EMC Test Report
for
LPRU 4410 B5B12A
(With LTE and NR signals)

Tested to: FCC Part 15 Subpart B
FCC Part 22 (Section 22.917(a))
FCC Part 27 (Section - 27.53(g))
ICES-003

Test Result summury

FCC/ ICES Section	Description	Specification/Method	Pass or Fail	Results in section
15.109 / 6.2	Radiated Emissions (RE)	FCC Part 15 / ICES 003 / ANSI C63.4	Pass	3.2
15.107 / 6.1	Conducted Emissions (CE) for AC Power	FCC Part 15 / ICES 003 / ANSI C63.4	Pass	3.3
27.53(C)	Transmitter Spurious Emissions (RE)	FCC Part 27 / ANSI C63.26	Pass	3.2
22.917(a)	Out of band Emissions (RE)	FCC Part 22 / ANSI C63.26	Pass	3.2

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Prepared for: Ericsson Canada

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Release control record

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Issue	Reason for change	Date released
01	initial release	7 May 2020

Approvals

Function	Name	Job title	Signature
Technical Reviewer	Scott Drysdale	Canada Wireless Manager	
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1. Executive summary

This document reports the Electromagnetic Compatibility (EMC) testing performed on the product called LPRU 4410 B5B12A for Ericsson Canada per project number 7169007217. The objective of the test activities is to evaluate compliance of the product to following EMC regulatory standards.

The LPRU 4410 B5B12A is verified to comply with the Class B Emissions requirements of these standards:

- FCC Part 15 Subpart B [5] (Class B)
- ICES 003 [9] (Class B)
- FCC Part 22[7] (Emissions Limitations for cellular equipment, Section 22.917(a))
- FCC Part 27 [8] (Digital Base Stations, Section - 27.53(g))

Information about the test result summary and, the equipment under test (EUT) is in the sections:

- Compliance summary
- Details of the equipment under test
- Detailed test results of Emissions

1.1 Compliance summary

The test results in this report apply only to the tested components that are identified in the section Assessed hardware.

The following table summarizes the EMC test results for the test cases performed on the LPRU 4410 B5B12A

Table 1: Summary of test results for the USA; FCC Part 15 subpart B

FCC Section	Description	Specification/Method	Pass or Fail	Results in section
15.109	Radiated Emissions (RE)	FCC Part 15/ANSI C63.4	Pass	3.2
15.107	Conducted Emissions (CE) for AC Power	FCC Part 15/ANSI C63.4	Pass	3.3

Table 2: Summary of test results for the USA; FCC Part 22

FCC Section	Description	Specification/Method	Pass or Fail	Results in section
22.917 (a)	Emissions Limitations for cellular equipment – Out of band emissions	FCC Part 22/ ANSI C63.26	Pass	3.2

Table 3: Summary of test results for the USA; FCC Part 27 subpart C

FCC Section	Description	Specification/Method	Pass or Fail	Results in section
27.53(g)	Transmitter Spurious Emissions (RE) – Digital Base Stations	FCC Part 27/ ANSI C63.26	Pass	3.2

Table 4: Summary of test results for Canada; ICES-003

ICES Section	Description	Specification/Method	Pass or Fail	Results in section
6.2	Radiated Emissions (RE)	ICES 003/ANSI C63.4	Pass	3.2
6.1	Conducted Emissions (CE) for AC Power	ICES 003/ANSI C63.4	Pass	3.3

2. Details of the equipment under test

This section describes the equipment under test (EUT).

2.1 Assessed hardware

The following table indicates the hardware components that were assessed during this test program.

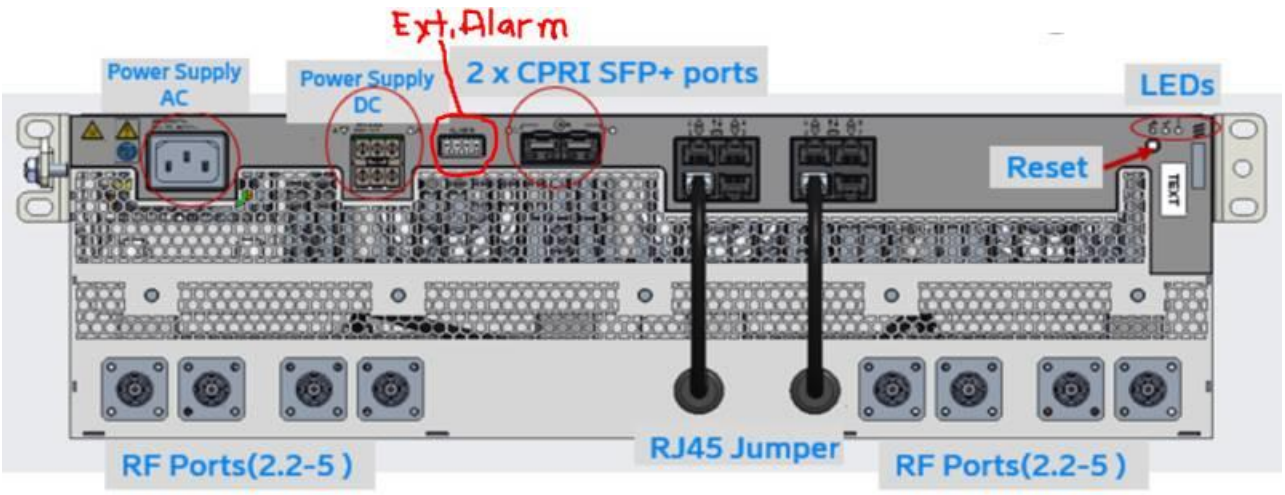
Table 5: Assessed hardware

Hardware component	Part number	Release
Low Power Radio Unit 4410 B5B12A (LPRU 4410, B5B12A)	KRC 161 879/1	R1B

2.2 Product overview

The product trade name is LPRU 4410 B5B12A. The LPRU 4410 product is an indoor wireless telecommunication product. It is a radio unit that provides cellular service. It can operate from AC power (100-250VAC) and DC power (-48VDC).

Figure 1: The EUT, LPRU 4410 B5B12A



Product data:	
Product	LPRU 4410 B5B12A
Revision:	R1B
P/N:	KRC 161 879/1
Nominal Voltage:	110VAC or -48VDC
Operating Temperature:	-5°C to +55°C
Dimensions: (H x W x D)	442 x 132 x 370mm (WxHxD)
Weight;	11.4 kg
Band 5: (BC2) - DL: 869 - 894MHz; UL: 824 - 849MHz	
Capability sets (SC):	CS16
Markets:	FCC
No of RF ports:	4 (1A,1B,1C,1D)
Output power per port:	50mW
Limitation outp power:	
IBW:	25MHz
IBW limitation:	Contiguous operations only
RAT supported	LTE+NBIoT IB/GB, NR, NR + LTE SC, MC
supported LTE BW:	5, 10MHz
supported NR BW:	5, 10, 15, 20MHz
Max No of carriers per port in MR:	
Max no of NR per port	2
Max no of LTE per port	5
Max no of GSM per port	
Modulations, LTE	QPSK, 16QAM, 64QAM, 256QAM
Modulations, GSM	
NB IoT IB per LTE host	1
NB IoT GB per LTE host (min 10MHz)	1
NB IoT SA per port	
NR FDD FR1	
CIPR	
Band 12A: (BC1) - DL: 729 - 745MHz; UL: 699 – 715MHz	
Capability sets (SC):	CS16
Markets:	FCC
No of RF ports:	4 (2A,2B,2C,2D)
Output power per port:	50mW
Limitation outp power:	

Product data:	
IBW:	16MHz
IBW limitation:	Contiguous operations only
RAT supported	LTE+NBIoT IB/GB, NR, NR + LTE SC, MC
supported LTE BW:	5, 10MHz
supported NR BW:	5, 10, 15MHz
Max No of carriers per port in MR:	3
Max no of NR per port	2
Max no of LTE per port	3
Max no of GSM per port	
Modulations, LTE	QPSK, 16QAM, 64QAM, 256QAM
Modulations, GSM	
NB IoT IB per LTE host	1
NB IoT GB per LTE host (min 10MHz)	1
NB IoT SA per port	
CIPR	

The Configurations of the LPRU 4410 B5B12A that were tested is shown in the section Configurations of the EUT. The EUT was tested in a tabletop setting.

2.3 Product port definition and EUT cable information

Table 6 identifies all the cables and ports on the EUT. The Environment of the cables is indoor.

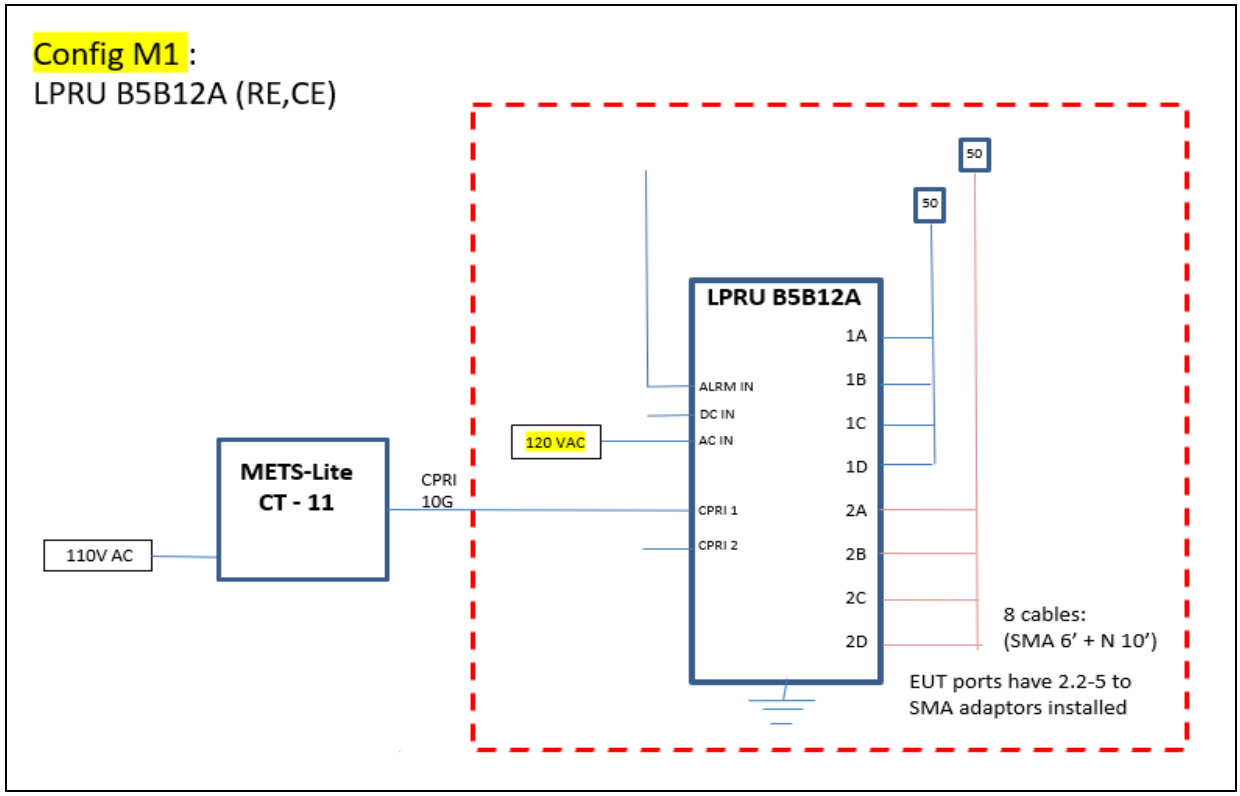
Table 6: System port definition

Port Name	Port Description	Port Type	Interface Detail	Plug-Cable Type	Port Test setup
AC-IN	100-250VAC, 50/60 Hz	AC Power	AC, single phase	C14, AC cable	6' cable, C14,
DC-IN-A/B	-48VDC, 3 Wire, A and B feed inputs	DC Power	3-wire or 2-wire	3-wire, AWG-10, 6mm2	1 branch is enough, test both 2w & 3w,
Alarm	External Alarm Input 1 and 2	Signal	2x2pin, single ended	AWG, unshielded,	1 branch
Data-1/2	CPRI -1 and -2	Telecom	CPRI, 2.5/5/9.8/10.1 Gbs	Optical SFP+ fiber (1km), No support for eCPRI	none
dRDI 1-8	IRU/DOT Interface, partly Internal	Internal	5G/10GBase-T, Ethernet	RJ-45, Cat6A, fixed internal termination	none
1A / 1B / 1C / 1D	RF I/O ports - Band 5	Antenna	to active DAS ports (Dot side1)	2.2-5 connector,	SMA adaptor used on all ports,
2A / 2B / 2C / 2D	RF I/O ports - Band 13	Antenna	to active DAS ports (Dot side 2)	2.2-5 connector,	SMA adaptor used on all ports,
MMI	LPRU Status LEDs	n/a	n/a	n/a	none
Ground	Ground Lug (EUT front)	Ground	AWG-6, wire	Dual Hole Flag Lug, AWG-6 (RPM777567)	6' Gnd cable attached

2.4 Configurations of the EUT

Figure 2 shows the configuration of the EUT for Emissions test.

Figure 2: Test configuration for Emission tests



2.4.1 Radiated Emissions Single RAT / Single Carrier Configurations with LTE

Figure 3: Tested carrier detail – Single RAT / Single carrier (LTE)

SR LTE, Config SC 1			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: L, 5MHz, 881.5MHz	1	B12A: L, 5MHz, 737MHz
SR LTE, Config SC 2			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NBIoT GB 876.4MHz (PRB1)	1	B12A: L, 10MHz, 737MHz
2	B5: L, 10MHz, 881.5MHz		
3	B5: NBIoT GB 886.4MHz (PRB50)		
SR LTE, Config SC 3			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: L, 10MHz, 881.5MHz	1	B12A: NBIoT GB 732.4MHz (PRB1)
		2	B12A: L, 10MHz, 737MHz
		3	B12A: NBIoT GB 741.6MHz (PRB50)
SR LTE, Config SC 3 Middle channel			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: L, 10MHz, 881.5MHz	1	B12A: NBIoT GB 732.4MHz (PRB1)
		2	B12A: L, 10MHz, 737MHz
		3	B12A: NBIoT GB 741.6MHz (PRB50)
SR LTE, Config SC 3 Bottom channel			
Carrier:	**Bottom**	Carrier:	**Bottom**
1	B5: L, 10MHz, 874MHz	1	B12A: NBIoT GB 729.4MHz (PRB1)
		2	B12A: L, 10MHz, 734MHz
		3	B12A: NBIoT GB 738.6MHz (PRB50)
SR LTE, Config SC 3 Top channel			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: L, 10MHz, 889MHz	1	B12A: NBIoT GB 735.4MHz (PRB1)
		2	B12A: L, 10MHz, 740MHz
		3	B12A: NBIoT GB 744.6MHz (PRB50)

Note: Radiated Emissions measurements were compared between SC 1, SC 2, and SC 3. SC3 was found to have higher emissions than SC 1 and SC 2. All plots with single carrier in this report are therefore measured using SC 3 carrier configurations.

2.4.2 Radiated Emissions Single RAT / MultiCarrier Configurations with LTE

Figure 4: Tested carrier detail – Single RAT / Multicarrier (LTE)

SR LTE, Config MC 5 (LTE Multi-carrier #5)			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: L, 10MHz, 874MHz	1	B12A: NBIoT GB 729.4MHz (PRB1)
2	B5: L, 10MHz, 884MHz	2	B12A: L, 10MHz, 734MHz
		3	B12A: NBIoT GB 738.6MHz (PRB50)
		4	B12A: L, 5MHz, 741.5MHz
SR LTE, Config MC 7 (LTE Multi-carrier #7)			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: L, 10MHz, 874MHz	1	B12A: NBIoT GB 729.4MHz (PRB1)
2	B5: L, 5MHz, 881.5MHz	2	B12A: L, 10MHz, 734MHz
3	B5: L, 5MHz, 886.5MHz	3	B12A: NBIoT GB 738.6MHz (PRB50)
		4	B12A: L, 5MHz, 741.5MHz

Note: Radiated Emissions measurements were compared between MC 5 and MC 7. MC5 was found to have higher emissions. All plots with multicarrier in this report are therefore measured using MC5 carrier configuration.

2.4.3 Radiated Emissions Single RAT / Single Carrier Configurations with NR

Figure 5: Tested carrier detail – Single Rate / Single carrier (NR)

SR NR, Config SC 1			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NR, 5MHz, 881.5MHz	1	B12A: NR, 5MHz, 737MHz
SR NR, Config SC 2			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NR, 10MHz, 881.5MHz	1	B12A: NR, 10MHz, 737MHz
SR NR, Config SC 3			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NR, 15MHz, 881.5MHz	1	B12A: NR, 15MHz, 737MHz
SR NR, Config SC 4			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NR, 20MHz, 881.5MHz	1	B12A: NR, 15MHz, 737MHz
SR NR, Config SC 3 Middle channel			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NR, 15MHz, 881.5MHz	1	B12A: NR, 15MHz, 737MHz
SR NR, Config SC 3 Bottom channel			
Carrier:	**Bottom**	Carrier:	**Bottom**
1	B5: NR, 15MHz, 876.5MHz	1	B12A: NR, 15MHz, 737MHz
SR NR, Config SC 3 Top channel			
Carrier:	**Top**	Carrier:	**Top**
1	B5: NR, 15MHz, 886.5MHz	1	B12A: NR, 15MHz, 737MHz

Note: Radiated Emissions measurements were compared between SC 1, SC 2, SC 3 and SC 4. SC 3 was found to have higher emissions than SC 1, SC 2 and SC 3. All plots with single carrier in this report are therefore measured using SC 3 carrier configuration.

2.4.4 Radiated Emissions Single RAT / MultiCarrier Configuration with NR

Figure 6: Tested carrier detail – Single RAT / MultiCarrier Configuration (NR)

SR NR, Config MC 1 (Multi-carrier NR Middle)			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NR, 15MHz, 876.5MHz	1	B12A: NR, 15MHz, 737MHz
2	B5: NR, 10MHz, 889.5MHz		

2.4.5 Radiated Emissions Multi RAT/MultiCarrier Configuration – NR+LTE

Figure 7: Tested carrier detail – MultiCarrier / Multi RAT Configuration (NR)

Multi RAT NR+LTE, Config MR 4			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NR, 15MHz, 876.5MHz	1	B12A: NR, 5MHz, 731.5MHz
2	B5: L, 10MHz, 889MHz	2	B12A: NBIoT GB 735.4MHz (PRB1)
		3	B12A: L, 10MHz, 740MHz
		4	B12A: NBIoT GB 744.6MHz (PRB50)
Multi RAT NR+LTE, Config MR 5			
Carrier:	**MIDDLE**	Carrier:	**MIDDLE**
1	B5: NR, 15MHz, 876.5MHz	1	B12A: NR, 15MHz, 737MHz
2	B5: L, 10MHz, 889MHz		

Note: Radiated Emissions measurements were compared between MR 4 and MR 5. MR 4 was found to have higher emissions than MR 5. All plots with single carrier in this report are therefore measured using MR 4 carrier configuration.

2.4.6 Conducted Emissions Carrier Configuration – LTE

Figure 8: CE tested carrier detail

Config M1 Carrier Config for CE			
B5 PORT 1A,1B, 1C,1D		B12A Port 2A, 2B, 2C, 2D	
BS type 1-C, CS16 (NR, E-UTRA), TC21		BS type 1-C, CS16 (NR, E-UTRA), TC21	
Carrier:	**(Conducted Emissions):**	Carrier:	**(Conducted Emissions):**
1	B5: NR, 15MHz, 876.5MHz	1	B12A: NR, 5MHz, 731.5MHz
2	B5: L, 10MHz, 889MHz	2	B12A: NBIoT GB 735.4MHz (PRB1)
		3	B12A: L, 10MHz, 740MHz
		4	B12A: NBIoT GB 744.6MHz (PRB50)

2.5 Modifications of the EUT during testing

The EUT was not modified prior to or during testing.

2.6 Inventory of the EUT and support equipments

The following tables identifies the inventory of the EUT.

Table 7: Inventory of the EUT & Support with LTE (RE & CE tests)

Equipment Role	Product Name	Product Number	Release	Product Serial#
EUT	LPRU 4410 B5B12A	KRC 161 879/1	R1B	TD3F063158
SFP+	Optical SFP+, LC Dual, SM, 10G, 1.4km	RDH 102 65/2		
AC power cable	generic, 14AWG, C14 plug, 2m	RPM 251 063	na	na
Optical Fiber	LC, SM, 20m	na	na	na
RF Adaptor	2.2-5 to SMA Adaptor	na	na	na
RF Cable	N-type, 10m	na	na	na
RF Cable	SMA, 2m	na	na	na
Cable	External Alarm cable, 4w, 22-AWG, 5m	na	na	na
Cable	Ground/FE Dual Hole Flag Lug, AWG-6 cable	RPM 777 567		
TEST SET	CT-10 (DU-SIM)	LPC 102 487/1		T01F311639
Software info				
IRU load: CXP9013268%17_R82GS				

3. Detailed test results of Emissions

Emissions from systems manifest themselves in two forms: conducted emissions on cables and radiated emissions from the entire system (i.e. electronic modules, hardware, and cables). Regulatory standards restrict these different forms of emissions generated by the system.

The temperature and humidity in the test facilities are controlled. The temperature is maintained between 20 ºC and 25 ºC, with a relative humidity between 30 % and 60 %. Levels are recorded and any exceptions are included in the detailed test results sections of this report.

3.1 Measurement instrumentation

The measurement instrumentation conforms to the relevant standards in this report: ANSI C63.2, CISPR 16, CISPR 22, and CISPR 32. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

3.2 Radiated Emissions, E-field

This test verifies that the EUT does not produce excess amounts of E-field Radiated Emissions (RE) that could interfere with licensed radiators.

3.2.1 Test specification and limits

The testing requirements are as follows.

Table 8: RE test requirements

Requirement	Method	Country of application
FCC Part 15, Subpart B	ANSI C63.4	USA
FCC Part 27,	ANSI C63.4	USA
ICES 003	ANSI C63.4	Canada

The limits of the RE tests are as follows.

Table 9: RE limits at 10 m for Class B of FCC

Frequency range (MHz)	FCC Part 15 & ICES 003 (dBμV/m)	Detector
30 to 88	29.5	Quasi-Peak
88 to 216	33.0	Quasi-Peak
216 to 960	35.5	Quasi-Peak
960 to 1000	43.5	Quasi-Peak
1000 to 40000	43.5 [1]	Average

Table 10: Emission limits for FCC Part 27 & Part 22

Frequency range (MHz)	EIRP Limit (dBm)	Calculated EIRP Limit in dBμV/m
30 - 40000	-13	82.2

3.2.2 Test procedure

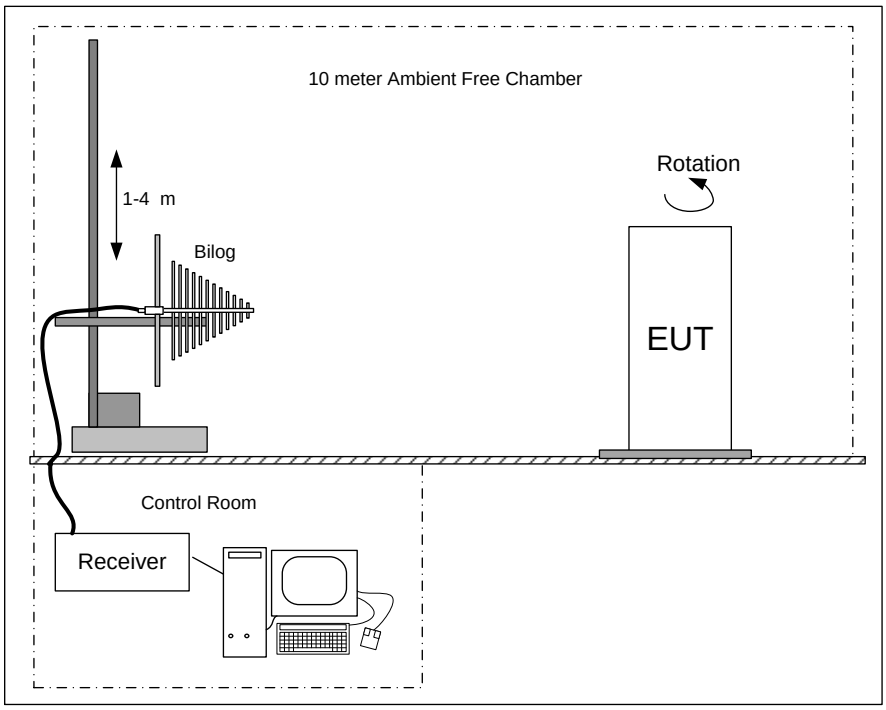
Verifications of the test equipment and AFC were performed before the installation of the EUT in accordance with the quality assurance procedures documented in the EMC test procedures document. The test was performed according to the relevant procedures listed in Table 8.

- The EUT was placed on the turntable inside the AFC (configured for normal operation). The system and its cables were separated from the ground plane by an insulating support 10 mm in height.
- For tests between 30 MHz and 1 GHz the receive antenna (BiLog®) was placed 3 m away from the EUT. An initial scan was performed to find emissions/frequencies requiring detailed measurement. The pre-scan was performed by rotating the system 360 degrees while recording all emissions

(frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 m, as well as both polarizations of the receiving antenna.

- For tests above 1 GHz the receive antenna (horn) was placed 3 m away from the EUT. Absorbing cones were placed on the floor between the antenna and the EUT. An initial scan was performed to find emissions/frequencies requiring detailed measurement. The pre-scan was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 m, as well as both polarizations of the receiving antenna.
- For tests between 18 and 40 GHz the receive horn antenna was placed at a 1 m distance from the EUT with the absorbing cones placed on the floor. An initial scan was performed to find emissions/frequencies requiring detail measurement. The pre-scan was performed on all sides of the EUT, using both polarization of the receive antenna to find any system emissions.
- For all above frequency ranges, the pre-scan peak data was compared to the limits. Peaks with less than 6 dB of margin were maximized using the proper detector: the EUT was rotated in azimuth over 360 degrees to identify the direction of maximum emission, antenna height was then varied from 1 to 4 m to obtain maximum emission level.

Figure 9: Setup of Radiated Emissions



3.2.3 Calculation of the compliance margin

The following example shows the way in which the compliance margin is calculated in the "RE Test Results" tables.

The rows in these tables are defined as follows.

Meter Reading (dBμV) =	Voltage measured using the spectrum analyzer with the proper detector
Correction (dB) =	Cumulative gain or loss of pre-amplifier and cables used in the measurement path (dB) + Antenna Factor (dB)
Level (dBμV/m) =	Corrected value or field strength, that is, the parameter of interest that is compared to the limit
Margin (dB) =	Level with respect to the appropriate limit (a negative Margin indicates that the Level is below the limit and that the measurement is a Pass)

The values in the Level row are calculated as follows: Level = Meter Reading + Correction (dB)

The values in the Margin row are calculated as follows: Margin = Level - Limit

3.2.4 Measurement uncertainties

The expanded measurement instrumentation uncertainty with a 95 % level of confidence, calculated according to the method described in CISPR 16 is:

- ± 3.8 dB between 30 MHz and 1 GHz
- ± 4.7 dB between 1 GHz and 10 GHz
- ± 4.8 dB between 10 GHz and 18 GHz
- ± 4.6 dB between 18 GHz and 26.5 GHz
- ± 4.8 dB between 26.5 GHz and 40 GHz

3.2.5 Test results of Radiated Emissions – (Single carrier-3, LTE – Middle chanel)

Test location: 10-meter Ambient Free Chamber (AFC)

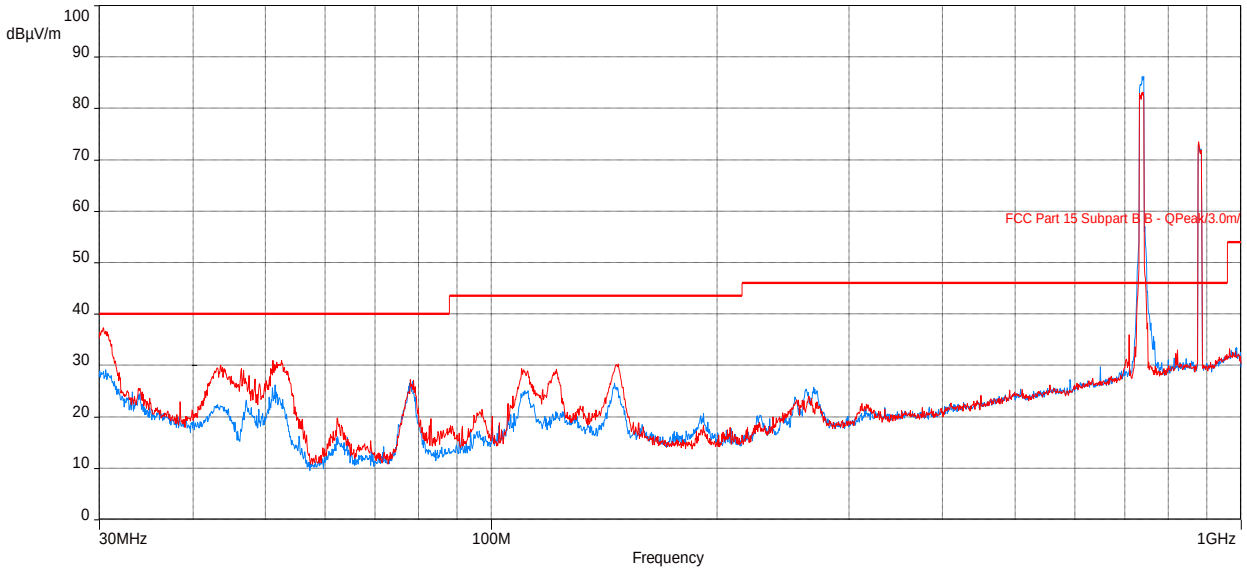
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 10: Plot of RE at 3 m – 30 to1000 MHz (LTE – Middle chanel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 11: RE test results from 30 to 1000 MHz for FCC Part 15 (LTE – Middle chanel)

Frequency (MHz)	Level Quasi Peak (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.39312821	34.29	40.00	-5.71	1.00	350.25	Vertical	-2.73
43.57791667	27.10	40.00	-12.90	1.00	333.75	Vertical	-9.18
52.56145546	28.41	40.00	-11.59	1.39	19.00	Vertical	-13.37

Table 12: RE test results from 30 to 1000 MHz for FCC Part 22/27 (LTE – Middle chanel)

Frequency (MHz)	Level (dBµV/m)	EIRP Limit (dBµV/m)	Margin to (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.39312821	34.29	82.2	-47.91	1.00	350.25	Vertical	-2.73
43.57791667	27.10	82.2	-55.10	1.00	333.75	Vertical	-9.18
52.56145546	28.41	82.2	-53.79	1.39	19.00	Vertical	-13.37

Note: In the table/Plot above, no emissions exceed the Part 22/Part 27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/Part 27, see antenna port conducted emissions in applicable test report.

Figure 11: Plot of RE at 3m from 1 to 10 GHz (LTE – Middle chanel)

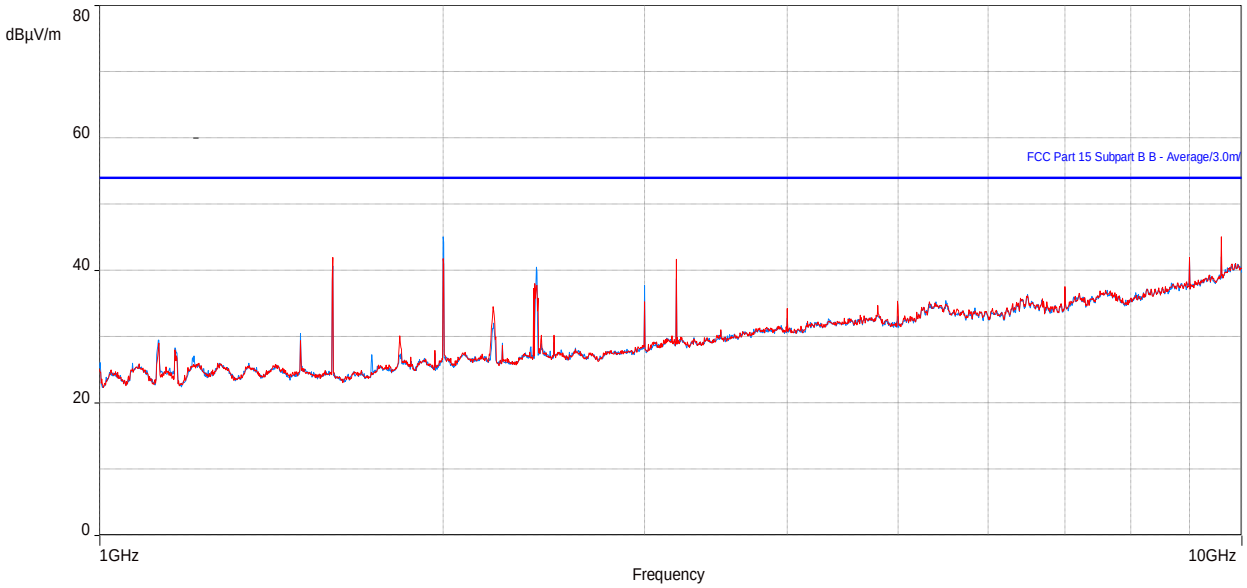


Table 13: RE test results from 1 to 10 GHz for Part 15 (LTE – Middle chanel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.990064	41.70	53.96	-12.26	2.99	104.50	Vertical	-11.97
1999.986538	45.04	53.96	-8.92	2.63	54.25	Horizontal	-9.56
3199.978526	41.01	53.96	-12.95	2.63	211.00	Vertical	-6.76
9599.936538	45.50	53.96	-8.46	1.00	39.75	Vertical	7.11

Table 14: RE test results from 1 to 10 GHz for Part 22/27 (LTE – Middle chanel)

Frequency (MHz)	Level (dBµV/m)	EIRP Limit (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.990064	41.70	82.2	-40.50	2.99	104.50	Vertical	-11.97
1999.986538	45.04	82.2	-37.16	2.63	54.25	Horizontal	-9.56
3199.978526	41.01	82.2	-41.19	2.63	211.00	Vertical	-6.76
9599.936538	45.50	82.2	-36.70	1.00	39.75	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 12: Plot of RE at 3m from 10 to 18 GHz (LTE – Middle chanel)

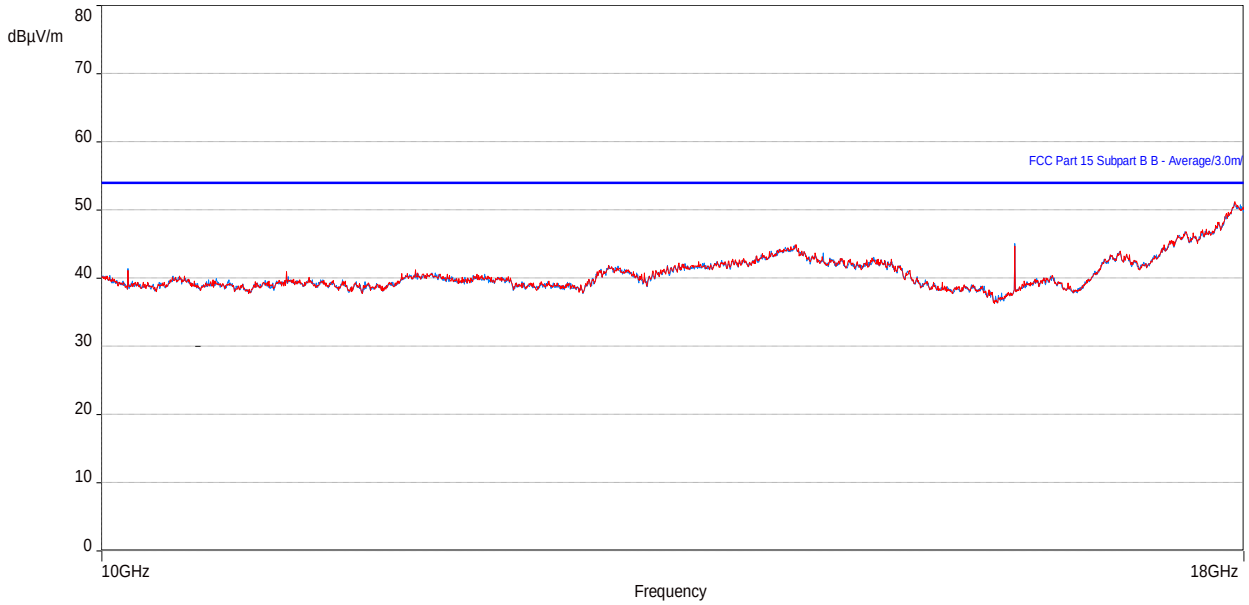


Table 15: RE test results from 10 to 18 GHz for FCC Part 15 (LTE – Middle chanel)

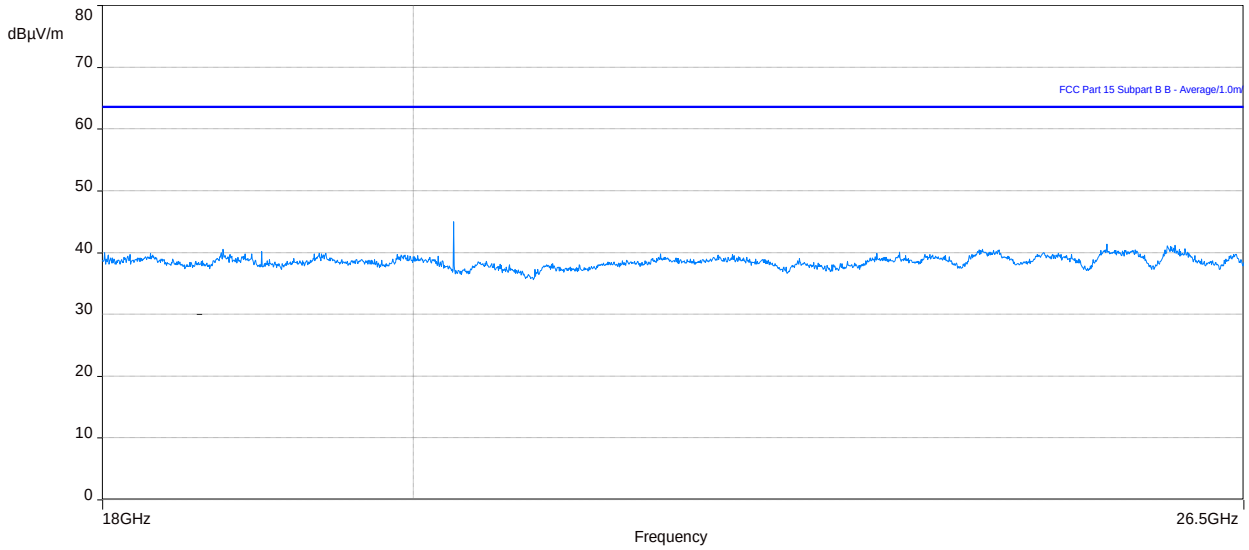
Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
15999.89263	44.30	53.96	-9.66	2.35	69.50	Horizontal	8.32
17463.64806	43.09	53.96	-10.87	4.00	53.00	Horizontal	16.85
17915.32597	47.69	53.96	-6.27	4.00	343.25	Horizontal	21.43
17918.78301	47.60	53.96	-6.36	4.00	336.00	Vertical	21.56

Table 16: RE test results from 10 to 18 GHz for FCC Part 22/27 (LTE – Middle chanel)

Frequency (MHz)	Level (dBµV/m)	EIRP Limit (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
15999.89263	44.30	82.2	-37.9	2.35	69.50	Horizontal	8.32
17463.64806	43.09	82.2	-39.11	4.00	53.00	Horizontal	16.85
17915.32597	47.69	82.2	-34.51	4.00	343.25	Horizontal	21.43
17918.78301	47.60	82.2	-34.6	4.00	336.00	Vertical	21.56

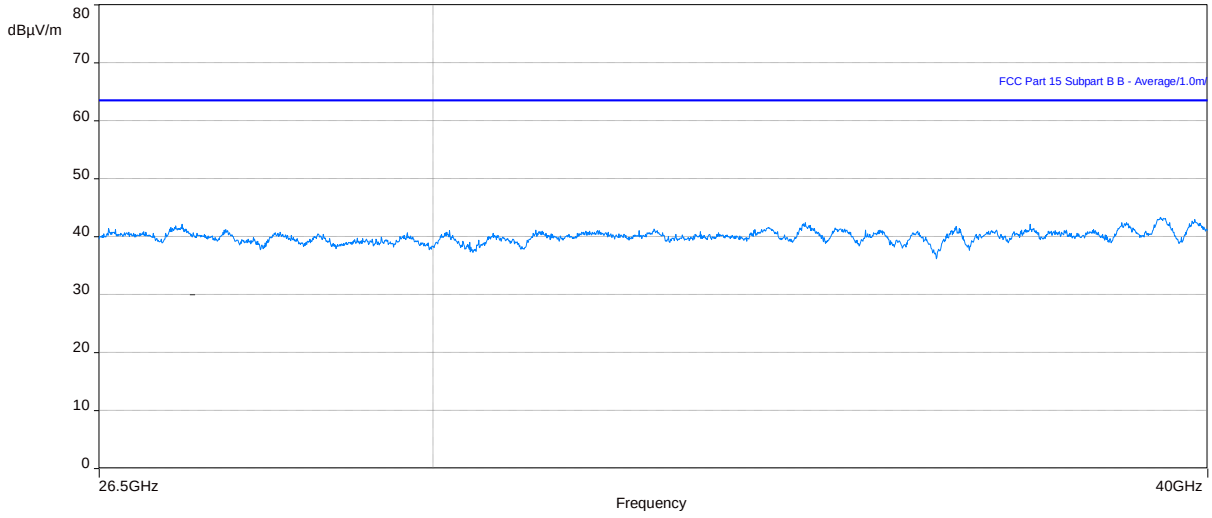
Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 13: Plot of RE at 1m from 18 to 26.5 GHz (LTE – Middle chanel)



Note 1: In the plot above No Emissions exceeds the FCC Part 15 limit.
Note 2: In the plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 14: Plot of RE at 1m from 26.5 to 40 GHz (LTE – Middle chanel)



Note 1: In the plot above No Emissions exceeds the FCC Part 15 limit.
Note 2: In the plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.6 Test results of Radiated Emissions – (Single carrier- 3, LTE - Bottom chanel)

Test location: 10-meter Ambient Free Chamber (AFC)

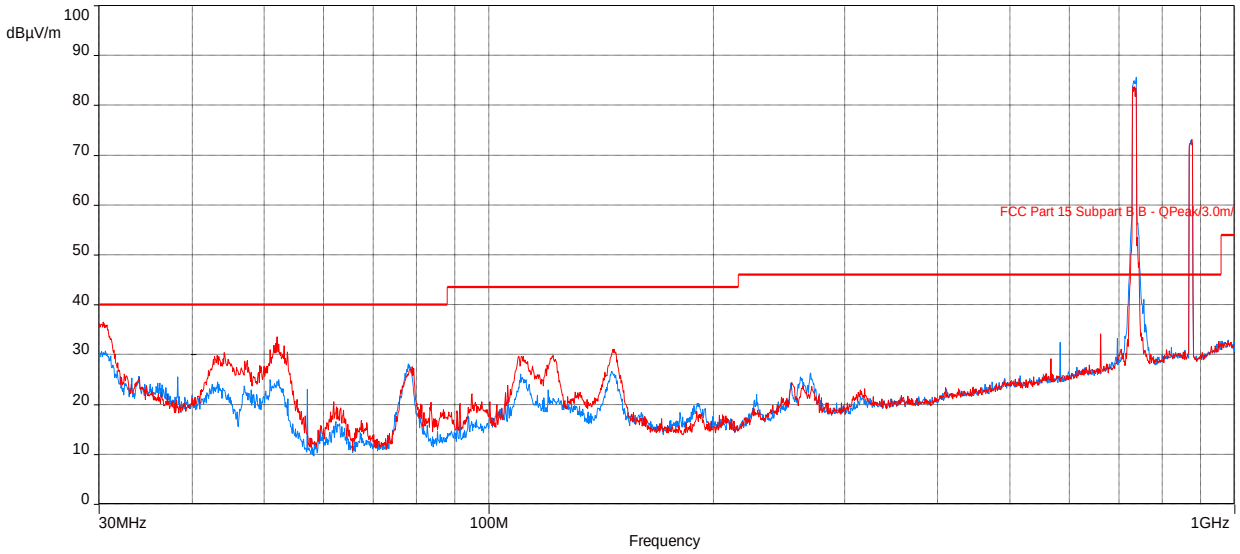
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 15: Plot of RE at 3 m – 30 to1000 MHz (LTE – Bottom channel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 17: RE test results from 30 to 1000 MHz for FCC Part 15 (LTE – Bottom channel)

Frequency (MHz)	Level Quasi Peak (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.37517949	35.01	40.00	-4.99	1.00	319.50	Vertical	-2.72
44.19869872	27.84	40.00	-12.16	1.00	319.50	Vertical	-9.49
52.05213428	30.03	40.00	-9.97	1.30	11.50	Vertical	-13.15
78.01403846	24.60	40.00	-15.40	2.10	98.25	Horizontal	-13.58

Table 18: RE test results from 30 to 1000 MHz for FCC Part 22/27 (LTE – bottom channel)

Frequency (MHz)	Level (dBµV/m)	EIRP Limit (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.37517949	35.01	82.2	-47.19	1.00	319.50	Vertical	-2.72
44.19869872	27.84	82.2	-54.36	1.00	319.50	Vertical	-9.49
52.05213428	30.03	82.2	-52.17	1.30	11.50	Vertical	-13.15
78.01403846	24.60	82.2	-57.6	2.10	98.25	Horizontal	-13.58

Note: In the table/Plot above, no emissions exceed the Part 22/Part 27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/Part 27, see antenna port conducted emissions in applicable test report.

Figure 16: Plot of RE at 3m from 1 to 10 GHz (LTE – Bottom channel)

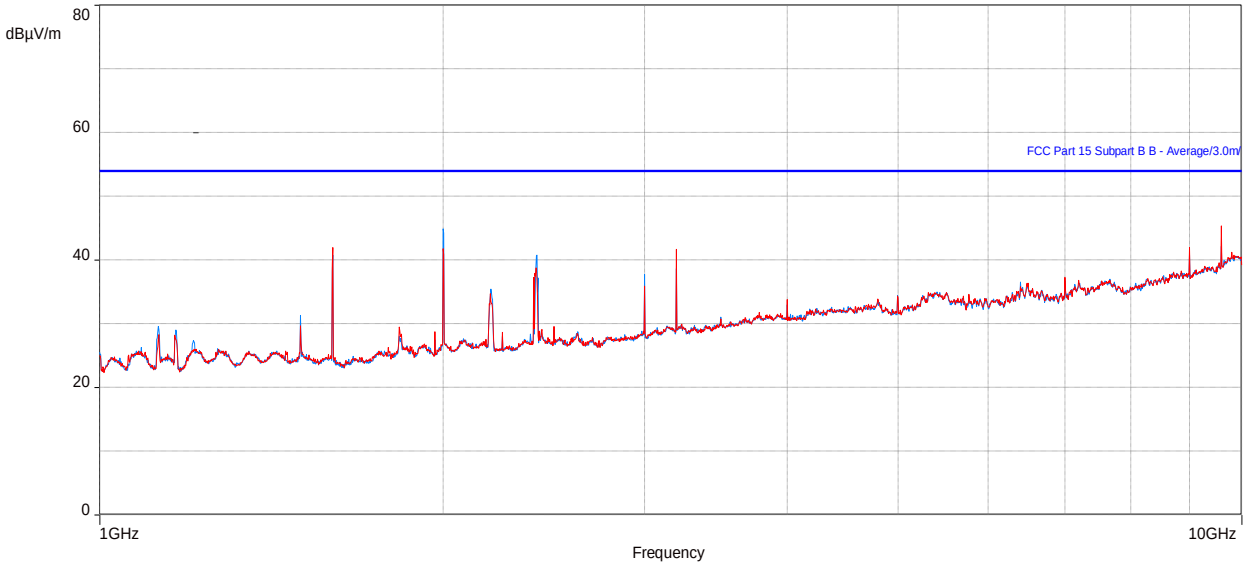


Table 19: RE test results from 1 to 10 GHz for FCC Part 15 (LTE – Bottom channel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.988462	40.25	53.96	-13.71	2.98	98.25	Vertical	-11.97
1999.986538	45.03	53.96	-8.93	2.63	55.25	Horizontal	-9.56
3199.976923	41.16	53.96	-12.80	2.56	211.25	Vertical	-6.76
9599.936538	46.15	53.96	-7.81	1.00	40.50	Vertical	7.11

Table 20: RE test results from 1 to 10 GHz for FCC Part 22/27 (LTE – Bottom channel)

Frequency (MHz)	Level (dBµV/m)	EIRP Limit (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.988462	40.25	82.2	-41.95	2.98	98.25	Vertical	-11.97
1999.986538	45.03	82.2	-37.17	2.63	55.25	Horizontal	-9.56
3199.976923	41.16	82.2	-41.04	2.56	211.25	Vertical	-6.76
9599.936538	46.15	82.2	-36.05	1.00	40.50	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.7 Test results of Radiated Emissions – (Single carrier- 3, LTE – Top chanel)

Test location: 10-meter Ambient Free Chamber (AFC)

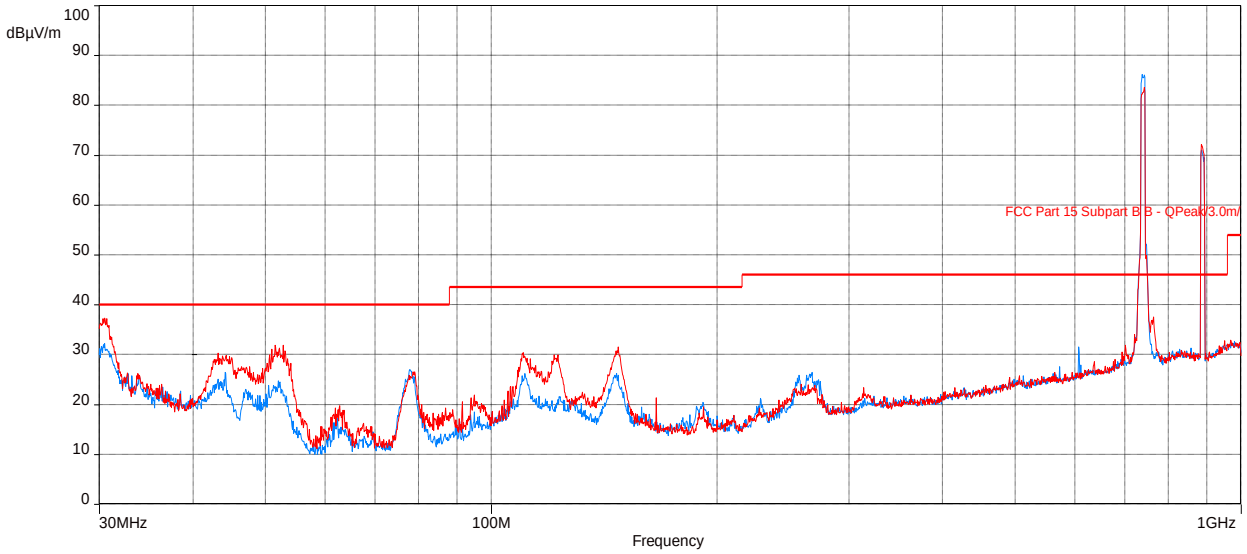
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 17: Plot of RE at 3 m – 30 to 1000 MHz (LTE – Top chanel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 21: RE test results from 30 to 1000 MHz for FCC part 15 (LTE – Top chanel)

Frequency (MHz)	Level Quasi peak (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.50515351	34.13	40.00	-5.87	1.17	5.00	Vertical	-2.78
43.17577531	27.45	40.00	-12.55	1.00	334.00	Vertical	-8.99
52.78919197	27.76	40.00	-12.24	1.27	24.50	Vertical	-13.48
147.6891633	26.28	43.52	-17.24	1.00	141.50	Vertical	-8.48

Table 22: RE test results from 30 to 1000 MHz for Part 22/27 (LTE – Top chanel)

Frequency (MHz)	Level (dBµV/m)	EIRP Limit (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.50515351	34.13	82.2	-48.07	1.17	5.00	Vertical	-2.78
43.17577531	27.45	82.2	-54.75	1.00	334.00	Vertical	-8.99
52.78919197	27.76	82.2	-54.44	1.27	24.50	Vertical	-13.48
147.6891633	26.28	82.2	-55.92	1.00	141.50	Vertical	-8.48

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 18: Plot of RE at 3m from 1 to 10 GHz (LTE – Top chanel)

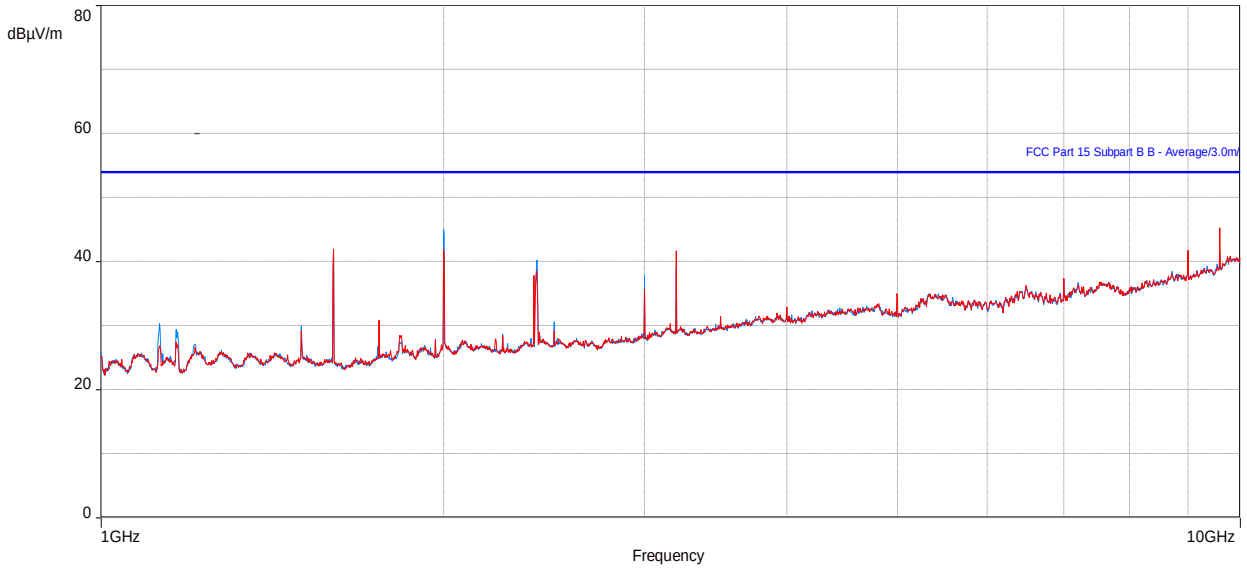


Table 23: RE test results from 1 to 10 GHz for FCC Part 15 (LTE – Top chanel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.990064	40.91	53.96	-13.05	2.99	105.50	Vertical	-11.97
1999.986538	45.03	53.96	-8.93	2.63	55.25	Horizontal	-9.56
3199.978526	40.99	53.96	-12.97	1.00	119.75	Vertical	-6.76
9599.933333	45.86	53.96	-8.10	1.00	40.75	Vertical	7.11

Table 24: RE test results from 1 to 10 GHz for FCC Part 22/27 (LTE – Top chanel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC part 27 (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.990064	40.91	53.96	-13.05	2.99	105.50	Vertical	-11.97
1999.986538	45.03	53.96	-8.93	2.63	55.25	Horizontal	-9.56
3199.978526	40.99	53.96	-12.97	1.00	119.75	Vertical	-6.76
9599.933333	45.86	53.96	-8.10	1.00	40.75	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamental. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.8 Test results of Radiated Emissions – (Multi carrier- 5, LTE – Middle chanel)

Test location: 10-meter Ambient Free Chamber (AFC)

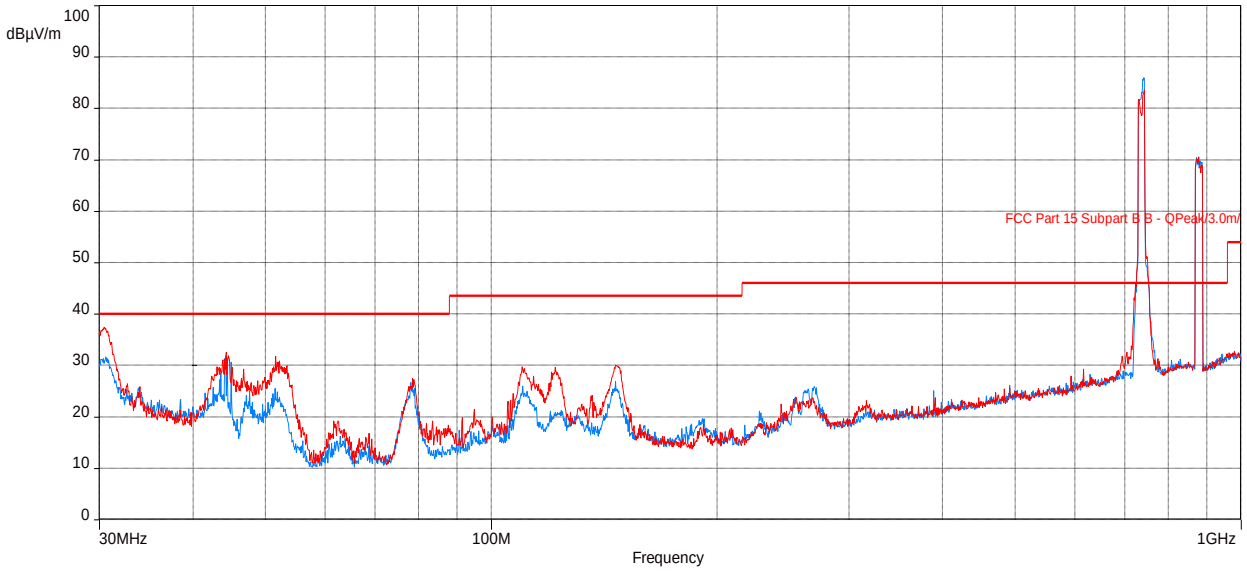
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 19: Plot of RE at 3 m – 30 to1000 MHz (MC 5, LTE – Middle chanel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 25: RE test results from 30 to 1000 MHz for FCC Part 15 (MC 5, LTE – Middle chanel)

Frequency (MHz)	Level Quasi Peak (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.4552311	36.74	40.00	-3.26	2.11	0.00	Vertical	-2.76
44.32603205	28.25	40.00	-11.75	1.44	326.50	Vertical	-9.55
51.56934008	29.10	40.00	-10.90	1.30	0.00	Vertical	-12.96
146.4459518	25.83	43.52	-17.69	1.05	247.75	Vertical	-8.44

Table 26: RE test results from 30 to 1000 MHz for FCC Part 27 (MC 5, LTE – Middle chanel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.4552311	36.74	82.2	-45.46	2.11	0.00	Vertical	-2.76
44.32603205	28.25	82.2	-53.95	1.44	326.50	Vertical	-9.55
51.56934008	29.10	82.2	-53.10	1.30	0.00	Vertical	-12.96
146.4459518	25.83	82.2	-56.37	1.05	247.75	Vertical	-8.44

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 20: Plot of RE at 3m from 1 to 10 GHz (MC 5, LTE – Middle chanel)

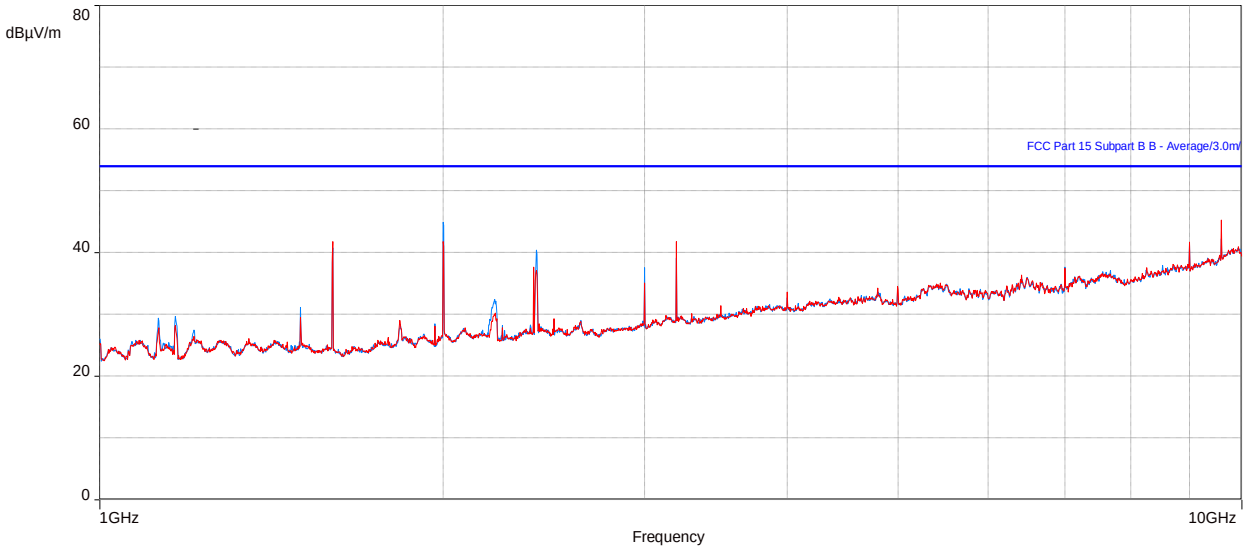


Table 27: RE test results from 1 to 10 GHz for FCC Part 15 (MC 5, LTE – Middle chanel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.988782	41.02	53.96	-12.94	2.99	105.50	Vertical	-11.97
1999.986538	45.18	53.96	-8.78	2.63	55.25	Horizontal	-9.56
2412.852244	26.62	53.96	-27.34	1.00	293.25	Horizontal	-8.75
3199.978526	41.08	53.96	-12.88	1.00	120.00	Vertical	-6.76
9599.936538	46.14	53.96	-7.82	1.00	40.75	Vertical	7.11

Table 28: RE test results from 1 to 10 GHz for FCC Part 27 (MC 5, LTE – Middle chanel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.988782	41.02	82.2	-41.18	2.99	105.50	Vertical	-11.97
1999.986538	45.18	82.2	-37.02	2.63	55.25	Horizontal	-9.56
2412.852244	26.62	82.2	-55.58	1.00	293.25	Horizontal	-8.75
3199.978526	41.08	82.2	-41.12	1.00	120.00	Vertical	-6.76
9599.936538	46.14	82.2	-36.06	1.00	40.75	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.9 Test results of Radiated Emissions (Single carrier- 3, NR 15 – Bottom chanel)

Test location: 10-meter Ambient Free Chamber (AFC)

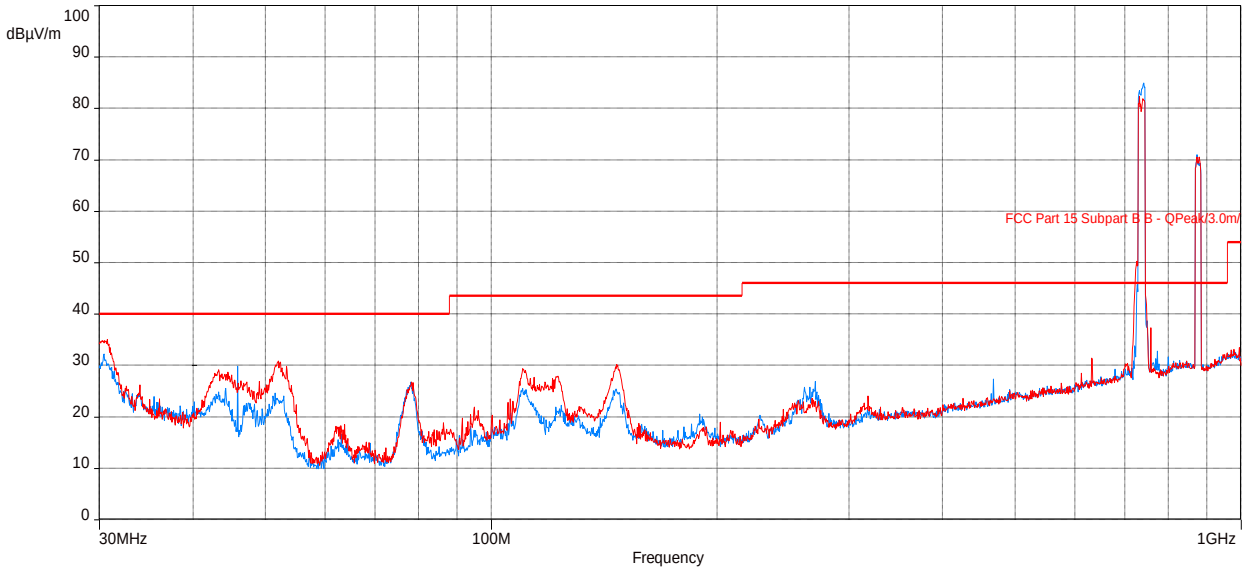
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 21: Plot of RE at 3 m – 30 to1000 MHz (SC 3 - NR 15 – Bottom channel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 29: RE test results from 30 to 1000 MHz for FCC Part 15 (SC 3- NR 15 – Bottom channel)

Frequency (MHz)	Level (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC Part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.48151315	30.05	40.00	-9.95	2.11	359.75	Horizontal	-2.77
30.74494905	34.13	40.00	-5.87	1.00	334.00	Vertical	-2.90
43.28291026	26.60	40.00	-13.40	1.57	340.75	Vertical	-9.04
147.0055159	26.04	43.52	-17.48	1.05	139.75	Vertical	-8.45

Table 30: RE test results from 30 to 1000 MHz - FCC Part 22/27 (SC 3 - NR 15 – Bottom channel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC Part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.48151315	30.05	82.2	-52.15	2.11	359.75	Horizontal	-2.77
30.74494905	34.13	82.2	-48.07	1.00	334.00	Vertical	-2.90
43.28291026	26.60	82.2	-55.6	1.57	340.75	Vertical	-9.04
147.0055159	26.04	82.2	-56.16	1.05	139.75	Vertical	-8.45

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 22: Plot of RE at 3m from 1 to 10 GHz (SC 3 - NR 15 – Bot channel)

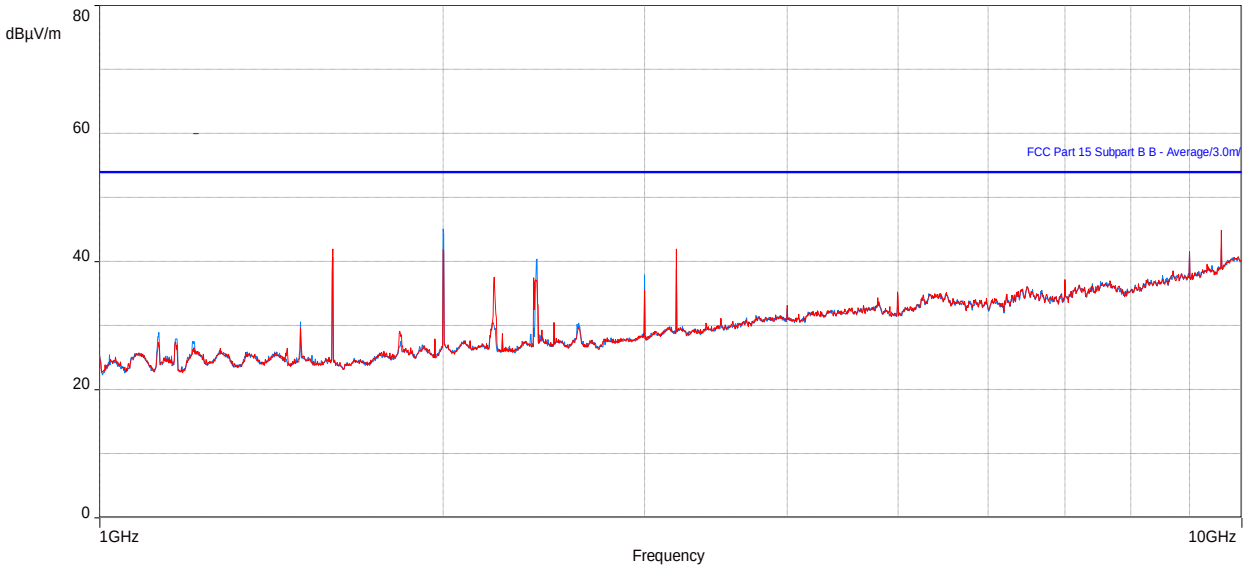


Table 31: RE test results from 1 to 10 GHz for FCC Part 15 (SC 3 - NR 15 – Bot channel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.990064	41.24	53.96	-12.72	2.99	105.25	Vertical	-11.97
1999.986538	45.14	53.96	-8.82	2.63	55.00	Horizontal	-9.56
3199.978526	41.03	53.96	-12.93	1.00	119.75	Vertical	-6.76
9599.936538	45.96	53.96	-8.00	1.00	40.75	Vertical	7.11

Table 32: RE test results from 1 to 10 GHz for FCC Part 22/27 (SC 3 - NR 15 – Bot channel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.990064	41.24	82.2	-40.96	2.99	105.25	Vertical	-11.97
1999.986538	45.14	82.2	-37.06	2.63	55.00	Horizontal	-9.56
3199.978526	41.03	82.2	-41.17	1.00	119.75	Vertical	-6.76
9599.936538	45.96	82.2	-36.24	1.00	40.75	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.10 Test results of Radiated Emissions (Single carrier 3, NR 15 – Middle channel)

Test location: 10-meter Ambient Free Chamber (AFC)

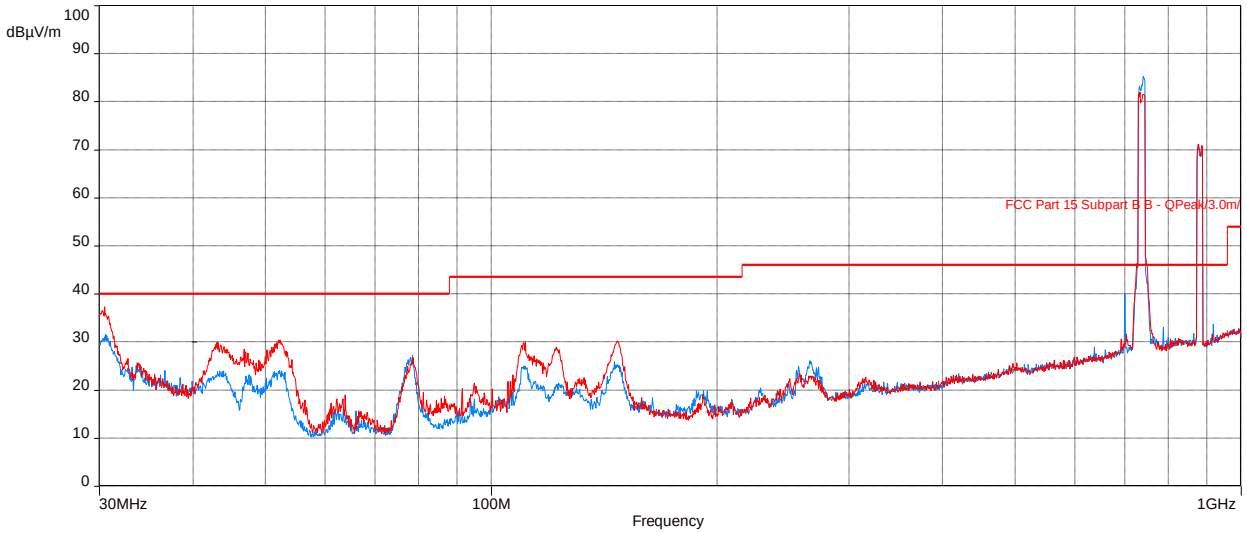
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 23: Plot of RE at 3 m – 30 to1000 MHz (SC 3, NR 15 – Middle channel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 33: RE test results from 30 to 1000 MHz for FCC Part 15 (SC 3, NR 15 – Middle channel)

Frequency (MHz)	Level (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC Part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.4960189	34.56	40.00	-5.44	1.00	0.00	Vertical	-2.78
43.05112854	27.50	40.00	-12.50	1.00	335.75	Vertical	-8.93
52.27866633	29.05	40.00	-10.95	1.40	18.75	Vertical	-13.25
147.2728815	26.25	43.52	-17.27	1.05	139.50	Vertical	-8.47

Table 34: RE test results from 30 to 1000 MHz - FCC Part 22/27 (SC 3, NR 15 – Middle channel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC Part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.4960189	34.56	82.2	-47.64	1.00	0.00	Vertical	-2.78
43.05112854	27.50	82.2	-54.7	1.00	335.75	Vertical	-8.93
52.27866633	29.05	82.2	-53.15	1.40	18.75	Vertical	-13.25
147.2728815	26.25	82.2	-55.95	1.05	139.50	Vertical	-8.47

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 24: Plot of RE at 3m from 1 to 10 GHz (SC 3, NR 15 – Middle channel)

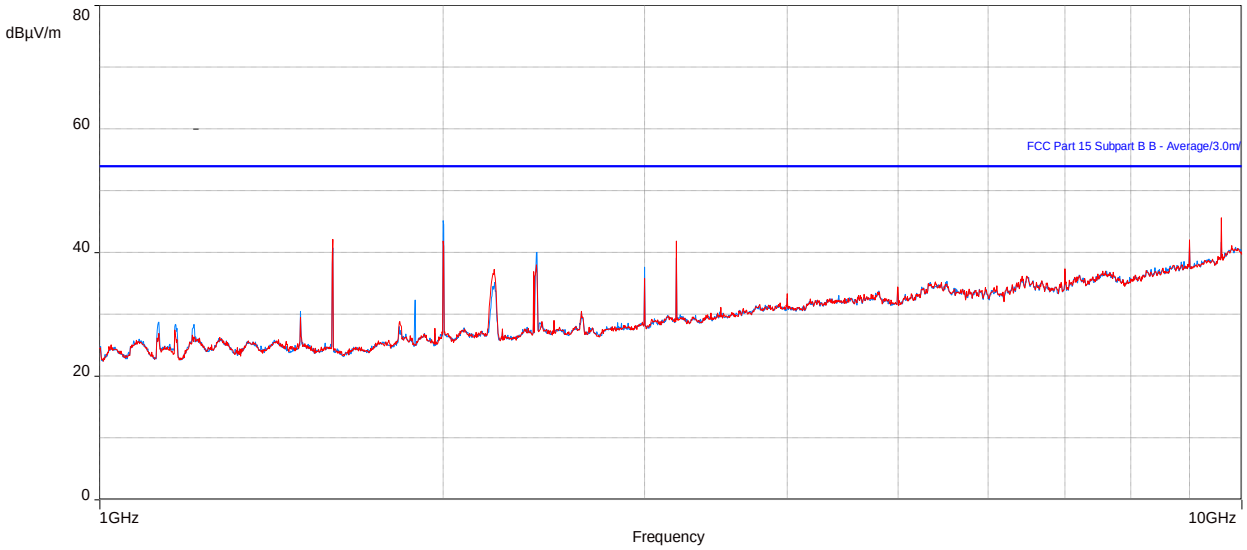


Table 35: RE test results from 1 to 10 GHz for FCC Part 15 (SC 3, NR 15 – Middle channel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.990385	41.03	53.96	-12.93	2.99	105.50	Vertical	-11.97
1999.986538	45.13	53.96	-8.83	2.63	55.00	Horizontal	-9.56
2414.075	25.82	53.96	-28.14	2.97	240.25	Horizontal	-8.76
3199.978526	41.04	53.96	-12.92	1.00	119.75	Vertical	-6.76
9599.933333	45.92	53.96	-8.04	1.00	40.75	Vertical	7.11

Table 36: RE test results from 1 to 10 GHz for FCC Part 22/27 (SC 3, NR 15 – Middle channel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.990385	41.03	53.96	-12.93	2.99	105.50	Vertical	-11.97
1999.986538	45.13	53.96	-8.83	2.63	55.00	Horizontal	-9.56
2414.075	25.82	53.96	-28.14	2.97	240.25	Horizontal	-8.76
3199.978526	41.04	53.96	-12.92	1.00	119.75	Vertical	-6.76
9599.933333	45.92	53.96	-8.04	1.00	40.75	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.11 Test results of Radiated Emissions (Single carrier 3, NR 15 – Top channel)

Test location: 10-meter Ambient Free Chamber (AFC)

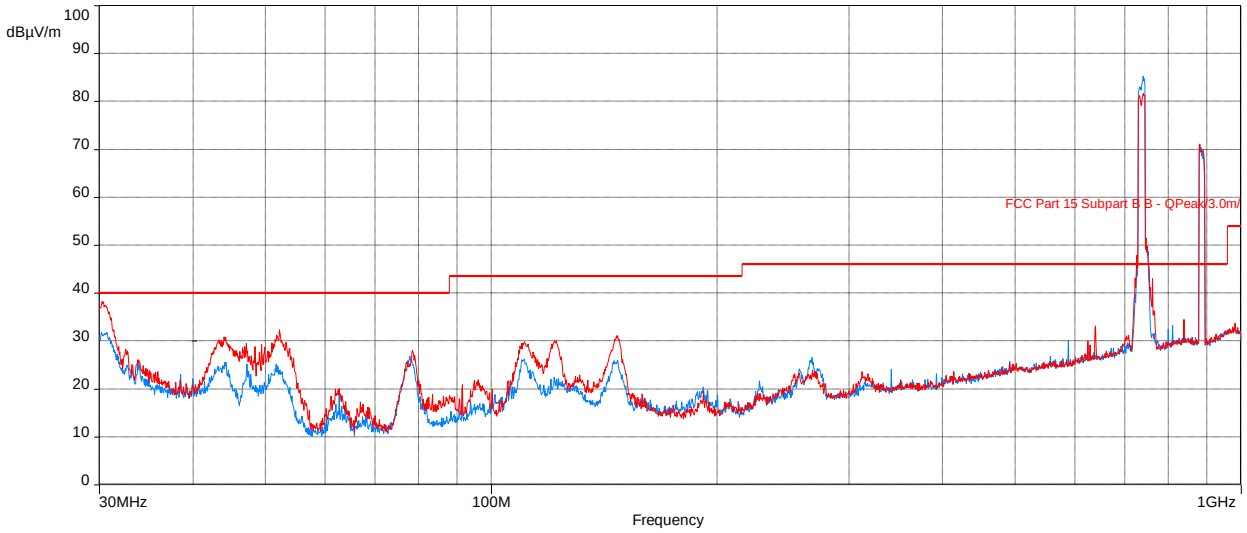
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 25: Plot of RE at 3 m – 30 to1000 MHz (SC 3, NR 15 – Top channel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 37: RE test results from 30 to 1000 MHz for FCC Part 15 (SC 3, NR 15 – Top channel)

Frequency (MHz)	Level (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC Part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.24312213	36.80	40.00	-3.20	1.95	5.25	Vertical	-2.66
43.98046121	28.17	40.00	-11.83	1.50	319.50	Vertical	-9.38
52.17121187	29.45	40.00	-10.55	1.30	19.00	Vertical	-13.20
147.0713077	26.59	43.52	-16.93	1.00	139.50	Vertical	-8.46

Table 38: RE test results from 30 to 1000 MHz - FCC Part 22/27 (SC 3, NR 15 – Top channel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC Part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.24312213	36.80	82.2	-45.40	1.95	5.25	Vertical	-2.66
43.98046121	28.17	82.2	-54.03	1.50	319.50	Vertical	-9.38
52.17121187	29.45	82.2	-52.75	1.30	19.00	Vertical	-13.20
147.0713077	26.59	82.2	-55.61	1.00	139.50	Vertical	-8.46

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 26: Plot of RE at 3m from 1 to 10 GHz (SC 3, NR 15 – Top channel)

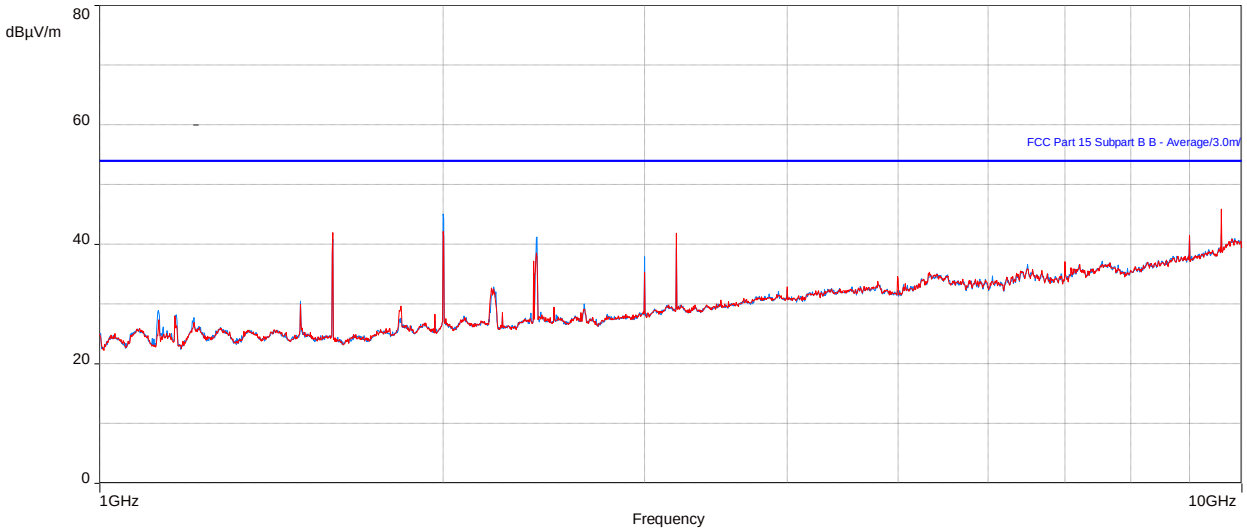


Table 39: RE test results from 1 to 10 GHz for FCC Part 15 (SC 3, NR 15 – Top channel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.990385	41.86	53.96	-12.10	1.39	47.75	Vertical	-11.97
1999.984936	45.13	53.96	-8.83	2.63	55.00	Horizontal	-9.56
2413.990064	25.05	53.96	-28.91	2.64	146.50	Horizontal	-8.76
3199.978526	41.35	53.96	-12.61	2.56	211.25	Vertical	-6.76
9599.933333	46.01	53.96	-7.95	1.00	40.75	Vertical	7.11

Table 40: RE test results from 1 to 10 GHz for FCC Part 22/27 (SC 3, NR 15 – Top channel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.990385	41.86	82.2	-40.34	1.39	47.75	Vertical	-11.97
1999.984936	45.13	82.2	-37.07	2.63	55.00	Horizontal	-9.56
2413.990064	25.05	82.2	-57.15	2.64	146.50	Horizontal	-8.76
3199.978526	41.35	82.2	-40.85	2.56	211.25	Vertical	-6.76
9599.933333	46.01	82.2	-36.19	1.00	40.75	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.12 Test results of Radiated Emissions (Multi carrier- 1, NR– Middle chanel)

Test location: 10-meter Ambient Free Chamber (AFC)

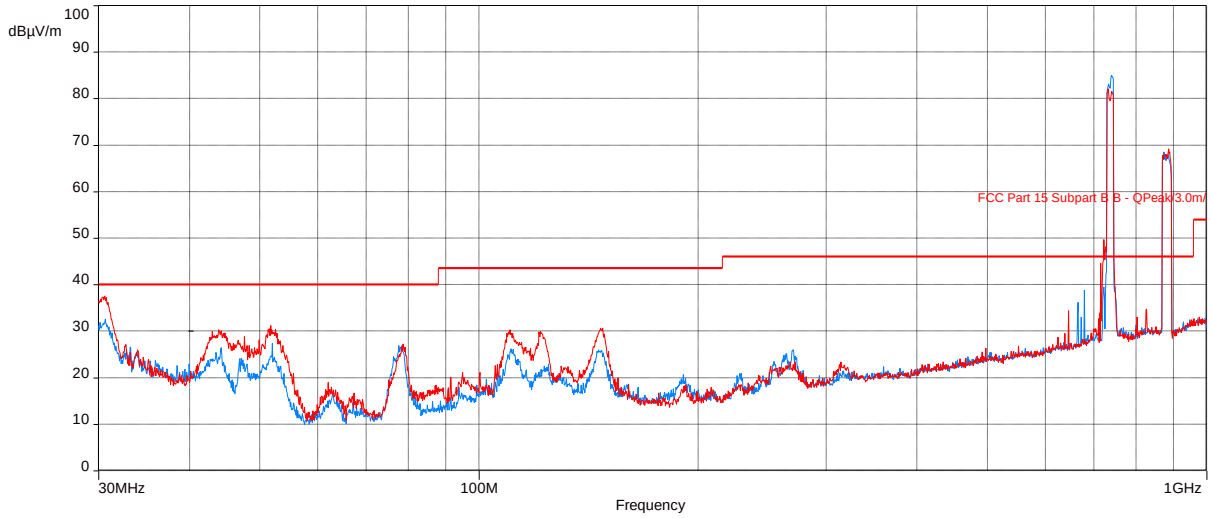
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 27: Plot of RE at 3 m – 30 to1000 MHz (MC - 1, NR– Middle chanel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 41: RE test results from 30 to 1000 MHz for FCC Part 15 (MC - 1, NR– Middle chanel)

Frequency (MHz)	Level (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC Part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.60391633	37.21	40.00	-2.79	1.96	0.00	Vertical	-2.83
43.87913428	29.46	40.00	-10.54	1.47	326.75	Vertical	-9.33
51.75376249	27.91	40.00	-12.09	1.30	0.00	Vertical	-13.03
146.993859	26.58	43.52	-16.94	1.00	141.50	Vertical	-8.45

Table 42: RE test results from 30 to 1000 MHz - FCC Part 22/27 (MC - 1, NR– Middle chanel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC Part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.60391633	37.21	82.2	-44.99	1.96	0.00	Vertical	-2.83
43.87913428	29.46	82.2	-52.74	1.47	326.75	Vertical	-9.33
51.75376249	27.91	82.2	-54.29	1.30	0.00	Vertical	-13.03
146.993859	26.58	82.2	-55.62	1.00	141.50	Vertical	-8.45

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 28: Plot of RE at 3m from 1 to 10 GHz (MC - 1, NR– Middle chanel)

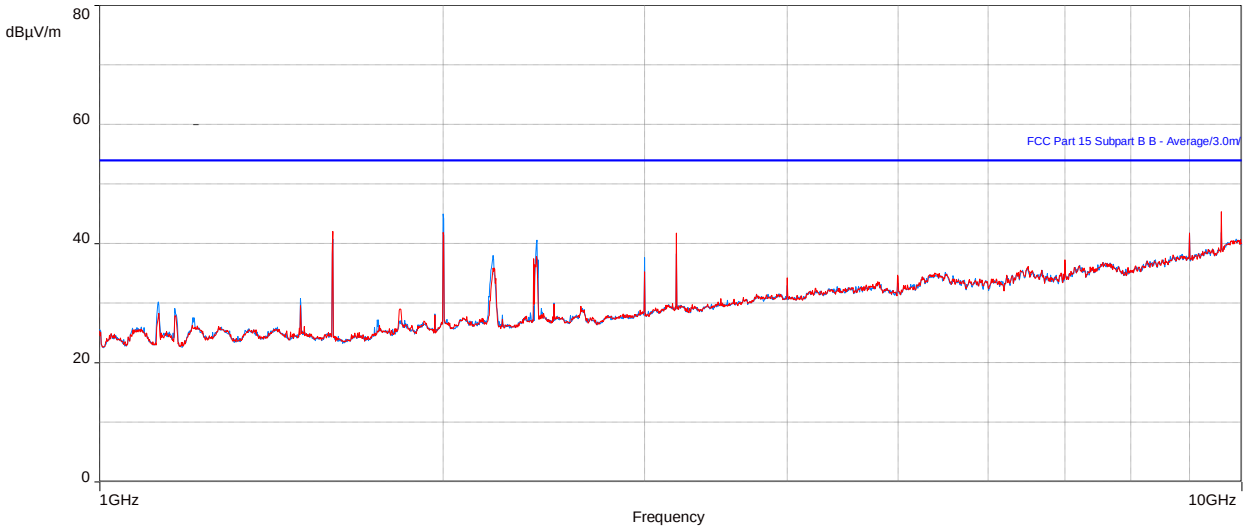


Table 43: RE test results from 1 to 10 GHz for FCC Part 15 (MC - 1, NR– Middle chanel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.988782	41.91	53.96	-12.05	1.46	47.75	Vertical	-11.97
1999.986538	44.94	53.96	-9.02	2.70	55.00	Horizontal	-9.56
2414.654167	26.60	53.96	-27.36	3.06	98.25	Horizontal	-8.77
3199.978526	41.10	53.96	-12.86	1.00	119.75	Vertical	-6.76
9599.933333	46.23	53.96	-7.73	1.00	40.50	Vertical	7.11

Table 44: RE test results from 1 to 10 GHz for FCC Part 22/27 (MC - 1, NR– Middle chanel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.988782	41.91	53.96	-12.05	1.46	47.75	Vertical	-11.97
1999.986538	44.94	53.96	-9.02	2.70	55.00	Horizontal	-9.56
2414.654167	26.60	53.96	-27.36	3.06	98.25	Horizontal	-8.77
3199.978526	41.10	53.96	-12.86	1.00	119.75	Vertical	-6.76
9599.933333	46.23	53.96	-7.73	1.00	40.50	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.13 Test results of Radiated Emissions (Multi-RAT 4 – NR + LTE – Middle channel)

Test location: 10-meter Ambient Free Chamber (AFC)

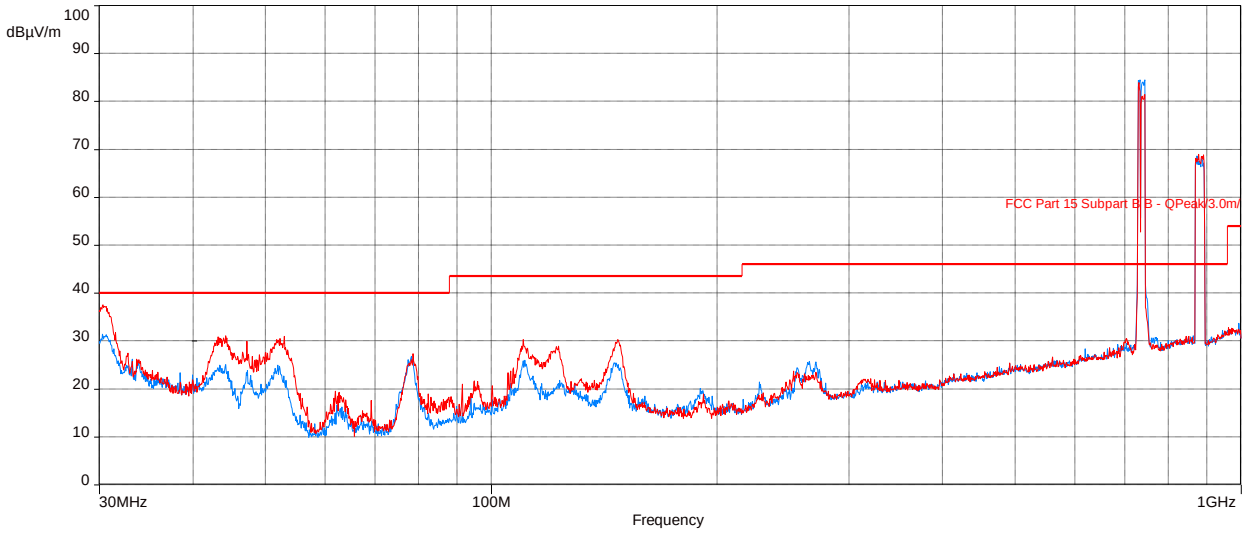
Date tested: 22 - 28 April 2020

Tested by: Krupal Patel

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 29: Plot of RE at 3 m – 30 to1000 MHz (MR 4 – NR + LTE – Mid channel)



Note: Peaks above the limit are leakage of the EUT's fundamentals from the 50-ohm terminations.

Table 45: RE test results from 30 to 1000 MHz for FCC Part 15 (MR 4 – NR + LTE – Mid channel)

Frequency (MHz)	Level (dBµV/m)	Limit Quasi-peak (dBµV/m)	Margin to FCC Part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.34861572	33.64	40.00	-6.36	1.04	360.00	Vertical	-2.71
44.23804521	27.64	40.00	-12.36	1.00	333.75	Vertical	-9.51
52.95810931	26.81	40.00	-13.19	1.44	17.00	Vertical	-13.55
147.6051441	25.87	43.52	-17.65	1.00	134.25	Vertical	-8.48

Table 46: RE test results from 30 to 1000 MHz - FCC Part 22/27 (MR 4 – NR + LTE – Mid channel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC Part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.34861572	33.64	82.2	-48.56	1.04	360.00	Vertical	-2.71
44.23804521	27.64	82.2	-54.56	1.00	333.75	Vertical	-9.51
52.95810931	26.81	82.2	-55.39	1.44	17.00	Vertical	-13.55
147.6051441	25.87	82.2	-56.33	1.00	134.25	Vertical	-8.48

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m, except for the fundamentals. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

Figure 30: Plot of RE at 3m from 1 to 10 GHz (MR 4 – NR + LTE – Mid channel)

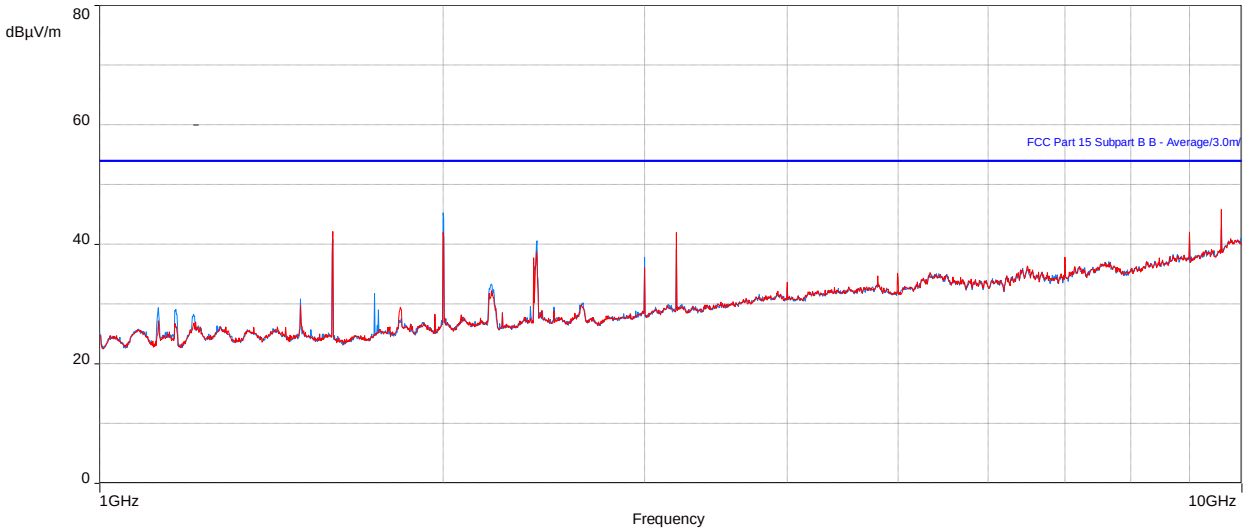


Table 47: RE test results from 1 to 10 GHz for FCC Part 15 (MR 4 – NR + LTE – Mid channel)

Frequency (MHz)	Level Average (dBµV/m)	Limit Average (dBµV/m)	Margin to FCC part 15 Class B (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.988462	40.97	53.96	-12.99	2.99	105.50	Vertical	-11.97
1999.986538	45.27	53.96	-8.69	2.63	55.00	Horizontal	-9.56
2414.864103	26.65	53.96	-27.31	2.99	91.25	Horizontal	-8.77
3199.976923	41.00	53.96	-12.96	1.00	120.00	Vertical	-6.76
9599.933333	46.33	53.96	-7.63	1.00	40.75	Vertical	7.11

Table 48: RE test results from 1 to 10 GHz for FCC Part 22/27 (MR 4 – NR + LTE – Mid channel)

Frequency (MHz)	Level (dBµV/m)	Limit EIRP (dBµV/m)	Margin to FCC part 22/27 (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
1599.988462	40.97	82.2	-41.23	2.99	105.50	Vertical	-11.97
1999.986538	45.27	82.2	-36.93	2.63	55.00	Horizontal	-9.56
2414.864103	26.65	82.2	-55.55	2.99	91.25	Horizontal	-8.77
3199.976923	41.00	82.2	-41.2	1.00	120.00	Vertical	-6.76
9599.933333	46.33	82.2	-35.87	1.00	40.75	Vertical	7.11

Note: In the table/Plot above, no emissions exceed the Part 22/27 radiated spurious emissions limit when converted to dBuV/m. For final spurious emissions measurements to FCC Part 22/27, see antenna port conducted emissions in applicable test report.

3.2.14 Radiated Emissions test setup pictures

Figure 31: Setup for RE tests at 30 MHz to 1 GHz with LTE (Single & Multi Carrier)

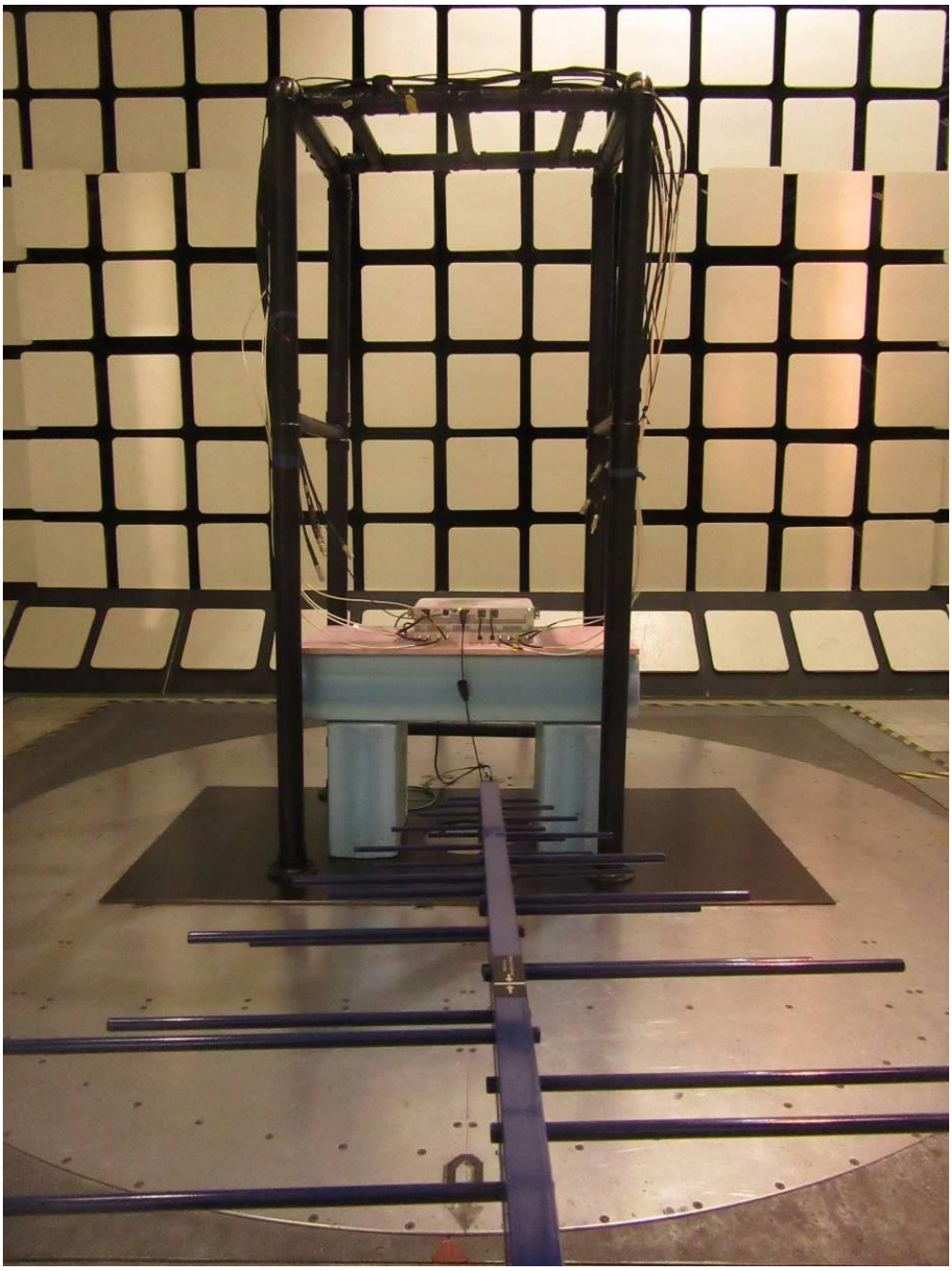
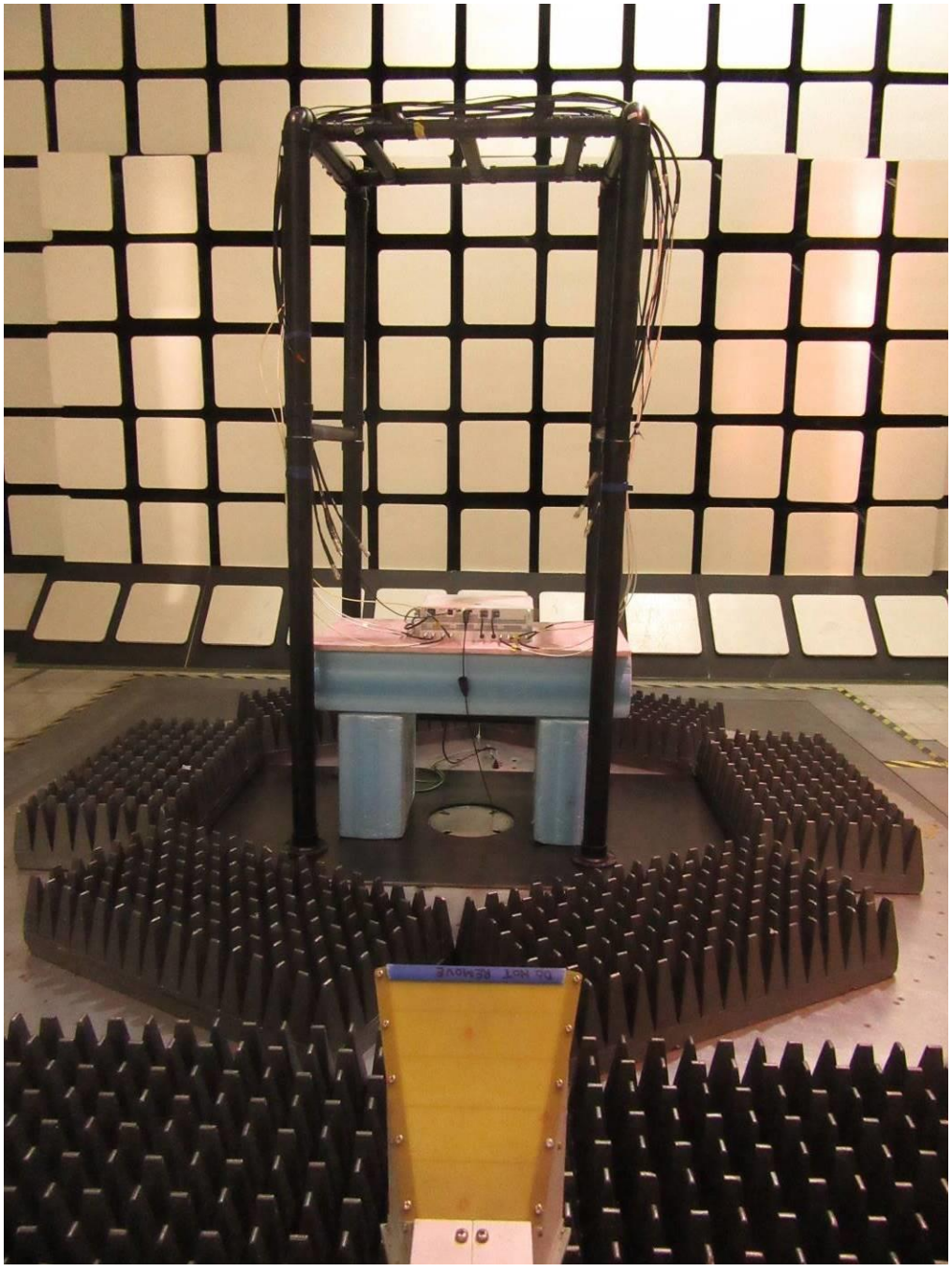


Figure 32: Setup for RE tests for above 1 GHz with LTE (Single & Multi Carrier)



3.2.15 Test equipment

The equipment used for E-field RE testing was as follows.

Table 49: Test equipment used for RE

Description	Make	Model number	Asset ID	Calibr. date	Calibr. due
EMC Automation Software	Nexio V3.18	BAT-EMC	F0163649	Not required	
Double Ridged Horn Antenna	Emco	3115	SSG012298	2019-05-01	2020-05-01
Bilog Antenna	Chase	CBL6111	SSG012564	2019-05-15	2020-05-15
RF Amplifier	Hewlett Packard	8447D	SSG013045	2020-01-08	2021-01-08
Pre-Amplifier	BNR	LNA	SSG012594	2019-05-22	2020-05-22
Horn Antenna (18 - 26.5 GHz)	Emco	3160-09	SSG012292	2019-08-26	2021-08-26
Horn Antenna (26.5 - 40 GHz)	Emco	3160-10	SSG012294	2019-08-26	2021-08-26
EMI Receiver	Rohde & Schwarz	ESU40	SSG013672	2019-10-08	2020-10-08
Coaxial Cable	Huber & Suhner	104PEA	SSG012041	2020-01-06	2021-01-06
Coaxial Cable	Huber & Suhner	106A	SSG012455	2020-01-06	2021-01-06
Coaxial Cable	Huber & Suhner	106A	SSG012711	2020-01-06	2021-01-06
Coaxial Cable	Micro-Coax	UFA 210B-1-1500-504504	SSG012376	2020-01-02	2021-01-02
Coaxial Cable	Huber & Suhner	ST18/Nm/Nm/36	SSG012786	2020-01-02	2021-01-02
Coaxial Cable	Huber & Suhner	101 PEA, Sucoflex	SSG012290	2018-11-13	2020-11-13

3.2.16 Test conclusion

The LPRU 4410 B5B12A has passed the E-field Radiated Emission (RE) tests with respect to the standards/sections listed in section Executive summary.

3.3 Conducted Emissions on AC power leads

This test verifies the EUT does not produce excessive Conducted Emissions (CE) on the AC main power leads.

3.3.1 Test specification and limits

The test requirements are as follows.

Table 50: CE test requirements on AC power leads

Requirement	Method	Country of application
FCC Part 15, Subpart B	ANSI C63.4	USA
ICES 003	ANSI C63.4	Canada

The limits of the CE tests on AC power leads are as follows.

Table 51: CE test limits on AC power leads for Class B

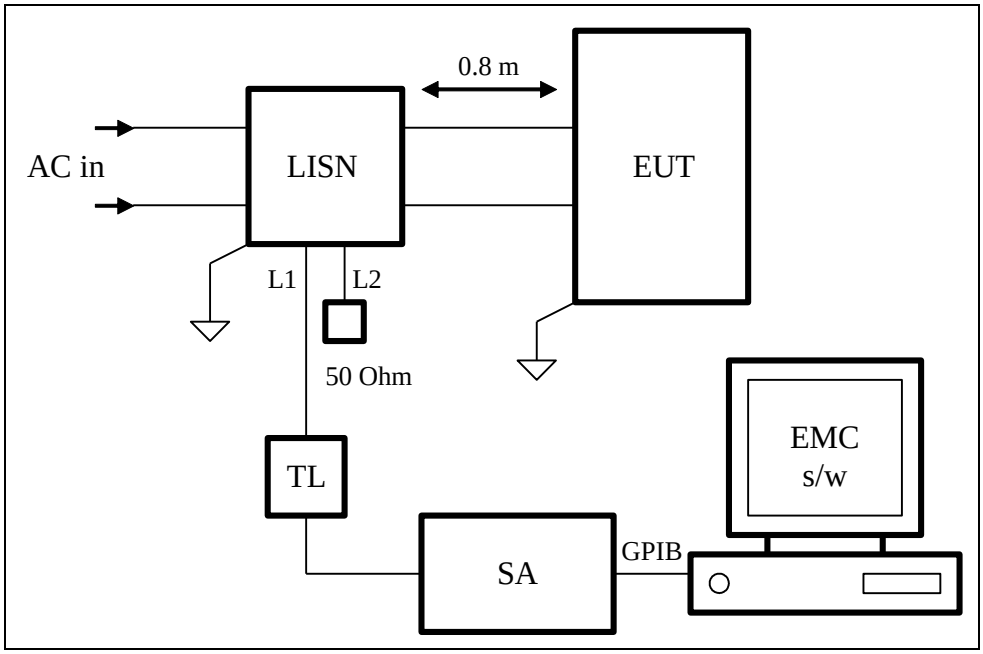
Frequency range (MHz)	**FCC Part 15 Average** (dBµV)	**FCC Part 15 Quasi-peak** (dBµV)
0.15 to 0.5	56 to 46	66 to 56
0.5 to 5	46	56
5 to 30	50	60

3.3.2 Test procedure

Verifications of the test equipment were performed before the installation of the EUT in accordance with the quality assurance procedures documented in the EMC test procedures document. The test was performed by the relevant procedures listed in Table 50.

Figure 33 shows the test method for regulatory CE measurements on AC Leads.

Figure 33: CE test method on AC leads for regulatory test cases



- The EUT was arranged and connected according to its normal mode of operation on a metallic ground plane. The EUT and all cables were insulated from the ground plane which extended by at least 0.5 m beyond the boundaries of the EUT.
- The LISNs were bonded to the ground plane; the distance between the boundary of the EUT and the closest surface of the LISN was 0.8 m. The mains cable between the EUT and the LISNs was 1 m long, or if more than 1 m, the excess cable was folded to form a non-inductive bundle, not exceeding 0.4 m in length. The safety ground connection of the EUT, if present, was connected to the reference ground plane.
- Conducted Emissions were measured by connecting the spectrum analyzer input, through the transient limiter, to the LISN outputs, L1 and L2 (the unused LISN output was terminated with a coaxial 50-Ohm termination).
- For each lead, a pre-scan was taken over the frequency range of the requirement, using peak detection on the spectrum analyzer. The pre-scan data was then compared to the specification limits. Frequencies close to the limit lines were measured using a QP and/or an AVG detector as required.

3.3.3 Calculation of the compliance margin

The compliance margin is computed in a similar way as for RE (see section Calculation of the compliance margin).

3.3.4 Measurement uncertainties

The expanded measurement instrumentation uncertainty, with a 95 % level of confidence, calculated according to the method described in CISPR 16 is: ± 2.8 dB on CISPR 22 AC power leads conducted emissions.

3.3.5 Test results of CE on AC power ports

Test location: Ground Plane

Date tested: 28 April 2020

Tested by: Kasi Sivaratnam

Test configurations are identified in the section Configurations of the EUT.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Black trace = Peak scan, Blue trace = Average scan

Figure 34: Plot of CE on AC port, line L1 for FCC Part 15 class B

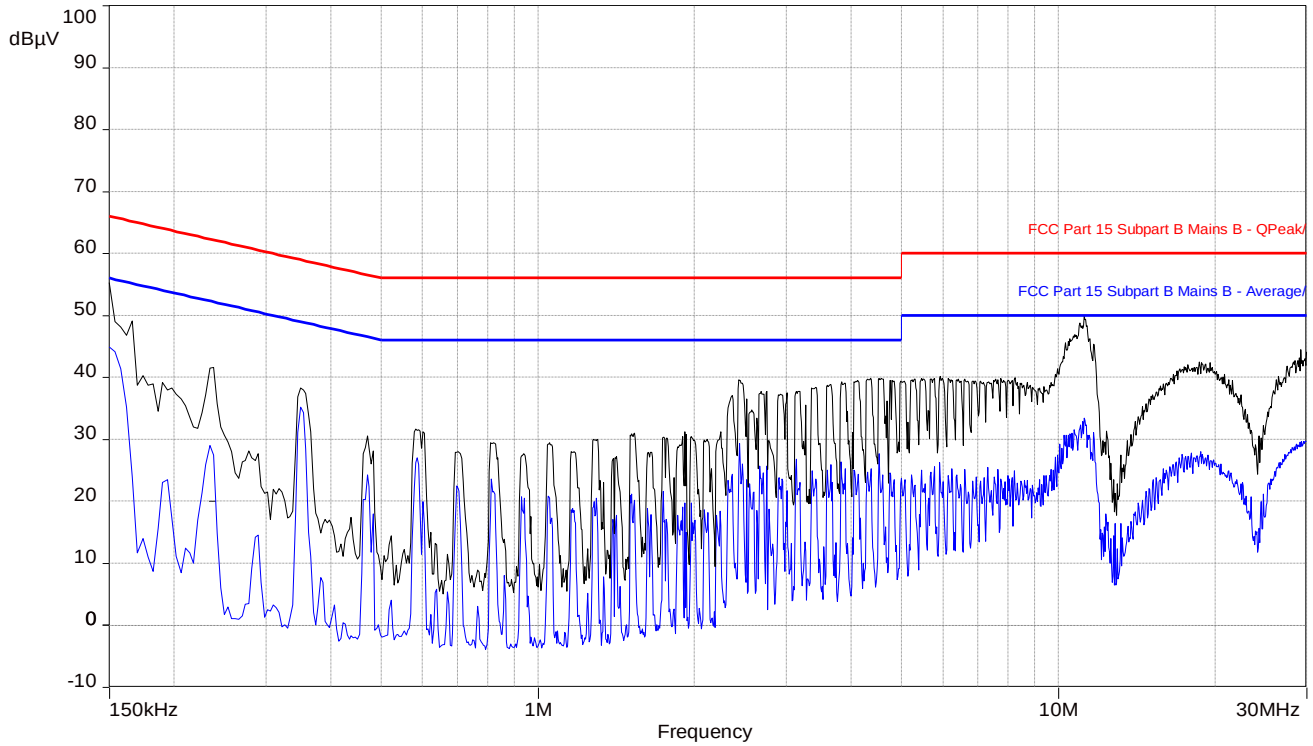


Table 52: CE test results on AC port, line L1 for FCC Part 15 class B

Frequency (MHz)	Level Average (dBµV)	Level Quasi-peak (dBµV)	Margin to Average Class B (dB)	Margin to Quasi-peak Class B (dB)	Limit Average (dBµV)	Limit Quasi-peak (dBµV)	Correction (dB)
0.1633	30.11	41.84	-25.25	-23.52	55.36	65.36	9.82
0.235552	28.89	37.84	-23.42	-24.46	52.31	62.31	9.79
0.35171	35.76	37.08	-13.21	-21.88	48.96	58.96	9.77
0.58173	26.70	30.56	-19.30	-25.44	46.00	56.00	9.76
0.821568	22.04	28.16	-23.96	-27.84	46.00	56.00	9.75
2.43216	24.95	38.18	-21.05	-17.82	46.00	56.00	9.76
11.214972	32.77	44.09	-17.23	-15.91	50.00	60.00	9.82
18.63656	25.16	36.04	-24.84	-23.96	50.00	60.00	9.99
29.220542	28.27	35.62	-21.73	-24.38	50.00	60.00	10.15

Figure 35: Plot of CE on AC port, line L2 for FCC Part 15 class B

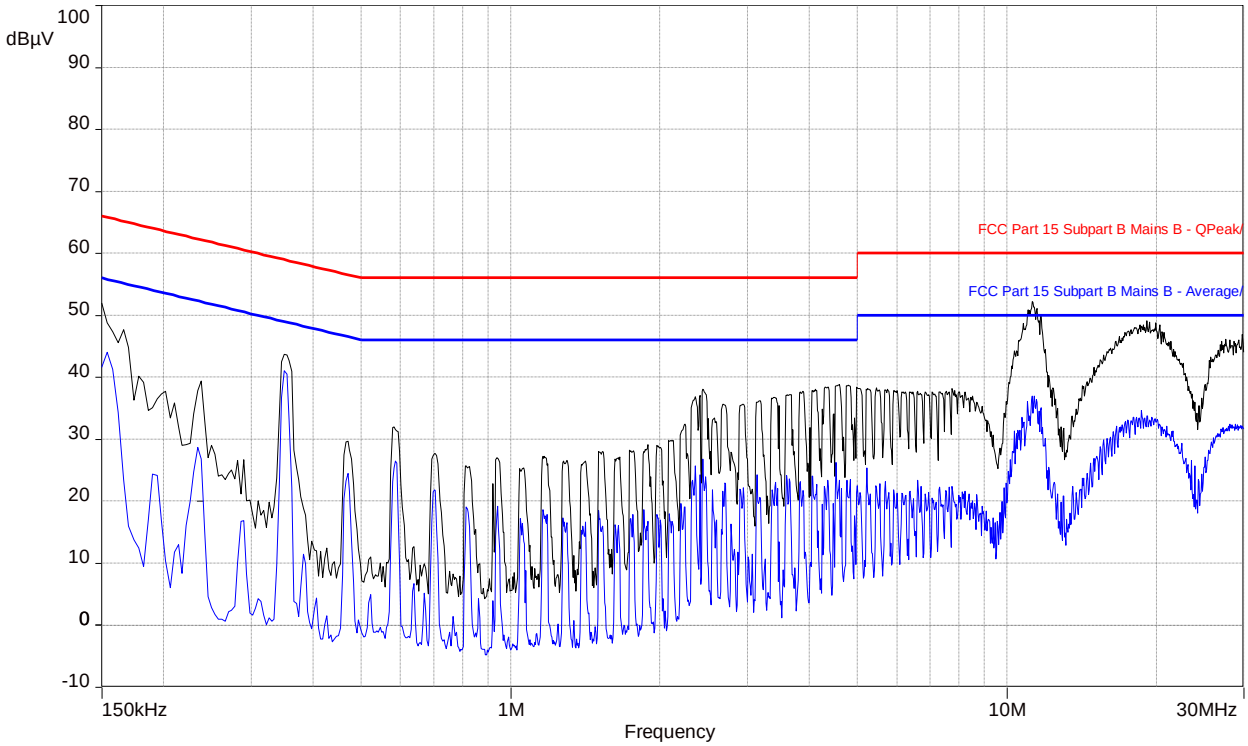
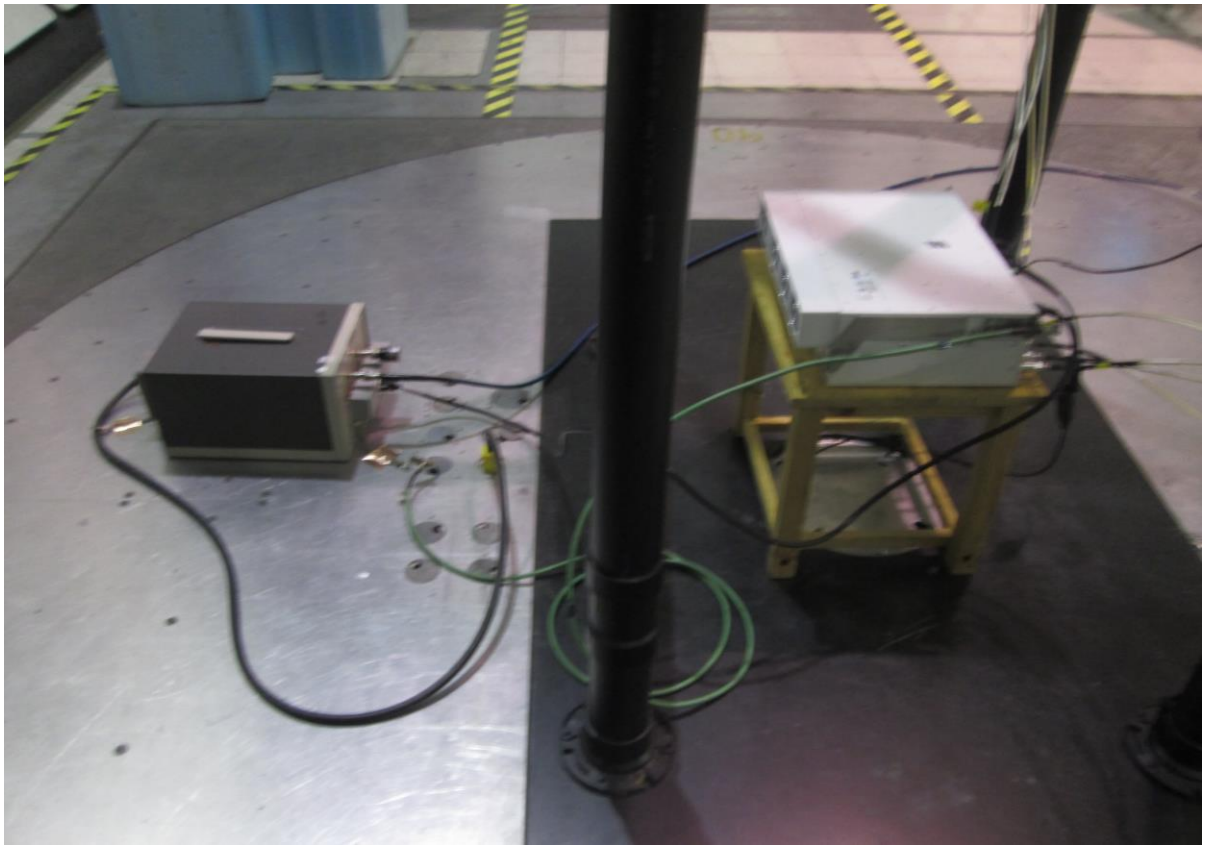


Table 53: CE test results on AC port, line L2 for FCC Part 15 class B

Frequency (MHz)	Level Average (dBµV)	Level Quasi-peak (dBµV)	Margin to Average Class B (dB)	Margin to Quasi-peak Class B (dB)	Limit Average (dBµV)	Limit Quasi-peak (dBµV)	Correction (dB)
0.162004	33.00	42.83	-22.36	-22.53	55.36	65.36	9.81
0.3518	41.50	42.80	-7.47	-16.17	48.96	58.96	9.76
2.438688	25.78	36.63	-20.22	-19.37	46.00	56.00	9.75
10.780092	32.21	45.16	-17.79	-14.84	50.00	60.00	9.80
11.242832	35.98	49.10	-14.02	-10.90	50.00	60.00	9.81
16.837932	31.22	41.79	-18.78	-18.21	50.00	60.00	9.96
19.144502	32.87	43.54	-17.13	-16.46	50.00	60.00	9.97
20.351296	31.71	41.84	-18.29	-18.16	50.00	60.00	9.99
25.729352	27.22	35.65	-22.78	-24.35	50.00	60.00	10.13
27.58613	30.77	38.25	-19.23	-21.75	50.00	60.00	10.16

Figure 36: Setup for CE tests on AC power cables



3.3.6 Test equipment

The equipment used for CE testing was as follows.

Table 54: Test equipment used for CE on AC power leads

Description	Make	Model number	Asset ID	Calibr. date	Calibr. due
EMC Automation Software	Nexio V3.18	BAT-EMC	F0163649	Not required	Not required
Line Impedance Stabilization Network	Emco	3825/2	SSG011780	2019-09-16	2020-09-16
Termination	Narda	374BNM	SSG012451	2019-10-02	2020-10-02
Coaxial Cable	Huber & Suhner	104PEA	SSG013080	2020-01-06	2021-01-06
Transient Limiter	Hewlett Packard	11947A	SSG012403	2020-01-08	2021-01-08
EMI Receiver	Rohde & Schwarz	ESCI	SSG013727	2019-09-12	2020-09-12

3.3.7 Test conclusion

The LPRU 4410 B5B12A has passed the Conducted Emissions (CE) test on AC power leads with respect to class B limit of FCC Part 15 Subpart B, and ICES-003.

4. References

The documents, regulations, and standards that are referenced throughout this test report are listed alphabetically as follows.

1. ANSI C63.2-2009, American National Standards Institute for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz – Specifications.
2. ANSI C63.4-2014, American National Standards Institute for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
3. CISPR 16 Publications (all parts and sections), Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1: Radio Disturbance and Immunity Measuring Apparatus.
4. CISPR 22 (2008, +IS 1, + IS 2, + IS 3: 2012), Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.
5. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations, Part 2, U.S. Federal Communications Commission.
6. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations, Part 15 Radio Frequency Devices, U.S. Federal Communications Commission.
7. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations, Part 22 – Public Mobile Services, U.S. Federal Communications Commission.
8. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations, Part 27 Miscellaneous Wireless Communications Services, U.S. Federal Communications Commission.
9. ICES-003 Issue 6 (2016), Spectrum Management and Telecommunications, Interference-Causing Equipment Standard: Information Technology Equipment (ITE) – Limits and methods of measurement.

4.1 Appendix A: Abbreviations

The abbreviations of terms used in this document are as follows.

Term	Definition
A	6 dB Coaxial Attenuator (Conducted Immunity)
AAN	Asymmetric Artificial Network (ISN)
AE	Auxiliary equipment
AFC	Ambient Free Chamber
ANSI	American National Standards Institute
AVG	Average detector
BiLog	Biconical Log-Periodic Hybrid antenna (a registered trademark of Schaffner-Chase EMC Limited, 1993)
CDN	Coupling-decoupling Network
CE	Conducted Emissions
CISPR	Comité International Spécial Perturbation Radioélectrique (International Special Committee on Radio Interference)
CSA	Canadian Standards Association
DN/P	Decoupling / Protection Network
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ETSI	European Telecommunications Standards Institute
EUT	equipment under test
GND	Ground
HCP	Horizontal Coupling Plane
HME	Harmonics Measurement Equipment
HV	High Voltage
HVP	High Voltage Probe
h/w	hardware
IC	Industry Canada
ICES	Canadian Specification: ICES-003, Issue 3, “Spectrum Management: Interference-causing equipment standard (Digital Apparatus)
IEC	International Electro Technical Association
ISN	Impedance Stabilization Network
LISN	Line Impedance Stabilization Network
ms	millisecond, unless otherwise specified
NA, na	not applicable

Term	Definition
PA	Broadband Power Amplifier
PK	Peak Detector
PS	Power Supply
QP	Quasi-peak Detector
QPA	Quasi-peak Adapter (for the Spectrum Analyzer)
R	100-ohm Injection Resistor (Conducted Immunity)
RBW	Resolution Bandwidth
RE	Radiated Emissions
RF	Radio-Frequency
RI	Radiated Immunity
RMS	Root-mean-square
s/w	software
SA	Spectrum Analyzer, the CISPR 16, ANSI C63.2 Compliant EMI meter
STP	Shielded Twisted Pair
T	50-ohm Coaxial Termination (Conducted Emissions / Immunity)
TL	Transient Limiter
UFA	Uniform field Area
VBW	Video Bandwidth

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