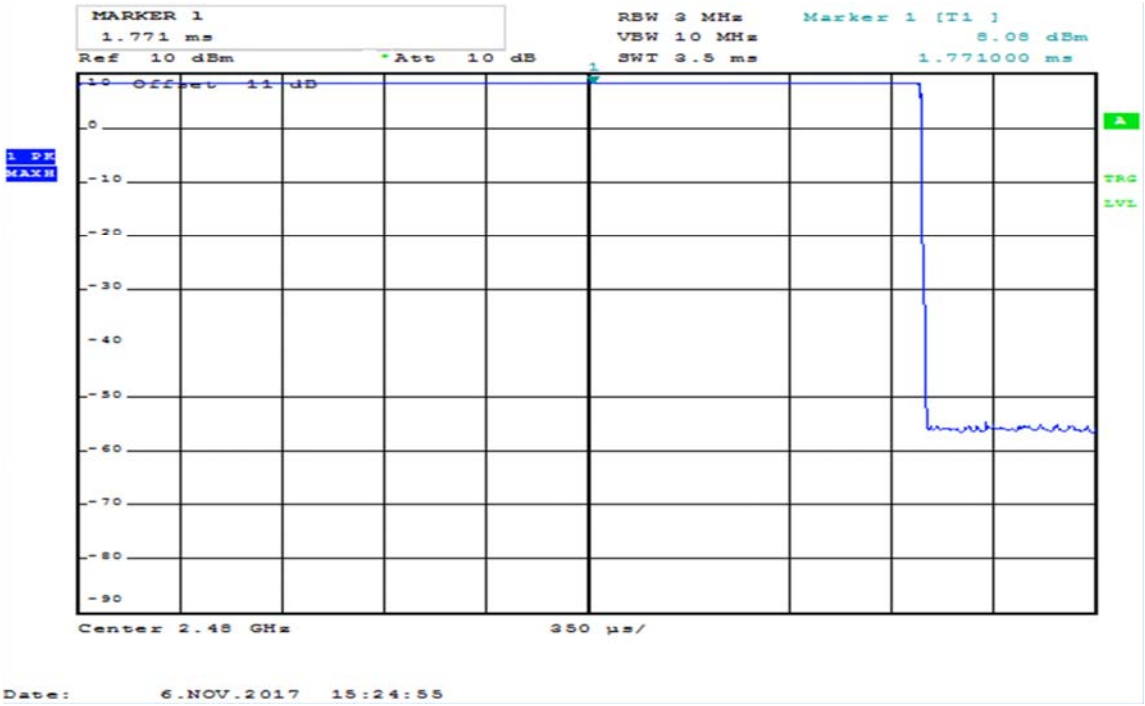
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



Conducted Power, 2402 MHz



Conducted Power, 2441 MHz



Conducted Power, 2480 MHz

3.7 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

Test Results: Complies

Measurement Data:

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
All	> 55	> 35	Pass

Measured with Peak Detector

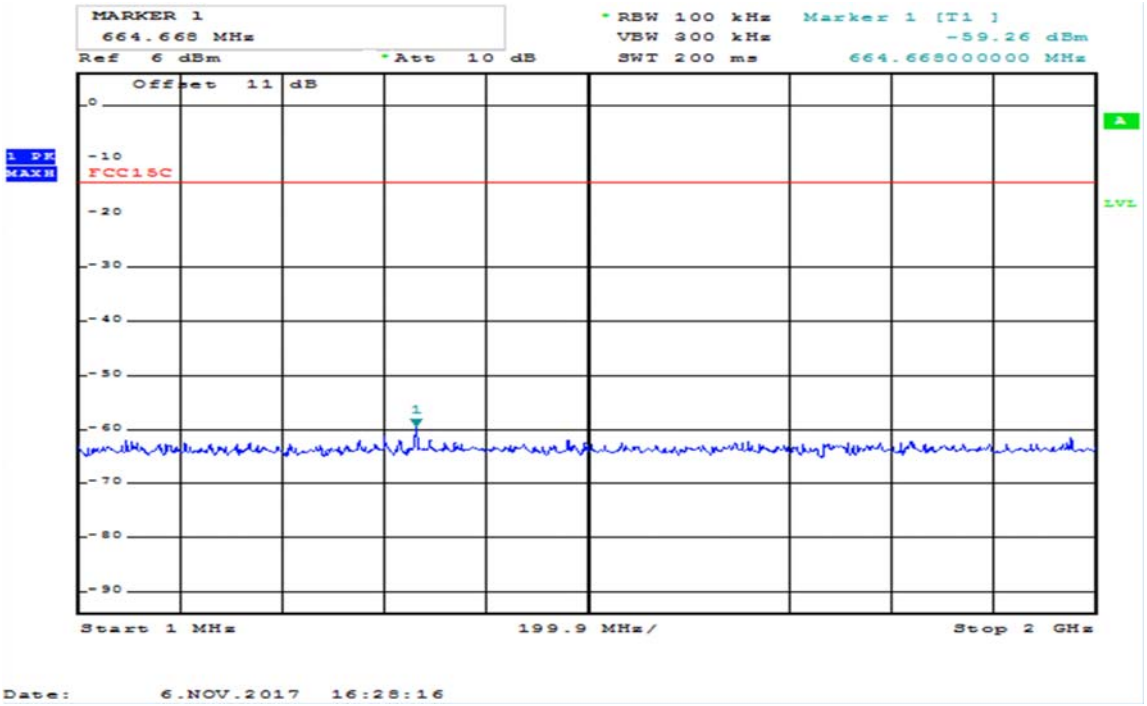
RF conducted power to 25 GHz: see attached plots.

Limit

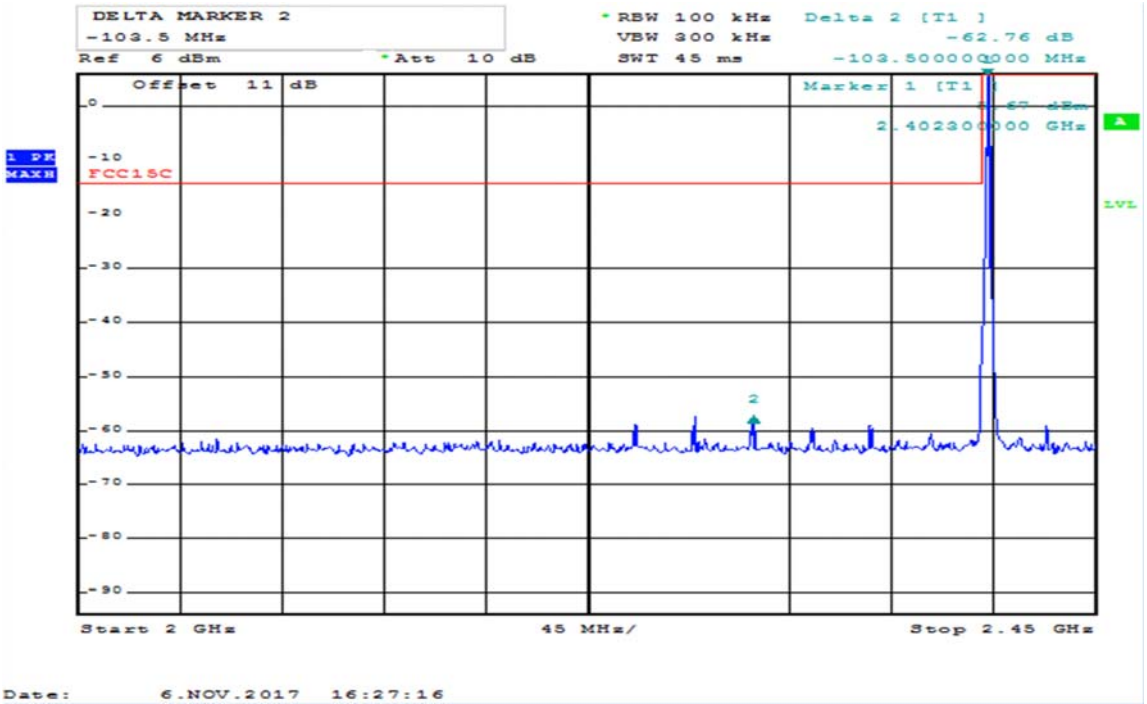
Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

Detector type shall be the same as used for measuring Output Power.

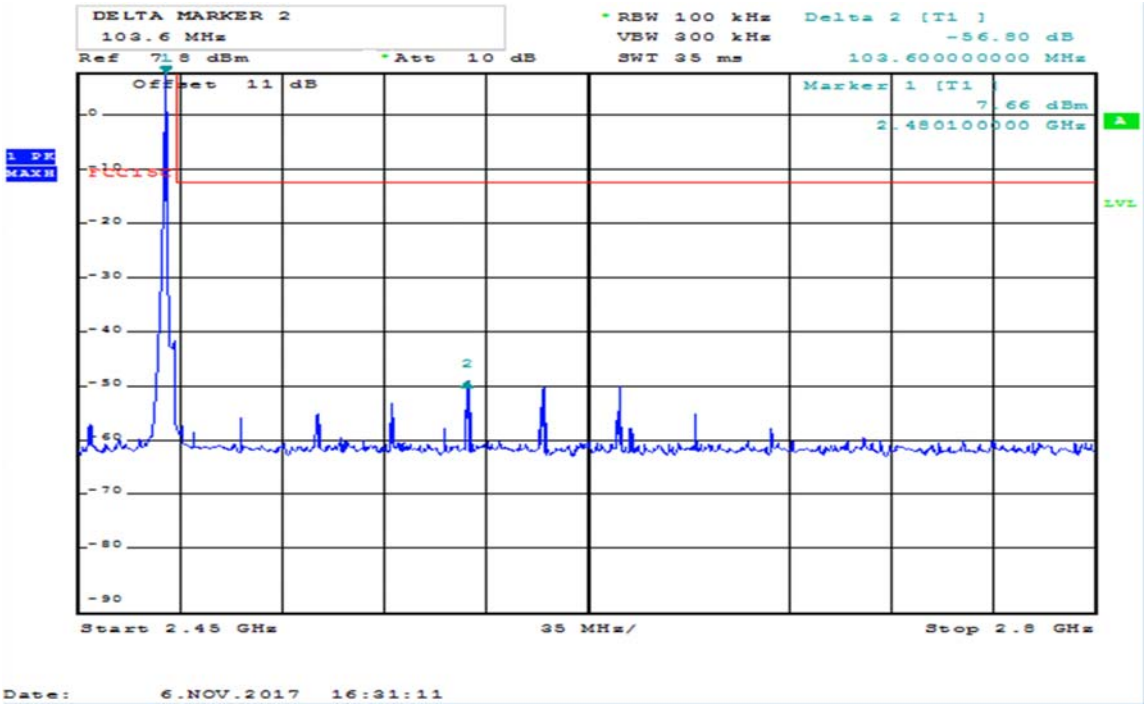
Attenuation below the general limits specified in part 15.209(a) is not required.



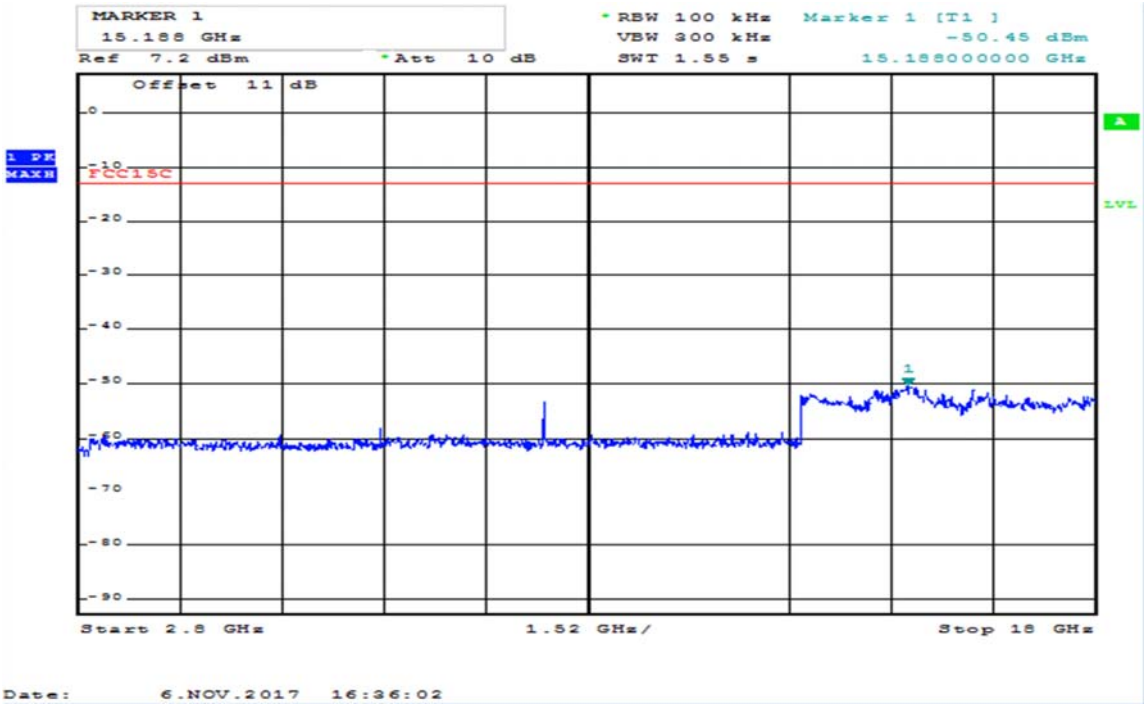
Conducted Emissions, 1 -2000MHz, ch00



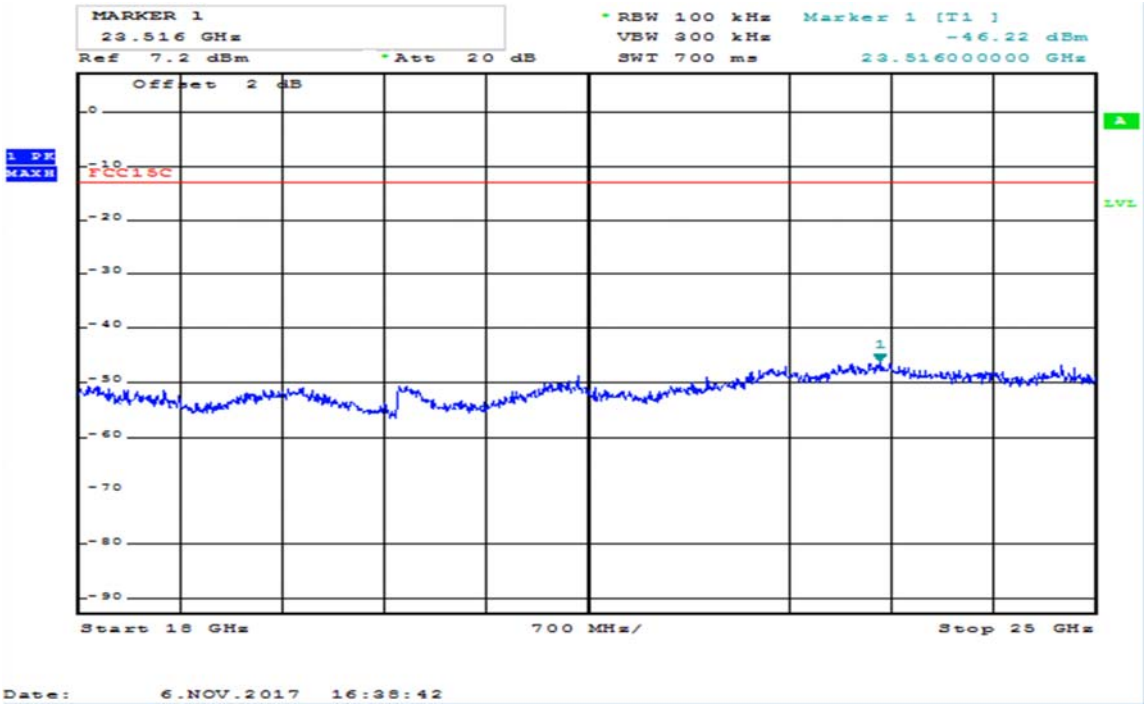
Conducted Emissions, 2000 -2450MHz, ch00



Conducted Emissions, 2450 -2800MHz, ch79



Conducted Emissions, 2800 -18000MHz, ch39



Conducted Emissions, 18000 -25000MHz, ch39

3.8 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED RSS-GEN, Issue 4 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 4, clause 8.9.

FCC (MHz)	ISED (MHz)	FCC (GHz)	ISED (GHz)
0.090-0.110		**0.96-1.24** **1.3-1.427**	**0.96-1.427**
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	5.677-5.683	**2.4835-2.5**	
6.215-6.218		**2.69-2.9**	**2.655-2.9**
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		**3.6-4.4**	**3.5-4.4**
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
108-121.94 **123-138**	**108-138**	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISED, all other frequencies are common.

3.9 Spurious Emissions (Radiated)

FCC Part 15.209

Test Results: Complies

Measurement Data:

Peak Detector:

Modulation and Bitrate	Calculated field strength (dBµV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
Hopping On	43.2	64.2	74	30.8	9.8
Hopping Off	40.0	64.5	74	34.0	9.5

Average Detector:

Modulation and Bitrate	Calculated field strength (dBµV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB	dB	
Hopping On	23.2	44.2	54	30.8	9.8
Hopping Off	20.0	44.5	54	34.0	9.5

Average values are calculated from Peak values.

See attached plots.

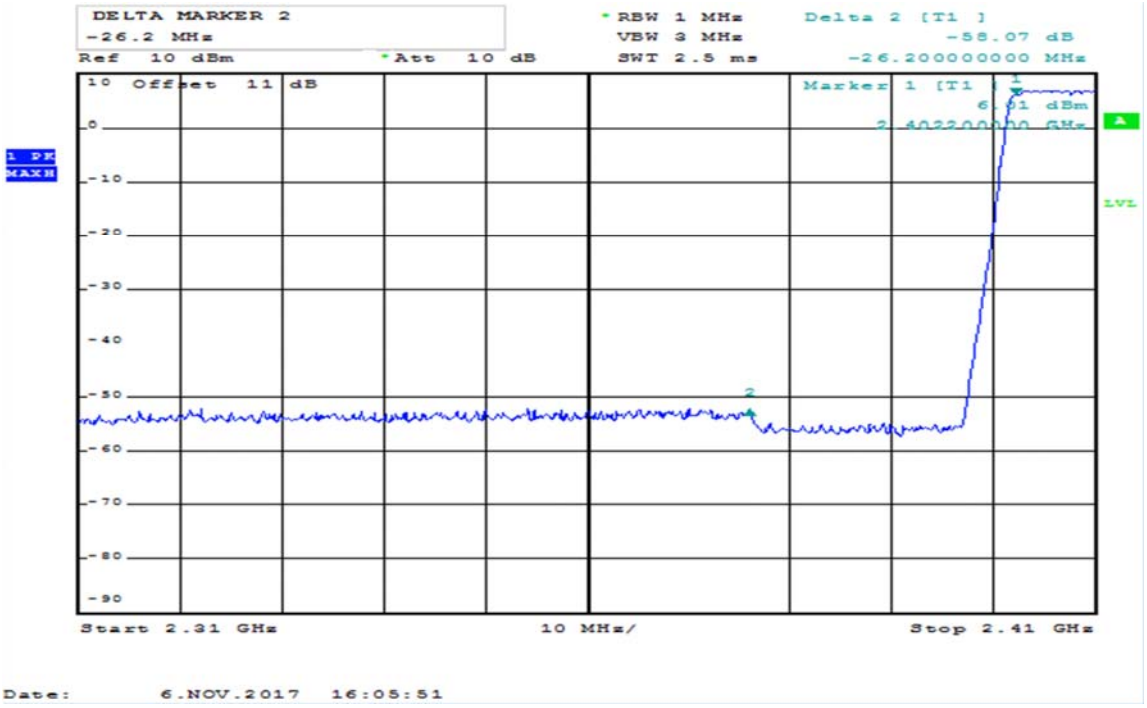
Carrier Freq (MHz)	EUT Mode	Carrier Power (dBm)	Carrier (dBµV/m)	Spurious Level (dB vs. Carrier)	Spurious Level (dBµV/m)
2402	Hopping ON	6.01	101.24	-58.07	43.2
2402	Hopping OFF	6.08	101.31	-61.29	40.0
2480	Hopping ON	7.95	103.18	-38.40	64.2
2480	Hopping OFF	7.96	103.19	-38.29	64.5

Duty Cycle Correction Factor

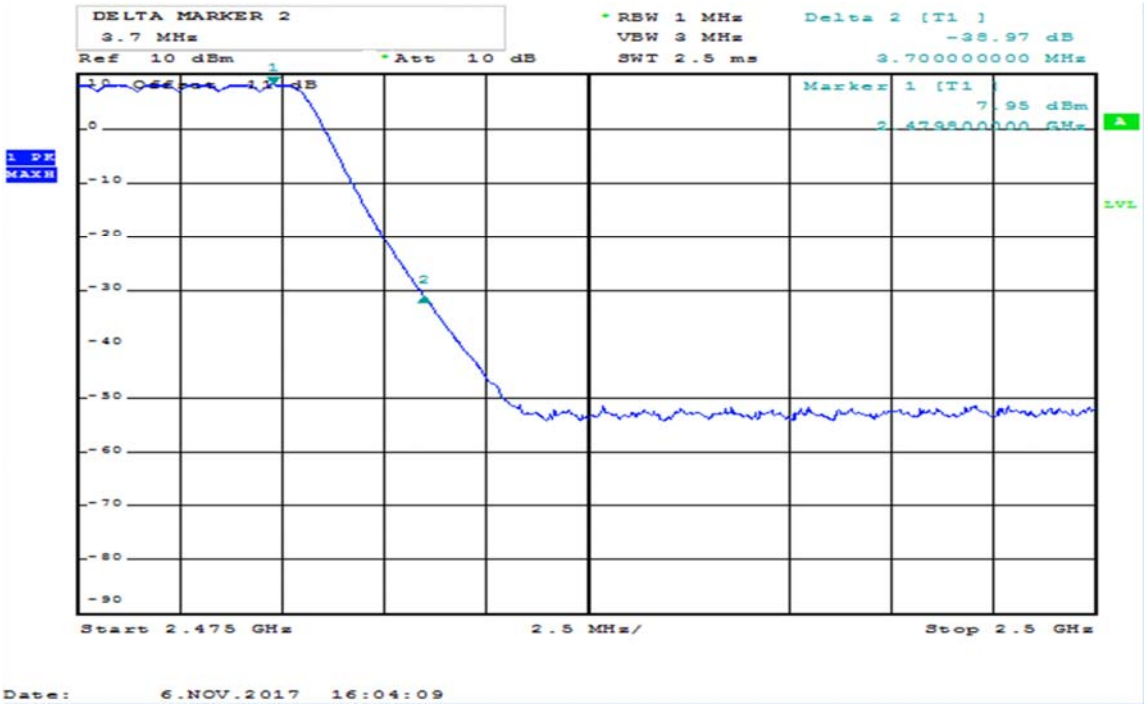
Correction Factor = -20 x log(Burst Length / (Frame Length * Number of Hopping Channels))

= -20 x log(2.91 / (3.76 * 20) dB = 28.25 dB

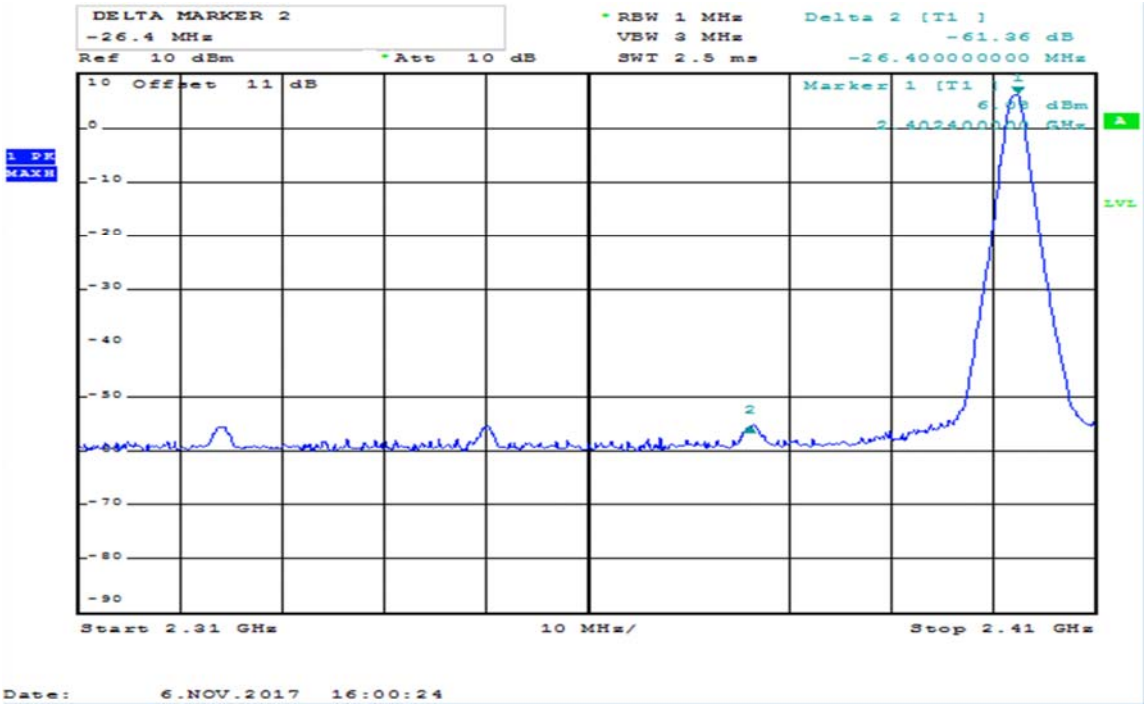
Maximum Allowed Correction Factor = 20 dB



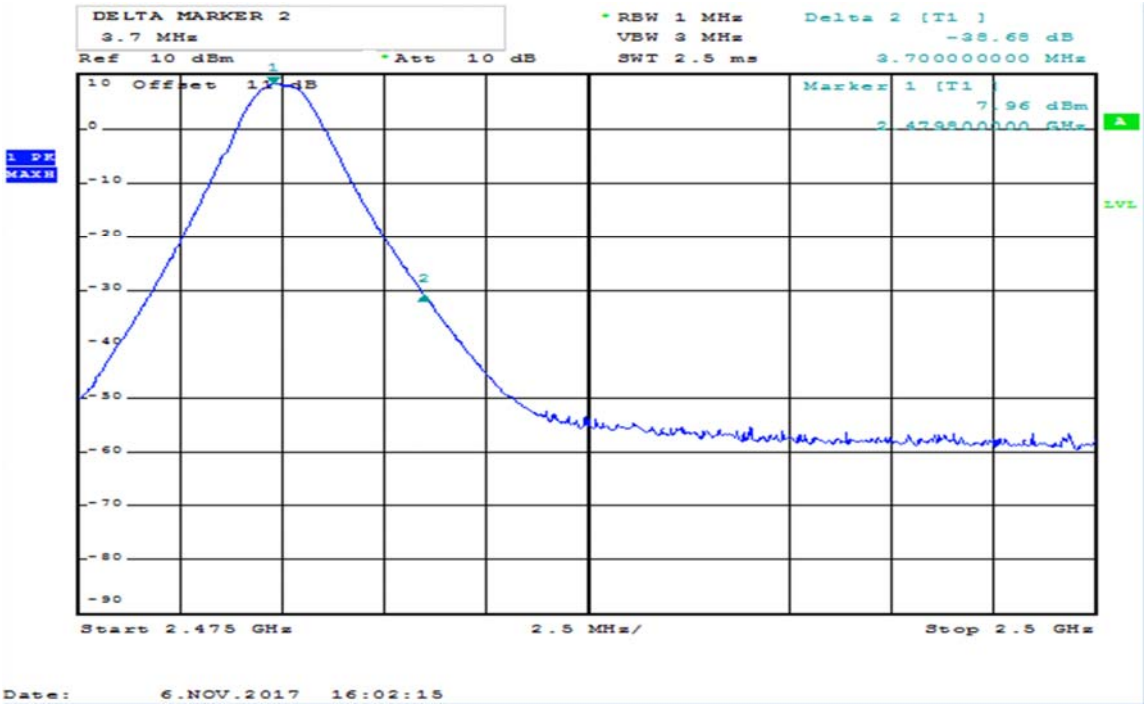
Band Edge, Lower, Peak, 2402 MHz, Hopping On



Band Edge, Upper, Peak, 2480 MHz, Hopping On



Band Edge, Lower, Peak, 2402 MHz, Hopping Off



Band Edge, Upper, Peak, 2480 MHz, Hopping Off

3.10 Radiated Emissions, below 1GHz

FCC 15.205, 15.209

ISED RSS-GEN, Issue 4, Clause 8.9

Test Results: Complies

Radiated emission 30 – 1000 MHz

Measuring distance 3m.

Tested in test mode with EUT transmitting on ch39.

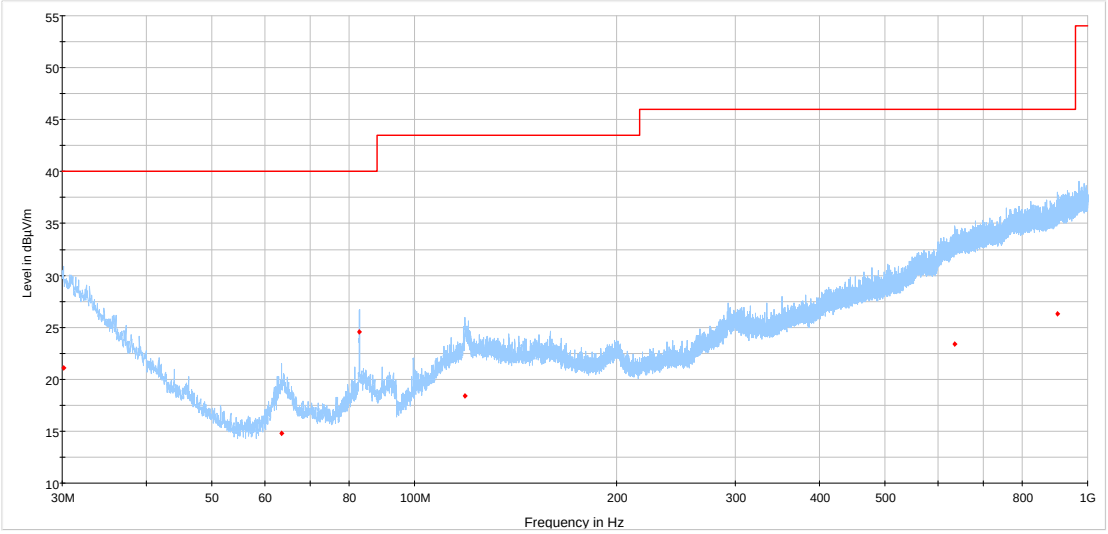
Measured values (QuasiPeak):

Frequency (MHz)	Polarization	Height (cm)	Azimuth (deg)	Bandwidth (kHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.12	V	174.6	258	120	21.1	40	18.9
63.51	V	106.7	9	120	14.8	40	25.2
82.92	V	121.3	179	120	24.6	40	15.4
118.95	V	102.0	286	120	18.4	43.5	25.1
635.16	H	282.3	92	120	23.4	46	22.6
902.31	H	366.8	66	120	26.3	46	19.7

See attached plots.

Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 4, clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency (MHz)	Quasi Peak (µV/m)	Quasi Peak (dBµV/m)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0



Radiated Emissions, 30 -1000MHz (Peak Detector)

3.11 Radiated Emissions, above 1GHz

FCC 15.205, 15.209

ISED RSS-GEN, Issue 4, Clause 8.9

Test Results: Complies

Measurement Data:

Radiated Emissions, 1-25 GHz

Measuring distance: 3m (1 – 18 GHz)
1m (18 – 26 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Measured values:

Frequency (MHz)	Channel	Polarization	Max Peak (dBµV/m)	Average (dBµV/m)	Peak Margin (dB)	Av Margin (dB)
4882	39	V	41.9	21.9	32.1	32.1
7323	39	V	43.3	23.3	30.7	30.7

All emissions are below the Average Limit even when measured with Peak Detector.

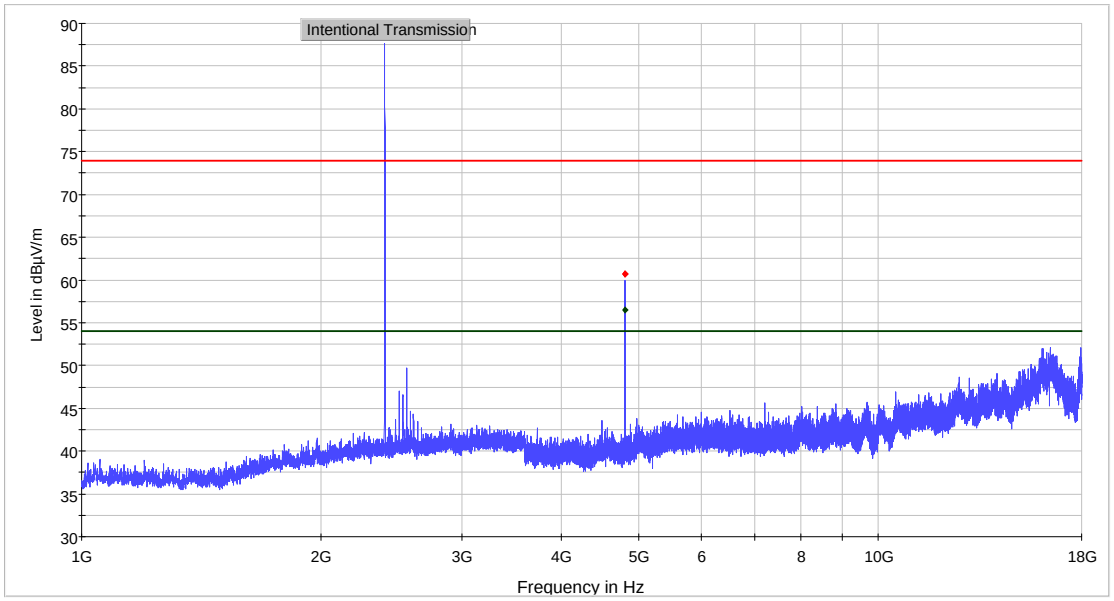
Average Values are calculated from Peak Values by Duty Cycle Correction Factor.

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer “Transducer factor”.

Plots shows scan performed without highpass filter, harmonics are generated in the preamplifier.

Requirements/Limit

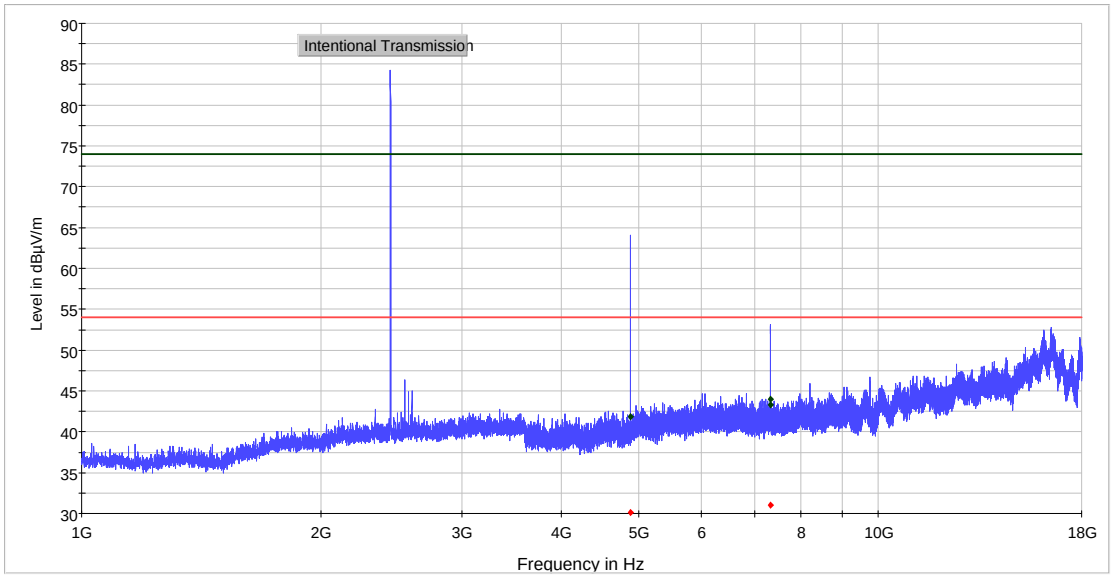
FCC	**Part 15.209 @ frequencies defined in §15.205**	
ISED	**RSS-GEN Issue 4, clause 8.9 @ frequencies defined in clause 8.10**	
	Radiated emission limit @3 meters	
Frequency (MHz)	**AV (dBµV/m)**	**Peak (dBµV/m)**
Above 1 GHz	**54.0**	**74.0**



RE 1 to 18 GHz TGE670 [low channel]

- MaxPeak-PK+ (Single)
- PK+_MAXH
- FCC Part 15 and ICES - Class B 3m Average Limit
- FCC Part 15 and ICES- Class B 3m Peak Limit
- CAverage-CAV (Single)

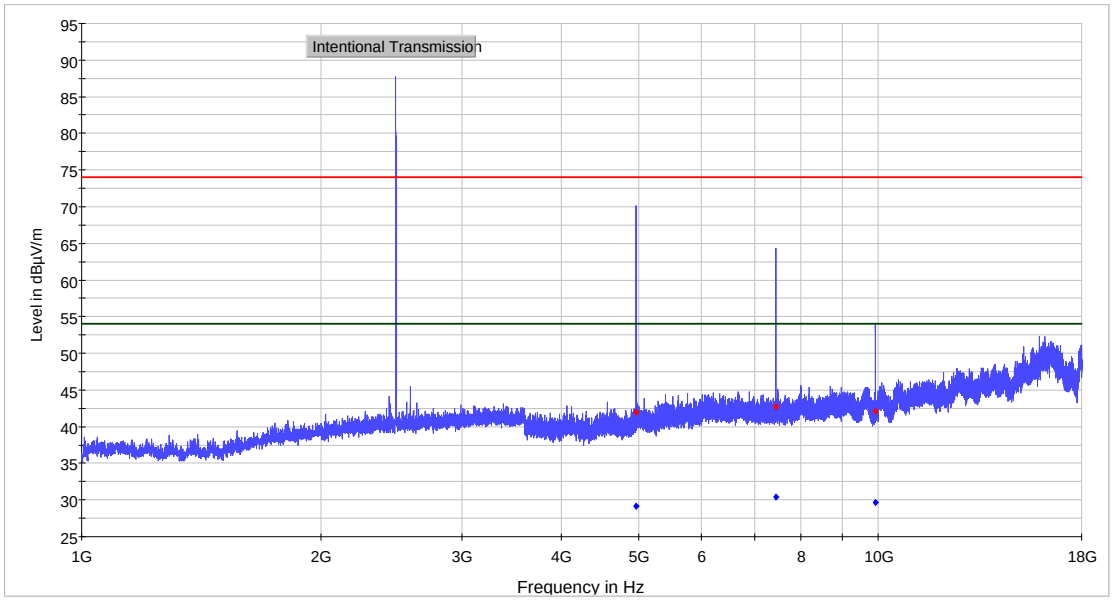
Radiated Emissions, 1 -18 GHz, ch00 (Peak)



RE 1 to 18 GHz TGE660 [middle channel]

- AVG_MAXH
- PK+_MAXH
- FCC Part 15 and ICES - Class B 3m Average Limit
- FCC Part 15 and ICES- Class B 3m Peak Limit
- MaxPeak-PK+ (Single)
- CAverage-CAV (Single)

Radiated Emissions, 1 -18 GHz, ch39 (Peak)



RE 1 to 18 GHz TGE670 [high channel]

PK+_MAXH
FCC Part 15 and ICES - Class B 3m Average Limit
FCC Part 15 and ICES- Class B 3m Peak Limit
CAverage-CAV (Single)
MaxPeak-PK+ (Single)

Radiated Emissions, 1 -18 GHz, ch78 (Peak)

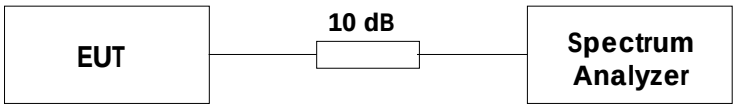
4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		**Uncertainty**
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted (RBW < 100 kHz)	**< 3.6 GHz**	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	**< 1 GHz**	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	**Frequency**	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Timing and Jitter Measurements		±2.0 ns
Frame Timing Measurements		±1.4 ppm
Receiver Blocking Levels		±1.0 dB
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

5 Test Setups

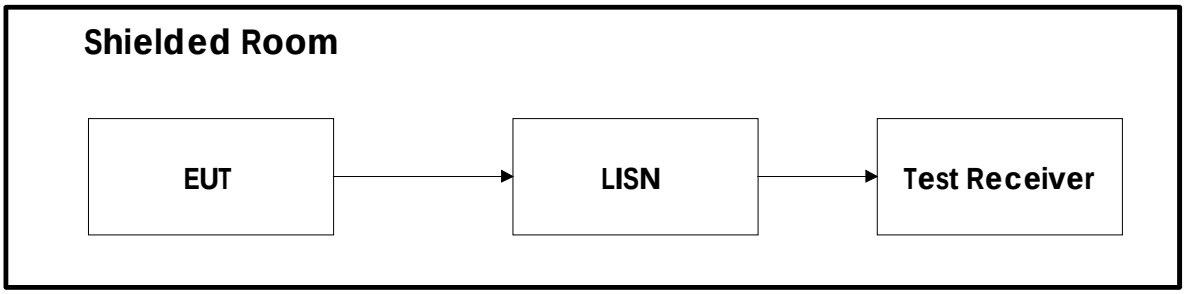
5.1 Conducted Emission Test



Test Set-up 3

This setup is used for all conducted emission tests.

5.2 Power Line Conducted Emissions Test



Test Set-Up 5

6 Test Equipment Used

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Testhouse.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSP30	Spectrum Analyzer	Rohde & Schwarz	LR 1551	2017.06	2019.06
2	6810.17B	Attenuator	Suhner	LR 1669	COU	
3	ESU 26	Receiver/spectrum analyzer	Rohde & Schwarz	FA002043	2017.01	2018.01
4	JB3	Hybrid Antenna	Sunol	FA002108		
5	Model 3117	Horn Antenna with Preamplifier	EMCO	FA002840		
6	ENV216	LISN	Rohde & Schwarz	FA002023	2017.05	2018.05
7	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

Note: COU – calibrate on use; N/A – Not Applicable

The software listed below has been used for one or more tests.

No.	Manufacturer	Name	Version	Comment
1	Agilent	Intuitlink Data Capture	2.1.0	Screenshots from HP 53310A
2	Rohde & Schwarz	EMC 32	9.26.01	Software for EMC Measurements of Power-Line Conducted Tests

Revision history

Version	Date	Comment	Sign
1.0	2017.11.14	First edition	FS