EMC Test Report
for
LPRU 4410 B5B13
(with NR update on B13)

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

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	6 August 2021

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 B5B13 for Ericsson Canada per project number 7169009803. The objective of the test activities is to evaluate compliance of the product to following EMC regulatory standards.

The LPRU 4410 B5B13 is verified to comply with the Class B Emissions requirements of these standards:

- FCC Part 15 Subpart B [5] (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(C))

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 B5B13

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(C)	Transmitter Spurious Emissions (RE) – Digital Base Stations	FCC Part 27/ ANSI C63.26	Pass	3.2

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 4: Assessed hardware

Hardware component	Part number	Release
Low Power Radio Unit 4410 B5B13 (LPRU 4410, B5B13)	KRC 161 887/1	R1B

2.2 Product overview

The product trade name is LPRU 4410 B5B13. 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 B5B13

Table 5: Product detail, LPRU 4410 B5B13

Product	LPRU with fan tray, Ph4 Mid Tier Dot
Revision	R1B
P/N	KRC 161 887/1
Nominal Voltage	110VAC or -48VDC
Operating Temperature	+0°C to +55°C
Bands	B5 (RF ports 1A,1B,1C,1D)
	B13 (RF ports 2A,2B,2C,2D)
Antennas	external
Output Power per band	4x50mW (FDD)
Single RAT (SRO) supported	B5: LTE-FDD, NBIoT IB/GB, NR
	B13: LTE-FDD, NBIoT IB/GB, NR
Mixed RAT (MRO) supported	B5: LTE + NR
	B13: LTE + NR
IBW	B5: 25MHz, B13: 10MHz
Nominal O/P per FDD Antenna Port	Single Carrier: 1 x 50mW (17dBm)
	Multi-Carrier: 2 x 25mW (14 dBm)
	Multi-Carrier: 3 x 16.7mW (12.2 dBm)
	Multi-Carrier: 4 x 12.5mW (11 dBm)
	Multi-Carrier: 5 x 10mW
Max number LTE carriers per Port	B5: Max 5 LTE carriers
	B13: Max 2 LTE carriers
Max number of NR carriers	B5: Max 2 NR carriers
	B13: Max 2 NR carriers
Max number of UTRA carriers	na
Modulation:	LTE: QPSK, 16QAM, 64QAM, 256 QAM (DL only)
Channel Bandwidth B5	LTE: 5, 10MHz
	WCDMA: na
	NBIoT GB/IB: 10MHz (min host LTE BW)
	NR: 5, 10, 15, 20MHz
Channel Bandwidth B13	LTE: 5, 10MHz
	WCDMA: na
	NBIoT GB/IB: 10MHz (min host LTE BW)
	NR: 5, 10MHz
IF Interface	Digital
Channel Raster	LTE: 100kHz,
Mounting	19' rack mount
Dimensions	442 x 132 x 370mm (WxHxD)
Weight	12.6 kg

The Configuration of the LPRU 4410 B5B13that was 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 is enough,
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, P1/P5 connected to internal cable, other ports no connection	Internal	5G/10GBase-T, Ethernet	RJ-45, Cat6A, fixed internal termination	none
1A / 1B / 1C / 1D	RF I/O ports - Band 5	RF/Antenna	to active DAS ports (Dot side -1)	2.2-5 connector,	SMA adaptor used on all ports,
2A / 2B / 2C / 2D	RF I/O ports - Band 13	RF/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

Two configurations were used for Emissions test; All configurations were defined by customer.

- Configuration 1 – Radiated Emissions test – DC powered EUT
- Configuration 2 – AC mains conducted Emissions test – AC powered EUT

Figure 2 and Figure 3 show the configurations of the EUT for Emissions test.

Figure 2: Test configuration for Radiated Emission tests – DC powered

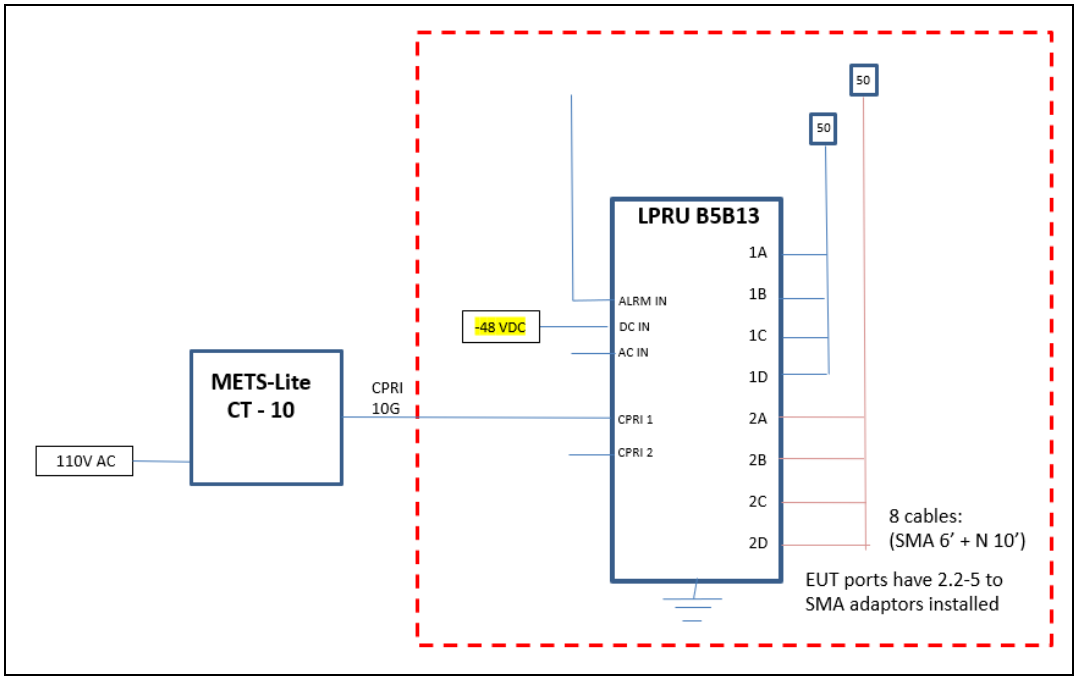
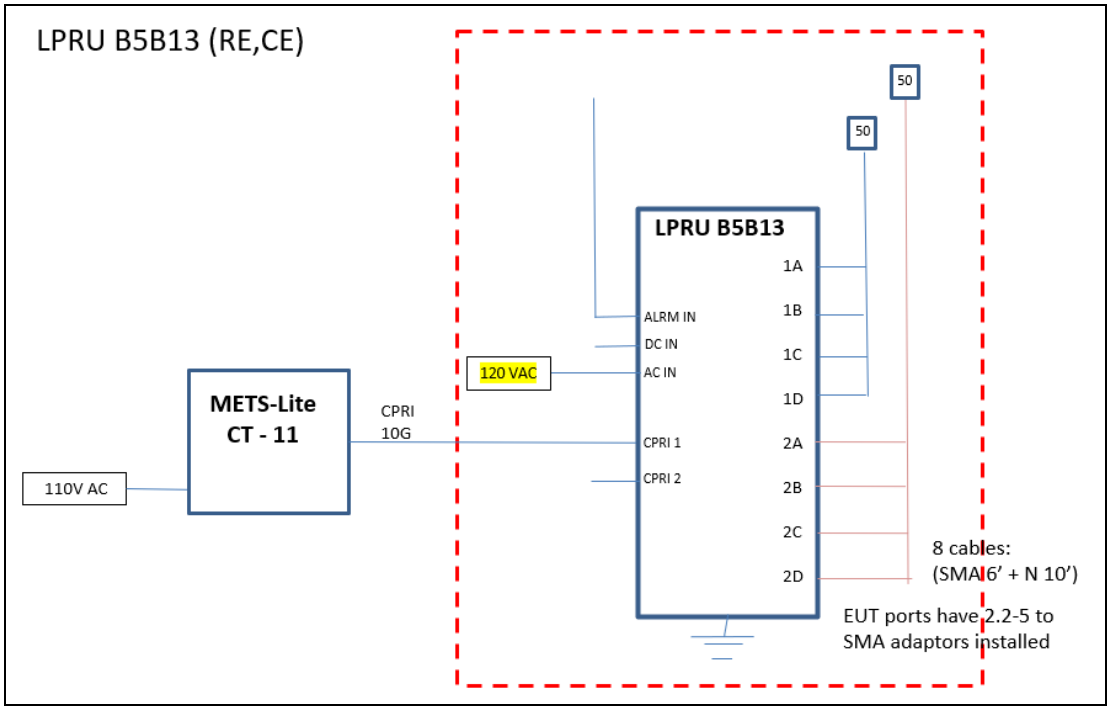


Figure 3: Test configuration for Conducted Emission tests – AC powered



2.4.1 Radiated Emissions Single RAT / Single Carrier configurations - NR

Figure 4: Carrier detail – Config (SC1) - Middle

SR NR Config SC1 Carrier setups for Emissions			
B5 PORT (1A,1B, 1C,1D)		B13 Port (2A, 2B, 2C, 2D)	
NR		NR	
Carrier:	**Middle**	Carrier:	**Middle**
1	B5: NR, 5MHz, 881.5MHz	1	B13: NR, 5MHz, 751MHz

Figure 5: Carrier detail – Config (SC2) - Middle

SR NR Config SC1 Carrier setups for Emissions			
B5 PORT (1A,1B, 1C,1D)		B13 Port (2A, 2B, 2C, 2D)	
NR		NR	
Carrier:	**Middle**	Carrier:	**Middle**
1	B5: NR, 5MHz, 881.5MHz	1	B13: NR, 10MHz, 751MHz

Note: Radiated Emissions measurements were compared between SC1, and SC2 middle channel. SC1 was found to have higher emissions than SC2; therefore EUT with SC1 carrier configuration was tested fully at all three channels and reported. See Figure 6 for tested carrier detail.

Figure 6: Tested carrier detail - Single RAT/Single Carrier configurations (NR)

SR NR Config SC1 Carrier setups for Emissions			
B5 PORT (1A,1B, 1C,1D)		B13 Port (2A, 2B, 2C, 2D)	
NR		NR	
Carrier:	**Bottom**	Carrier:	**Bottom**
1	B5: NR, 5MHz, 871.5MHz	1	B13: NR, 5MHz, 748.5MHz
Carrier:	**Middle**	Carrier:	**Middle**
1	B5: NR, 5MHz, 881.5MHz	1	B13: NR, 5MHz, 751MHz
Carrier:	**Top**	Carrier:	**Top**
1	B5: NR, 5MHz, 891.5MHz	1	B13: NR, 5MHz, 753.5MHz

2.4.2 Radiated Emissions Single RAT / Multi Carrier configurations - NR

Figure 7: Tested carrier detail - Single RAT/Multi Carrier configurations (NR)

MC NR Config MC Carrier setups for Emissions			
B5 PORT (1A,1B, 1C,1D)		B13 Port (2A, 2B, 2C, 2D)	
NR		NR	
Carrier:	**Middle**	Carrier:	**Middle**
1	B5: NR, 5MHz, tbd MHz	1	B13: NR, 5MHz, 748.5MHz
2	B5: NR, 5MHz, tbd MHz	2	B13: NR, 5MHz, 753.5MHz

2.4.3 Radiated Emissions Multi RAT/Multi Carrier configurations – NR + LTE

Figure 8: Carrier detail – Config (MR1) - Middle

MR LTE + NR Config MR1 Carrier setups for Emissions			
B5 PORT (1A,1B, 1C,1D)		B13 Port (2A, 2B, 2C, 2D)	
LTE+NR		LTE+NR	
Carrier:	**Middle**	Carrier:	**Middle**
1	B5: LTE, 10MHz, tbd MHz	1	B13: LTE, 5MHz, 748.5MHz
2	B5: NBIoT GB tbd MHz (PRB50)	2	B13: NR, 5MHz, 753.5MHz
3	B5: NR, 5MHz, tbd MHz		

Figure 9: Carrier detail – Config (MR2) - Middle

MR LTE + NR Config MR2 Carrier setups for Emissions			
B5 PORT (1A,1B, 1C,1D)		B13 Port (2A, 2B, 2C, 2D)	
LTE+NR		LTE+NR	
Carrier:	**Middle**	Carrier:	**Middle**
1	B5: LTE, 10MHz, tbd MHz	1	B13: LTE, 5MHz, 748.5MHz
2	B5: NBIoT GB tbd MHz (PRB50)	2	B13: NR, 5MHz, 753.5MHz
3	B5: NR, 5MHz, tbd MHz		
4	B5: NR, 5MHz, tbd MHz		

Note: Radiated Emissions measurements were compared between MR1, and MR2 middle channel. MR2 was found to have higher emissions than MR1; therefore EUT with MR2 carrier configuration was tested at Middle channels and reported. See Figure 10 for tested carrier detail.

Figure 10: Tested carrier detail – Multi RAT/Multi Carrier configurations (NR + LTE)

MR LTE + NR Config MR2 Carrier setups for Emissions			
B5 PORT (1A,1B, 1C,1D)		B13 Port (2A, 2B, 2C, 2D)	
LTE+NR		LTE+NR	
Carrier:	**Middle**	Carrier:	**Middle**
1	B5: LTE, 10MHz, tbd MHz	1	B13: LTE, 5MHz, 748.5MHz
2	B5: NBIoT GB tbd MHz (PRB50)	2	B13: NR, 5MHz, 753.5MHz
3	B5: NR, 5MHz, tbd MHz		
4	B5: NR, 5MHz, tbd MHz		

2.4.4 Conducted Emissions Carrier Configuration – (NR + LTE)

Figure 11: CE tested carrier detail

MR LTE + NR Config MR2 Carrier setups for Emissions			
B5 PORT (1A,1B, 1C,1D)		B13 Port (2A, 2B, 2C, 2D)	
LTE+NR		LTE+NR	
Carrier:	**Middle**	Carrier:	**Middle**
1	B5: LTE, 10MHz, tbd MHz	1	B13: LTE, 5MHz, 748.5MHz
2	B5: NBIoT GB tbd MHz (PRB50)	2	B13: NR, 5MHz, 753.5MHz
3	B5: NR, 5MHz, tbd MHz		
4	B5: NR, 5MHz, tbd MHz		

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 NR (RE & CE tests)

Equipment Role	Product Name	Product Number	Release	Product Serial#
EUT	LPRU 4410 B5B13	KRC 161 887/1	R1B	TD3F062322
AC power cable	generic, 14AWG, C14 plug, 2m	RPM 251 063	na	na
DC power cable	2W DC Power Cable	RPM 777 825/02500	na	na
DC extension cable	TUV DC power cable, 13mm2, 4m	na	na	na
Optical Fiber	LC, SM, 50m	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
Ext Alarm Cable	Custom, 4w, 16-AWG, 5m	na	na	na
TEST SET	CT-10, METS-Lite2, DU-SIM	LPC 102 487/1	R1C	TO1F311639
Software info				
EUT load: CXP2030045_17-R9A99 RUX rev: R9F RUX testDef: RRUS_DOT_Ph4_B5B13_LTE_Finaluse_V1				

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 22	ANSI C63.26	USA
FCC Part 27	ANSI C63.26	USA

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 22 & Part 27

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

3.2.2 Test procedure

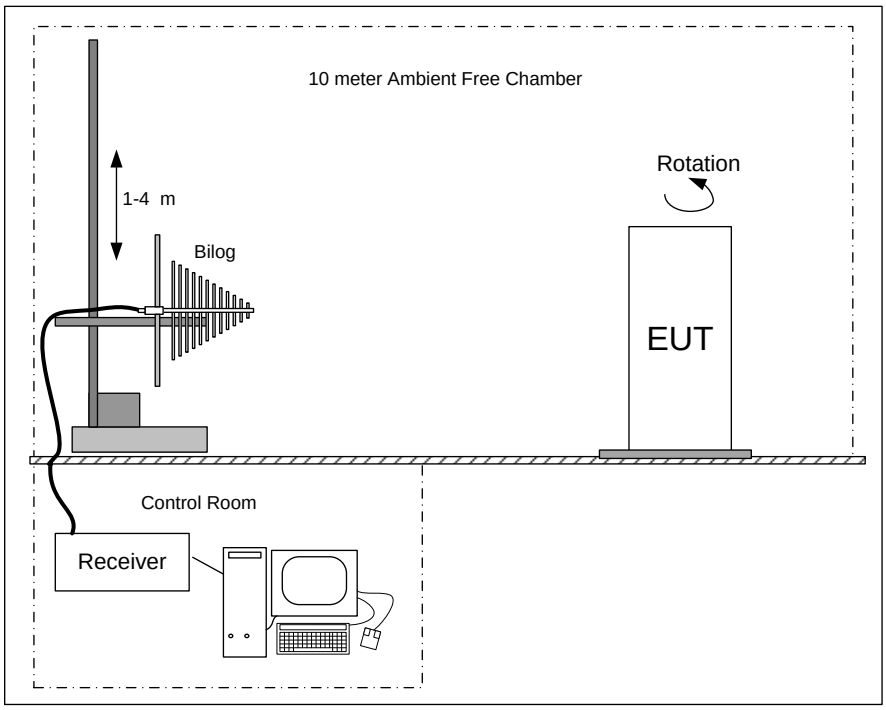
Verifications of the test equipment and AFC were performed before the installation of the EUT in accordance with the quality assurance procedures documented in the EMC test procedures document. The test was performed according to the relevant procedures listed in Table 8.

- 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 12: 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

3.2.5 Test results of RE (Single RAT / Single Carrier) - NR

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

Date tested: 1 - 8, June 2021

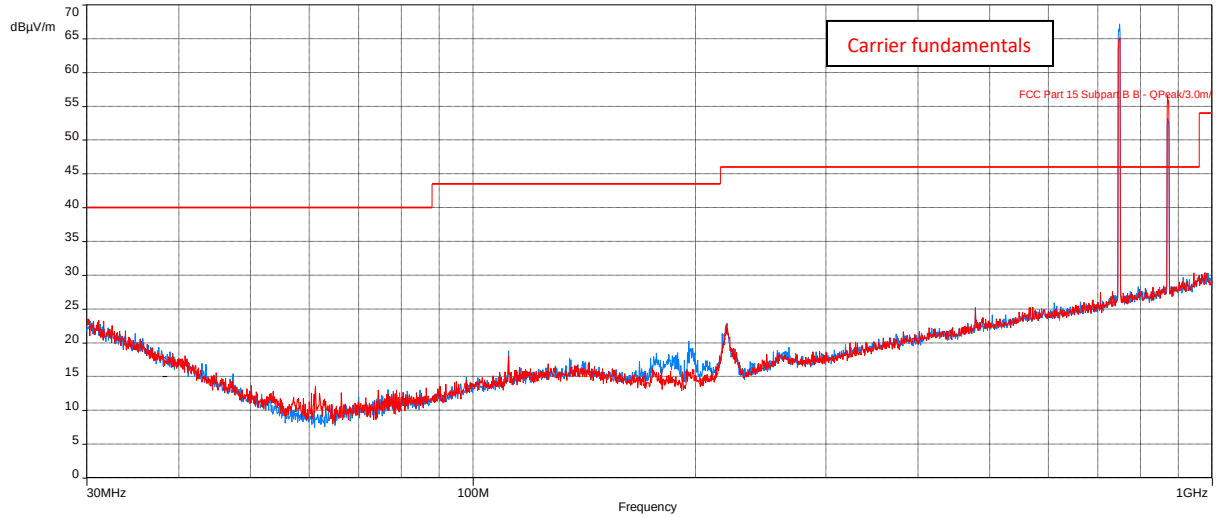
Tested by: Krupal Patel & Christopher Richer

Test configuration is listed as SC - NR in Figure 6 as identified in the section Configurations of the EUT. For the following test results that have supporting data tables with worst case emissions, negative margin values indicate a pass.

Red trace – Vertical antenna polarity, Blue trace – Horizonatal antenna polarity

3.2.5.1 Single RAT/Single Carrier (SC, NR – Bottom channel)

Figure 13: Plot of RE at 3 m – 30 to1000 MHz (SC- NR- Bottom channel)



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 (Bottom channel)

Frequency (MHz)	Level (dBµV)	Limit Quasi-peak (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
111.5459838	12.40	43.52	-31.12	2.55	96.25	Horizontal	-9.53
111.6620226	16.20	43.52	-27.32	2.05	350.50	Vertical	-9.52
221.2012628	18.86	46.02	-27.16	1.00	11.50	Vertical	-9.82
221.2082723	20.00	46.02	-26.02	1.73	11.75	Horizontal	-9.82

Table 12: RE test results from 30 to 1000 MHz for FCC Part 22/27 (Bottom channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
111.5459838	12.40	82.2	-69.80	2.55	96.25	Horizontal	-9.53
111.6620226	16.20	82.2	-66.00	2.05	350.50	Vertical	-9.52
221.2012628	18.86	82.2	-63.34	1.00	11.50	Vertical	-9.82
221.2082723	20.00	82.2	-62.20	1.73	11.75	Horizontal	-9.82

Note: In the table/Plot above, no emissions exceed the FCC 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 3m from 1 to 10 GHz (SC- NR- Bottom channel)

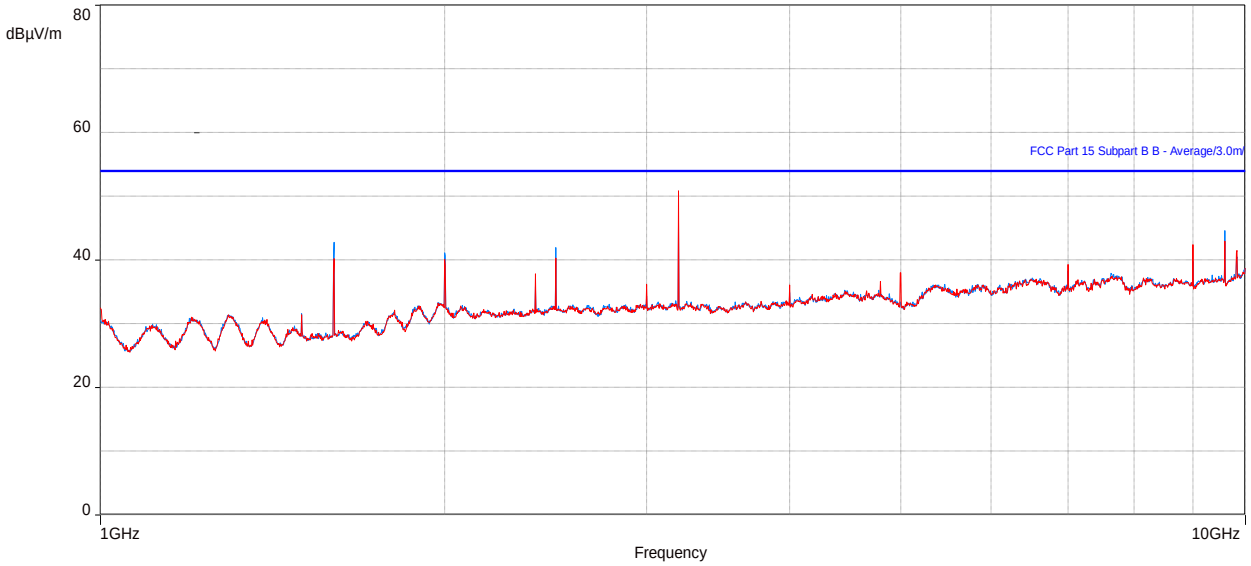


Table 13: RE test results from 1 to 10 GHz for FCC part 15 (Bottom channel)

Frequency (MHz)	Level Average (dBµV)	Limit Average (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
3199.978526	51.08	53.96	-2.88	2.07	189.50	Vertical	-4.43
9599.934936	43.09	53.96	-10.87	1.00	26.25	Vertical	3.52
1599.988782	42.15	53.96	-11.81	3.48	297.50	Horizontal	-10.03
3199.978526	45.48	53.96	-8.48	1.73	326.50	Horizontal	-4.43

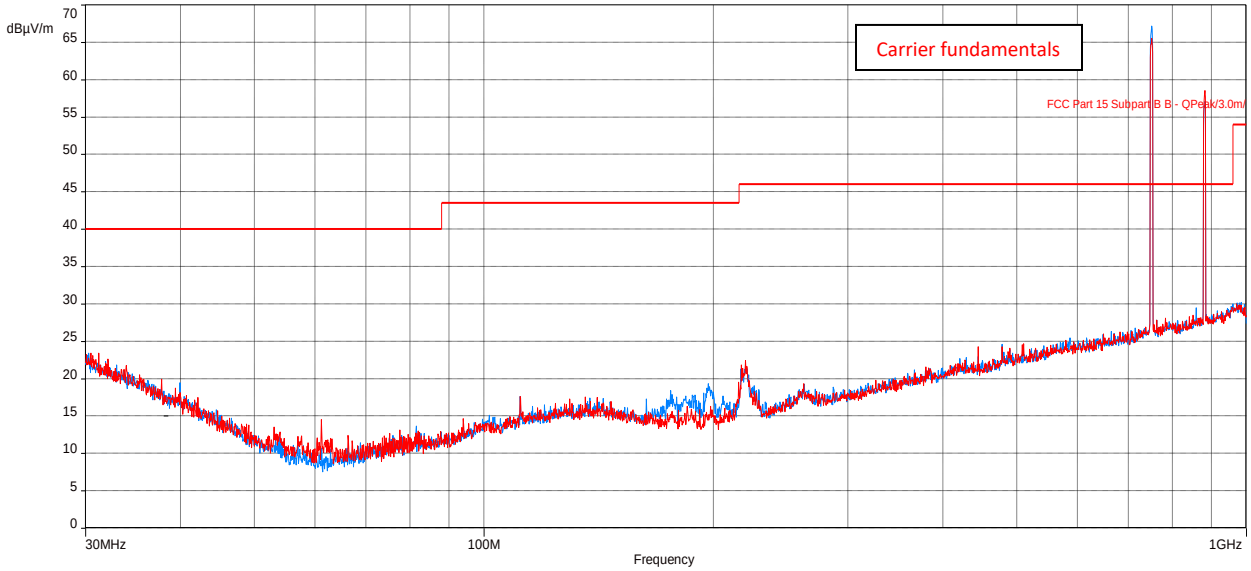
Table 14: RE test results from 1 to 10 GHz for FCC Part 22/27 (Bottom channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
3199.978526	51.08	82.2	-31.12	2.07	189.50	Vertical	-4.43
9599.934936	43.09	82.2	-39.11	1.00	26.25	Vertical	3.52
1599.988782	42.15	82.2	-40.05	3.48	297.50	Horizontal	-10.03
3199.978526	45.48	82.2	-36.72	1.73	326.50	Horizontal	-4.43

Note: In the table/Plot above, no emissions exceed the FCC 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.

3.2.5.2 Single RAT/Single Carrier (SC, NR – Middle channel)

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



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

Table 15: RE test results from 30 to 1000 MHz for FCC part 15 (Middle channel)

Frequency (MHz)	Level (dBµV)	Limit Quasi-peak (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.31103205	18.48	40.00	-21.52	1.16	212.50	Horizontal	-1.94
220.3224936	18.38	46.02	-27.64	1.00	11.75	Vertical	-9.89
220.3363941	19.56	46.02	-26.46	1.77	11.50	Horizontal	-9.89

Table 16: RE test results from 30 to 1000 MHz for FCC Part 22/27 (Middle channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
30.31103205	18.48	82.2	-63.72	1.16	212.50	Horizontal	-1.94
220.3224936	18.38	82.2	-63.82	1.00	11.75	Vertical	-9.89
220.3363941	19.56	82.2	-62.64	1.77	11.50	Horizontal	-9.89

Note: In the table/Plot above, no emissions exceed the FCC 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 16: Plot of RE at 3m from 1 to 10 GHz (SC- NR- Middle channel)

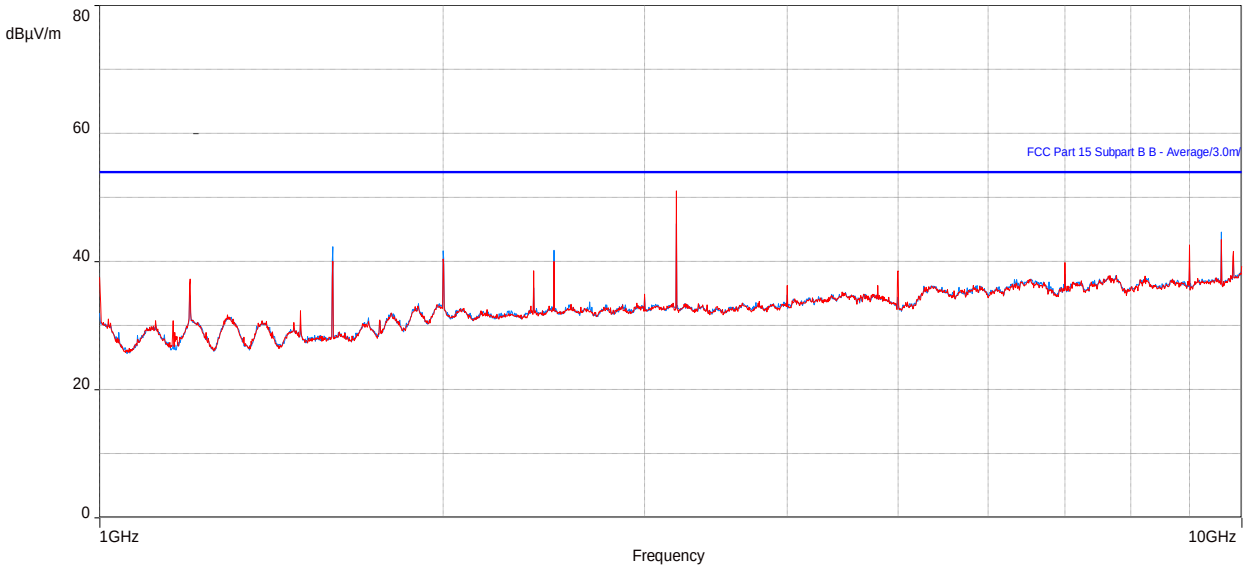


Table 17: RE test results from 1 to 10 GHz for FCC part 15 (Middle channel)

Frequency (MHz)	Level Average (dBµV)	Limit Average (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
3199.978526	51.12	53.96	-2.84	2.42	190.75	Vertical	-4.43
9599.934936	43.05	53.96	-10.91	1.00	26.25	Vertical	3.52
1599.988782	42.34	53.96	-11.62	3.48	298.50	Horizontal	-10.03

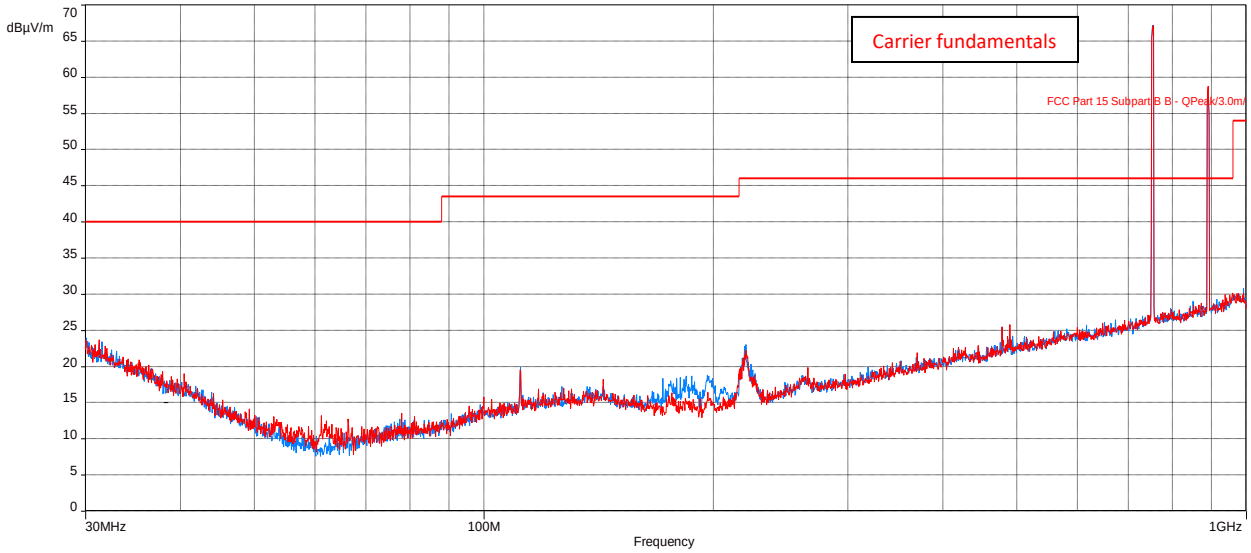
Table 18: RE test results from 1 to 10 GHz for FCC Part 22/27 (Middle channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
3199.978526	51.12	82.2	-31.08	2.42	190.75	Vertical	-4.43
9599.934936	43.05	82.2	-39.15	1.00	26.25	Vertical	3.52
1599.988782	42.34	82.2	-39.86	3.48	298.50	Horizontal	-10.03

Note: In the table/Plot above, no emissions exceed the FCC 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.

3.2.5.3 Single RAT/Single Carrier (SC, NR – Top channel)

Figure 17: Plot of RE at 3 m – 30 to1000 MHz (SC- NR- Top channel)



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

Table 19: RE test results from 30 to 1000 MHz for FCC part 15 (Top channel)

Frequency (MHz)	Level (dBµV)	Limit Quasi-peak (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
31.26913428	18.12	40.00	-21.88	2.73	53.00	Vertical	-2.43
111.6152595	18.00	43.52	-25.52	2.58	112.75	Horizontal	-9.52
219.5770608	19.38	46.02	-26.64	1.57	11.75	Horizontal	-9.97
220.7255159	18.39	46.02	-27.63	1.00	11.50	Vertical	-9.85

Table 20: RE test results from 30 to 1000 MHz for FCC Part 22/27 (Top channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
31.26913428	18.12	82.2	-64.08	2.73	53.00	Vertical	-2.43
111.6152595	18.00	82.2	-64.2	2.58	112.75	Horizontal	-9.52
219.5770608	19.38	82.2	-62.82	1.57	11.75	Horizontal	-9.97
220.7255159	18.39	82.2	-63.81	1.00	11.50	Vertical	-9.85

Note: In the table/Plot above, no emissions exceed the FCC 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 18: Plot of RE at 3m from 1 to 10 GHz (SC- NR- Top channel)

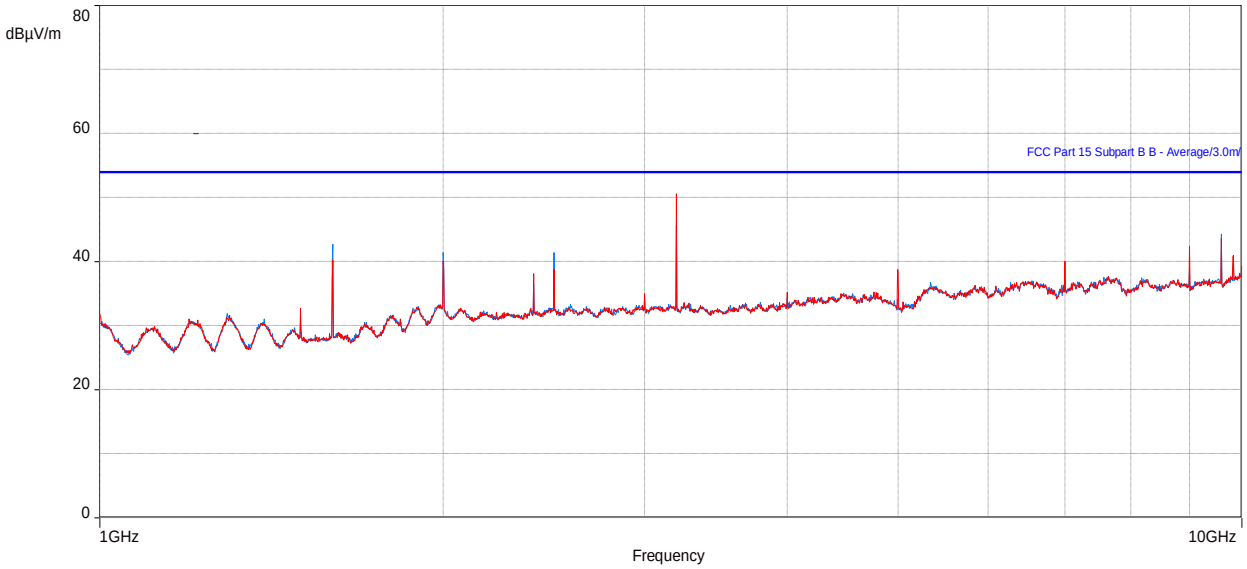


Table 21: RE test results from 1 to 10 GHz for FCC part 15 (Top channel)

Frequency (MHz)	Level Average (dBµV)	Limit Average (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.990064	42.12	53.96	-11.84	3.48	297.50	Horizontal	-10.03
3199.978526	50.99	53.96	-2.97	2.07	189.75	Vertical	-4.43
9599.934936	43.30	53.96	-10.66	1.00	26.00	Vertical	3.52

Table 22: RE test results from 1 to 10 GHz for FCC Part 22/27 (Top channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.990064	42.12	82.2	-40.08	3.48	297.50	Horizontal	-10.03
3199.978526	50.99	82.2	-31.21	2.07	189.75	Vertical	-4.43
9599.934936	43.30	82.2	-38.90	1.00	26.00	Vertical	3.52

Note: In the table/Plot above, no emissions exceed the FCC 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.

3.2.6 Test results of RE (Single RAT/Multi Carrier) - NR

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

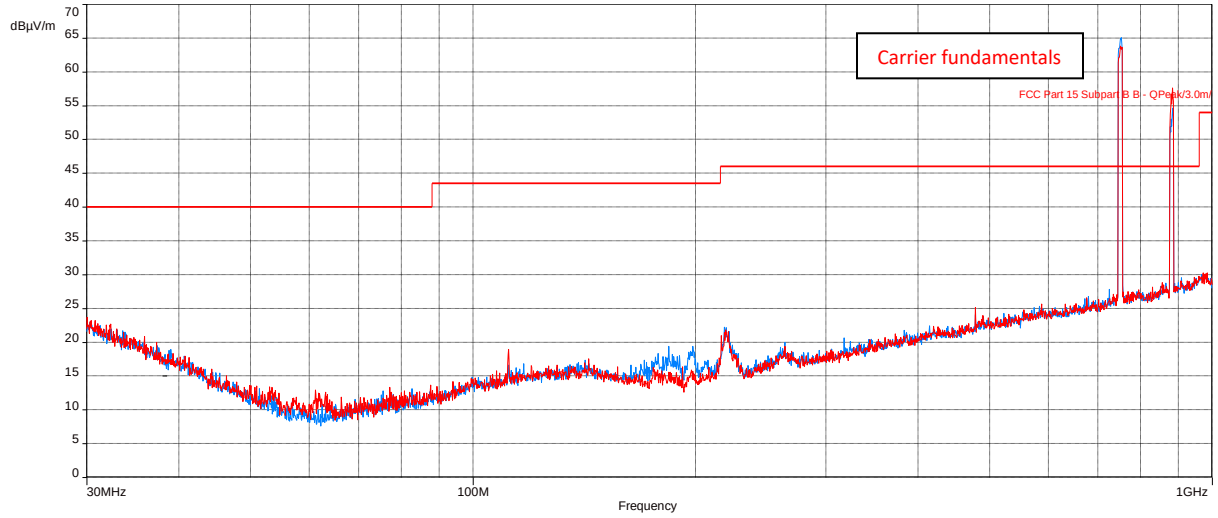
Date tested: 1 - 8, June 2021

Tested by: Krupal Patel & Christopher Richer

Test configuration is listed as MC - NR in Figure 7 as identified in the section Configurations of the EUT. For the following test results that have supporting data tables with worst case emissions, negative margin values indicate a pass.

Red trace – Vertical antenna polarity, Blue trace – Horizonatal antenna polarity

Figure 19: Plot of RE at 3 m – 30 to1000 MHz (MC, NR – Mid channel)



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

Table 23: RE test results from 30 to 1000 MHz for FCC part 15 (Mid channel)

Frequency (MHz)	Level (dBµV)	Limit Quasi-peak (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
111.6879005	15.39	43.52	-28.13	2.87	91.00	Horizontal	-9.52
218.8678559	19.62	46.02	-26.40	1.67	11.75	Horizontal	-10.04
221.6222021	18.86	46.02	-27.16	1.00	11.50	Vertical	-9.81

Table 24: RE test results from 30 to 1000 MHz for FCC Part 22/27 (Mid channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
111.6879005	15.39	82.2	-66.81	2.87	91.00	Horizontal	-9.52
218.8678559	19.62	82.2	-62.58	1.67	11.75	Horizontal	-10.04
221.6222021	18.86	82.2	-63.34	1.00	11.50	Vertical	-9.81

Note: In the table/Plot above, no emissions exceed the FCC 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 20: Plot of RE at 3m from 1 to 10 GHz (MC, NR- Mid channel)

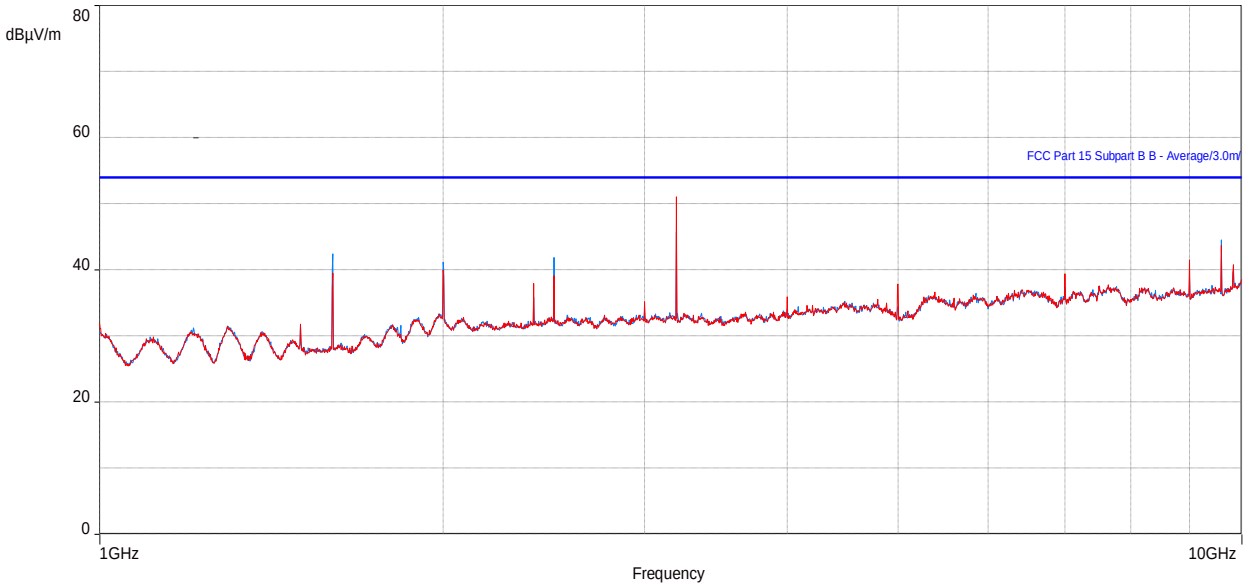


Table 25: RE test results from 1 to 10 GHz for FCC part 15 (Mid channel)

Frequency (MHz)	Level Average (dBµV)	Limit Average (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.988782	41.75	53.96	-12.21	1.00	319.25	Horizontal	-10.03
1599.988782	39.52	53.96	-14.44	1.87	225.50	Vertical	-10.03
3199.978526	45.32	53.96	-8.64	1.73	326.50	Horizontal	-4.43
3199.978526	50.62	53.96	-3.34	2.01	197.25	Vertical	-4.43

Table 26: RE test results from 1 to 10 GHz for FCC Part 22/27 (Mid channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.988782	41.75	82.2	-40.45	1.00	319.25	Horizontal	-10.03
1599.988782	39.52	82.2	-42.68	1.87	225.50	Vertical	-10.03
3199.978526	45.32	82.2	-36.88	1.73	326.50	Horizontal	-4.43
3199.978526	50.62	82.2	-31.58	2.01	197.25	Vertical	-4.43

Note: In the table/Plot above, no emissions exceed the FCC 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.

3.2.7 Test results of RE (Multi RAT/Multi Carrier) - NR + LTE

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

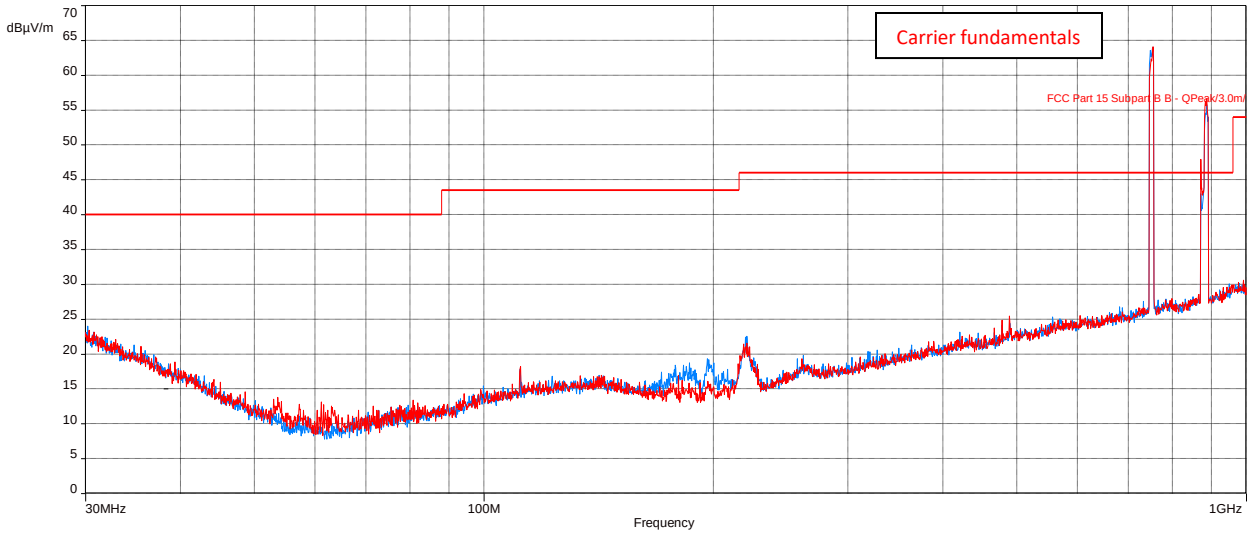
Date tested: 1-8 June, 2021

Tested by: Krupal Patel & Christopher Richer

Test configuration is listed as MR – LTE + NR in Figure 10 as identified in the section Configurations of the EUT. For the following test results that have supporting data tables with worst case emissions, negative margin values indicate a pass.

Red trace – Vertical antenna polarity, Blue trace – Horizonatal antenna polarity

Figure 21: Plot of RE at 3 m – 30 to1000 MHz (MR, NR+LTE – Mid channel)



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

Table 27: RE test results from 30 to 1000 MHz for FCC part 15 (Mid channel)

Frequency (MHz)	Level (dBµV)	Limit Quasi-peak (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
111.6620226	16.20	43.52	-27.32	2.05	350.50	Vertical	-9.52
221.2012628	18.86	46.02	-27.16	1.00	11.50	Vertical	-9.82
221.2082723	20.00	46.02	-26.02	1.73	11.75	Horizontal	-9.82

Table 28: RE test results from 30 to 1000 MHz for FCC Part 22/27 (Mid channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (deg)	Polarization	Correction (dB)
111.6620226	16.20	82.2	-66.00	2.05	350.50	Vertical	-9.52
221.2012628	18.86	82.2	-63.34	1.00	11.50	Vertical	-9.82
221.2082723	20.00	82.2	-62.20	1.73	11.75	Horizontal	-9.82

Note: In the table/Plot above, no emissions exceed the FCC 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 22: Plot of RE at 3m from 1 to 10 GHz (MR, NR+LTE – Mid channel)

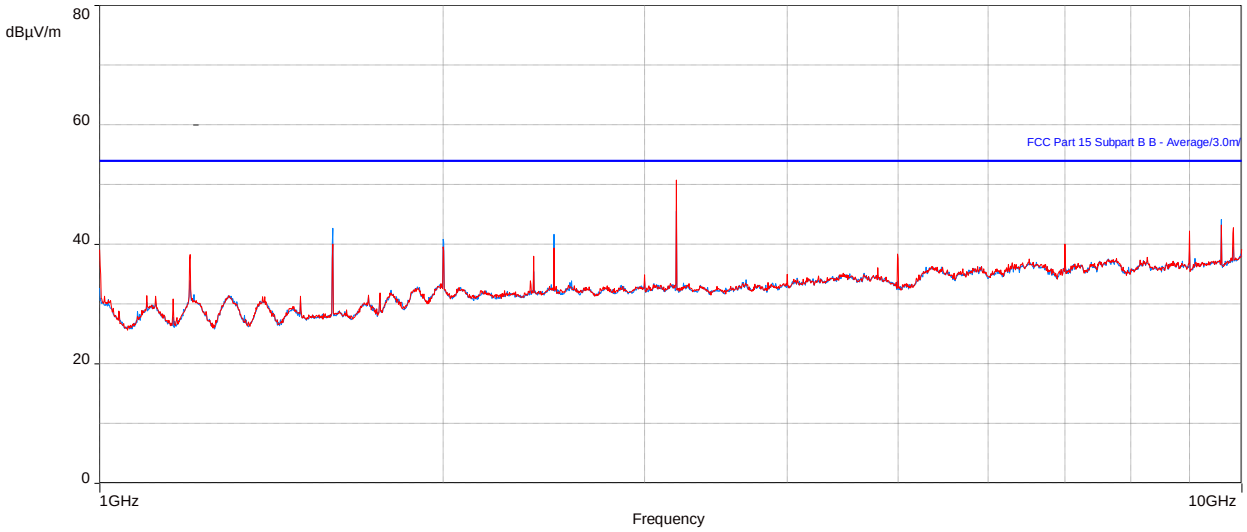


Table 29: RE test results from 1 to 10 GHz for FCC part 15 (Mid channel)

Frequency (MHz)	Level Average (dBµV)	Limit Average (dBµV)	Margin to Class B Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.988782	42.05	53.96	-11.91	3.48	297.50	Horizontal	-10.03
2499.982372	40.99	53.96	-12.97	3.00	69.25	Horizontal	-5.47
3199.978526	50.87	53.96	-3.09	2.07	189.75	Vertical	-4.43
9599.934936	43.44	53.96	-10.52	1.00	26.25	Vertical	3.52

Table 30: RE test results from 1 to 10 GHz for FCC Part 22/27 (Mid channel)

Frequency (MHz)	Level (dBµV)	Limit EIRP (dBµV)	Margin to EIRP Limit (dB)	Height (m)	Azimuth (degrees)	Polarization	Correction (dB)
1599.988782	42.05	82.2	-40.15	3.48	297.50	Horizontal	-10.03
2499.982372	40.99	82.2	-41.21	3.00	69.25	Horizontal	-5.47
3199.978526	50.87	82.2	-31.33	2.07	189.75	Vertical	-4.43
9599.934936	43.44	82.2	-38.76	1.00	26.25	Vertical	3.52

Note: In the table/Plot above, no emissions exceed the FCC 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 Radiated Emissions test setup pictures

Figure 23: Setup for RE tests at 30 MHz to 1 GHz

3.2.9 Test equipment

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

Table 31: 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	not required
Bilog Antenna	TESEQ	CBL 6111D	SSG013965	2021-05-04	2022-05-04
Horn Antenna 3MCH 00003	ETS	3117	LAVE04211	2021-03-30	2022-03-30
EMI Receiver	Rohde & Schwarz	ESU26	SSG013729	2021-03-31	2022-03-31
EMI Receiver	Rohde & Schwarz	ESU40	SSG013672	2020-10-29	2021-10-29
Coaxial Cable	Huber & Suhner	106A	SSG013841	2021-01-05	2022-01-05
Coaxial Cable	Huber & Suhner	106A	SSG012711	2021-01-05	2022-01-05
Coaxial Cable	Huber & Suhner	104PEA	SSG012041	2021-01-05	2022-01-05
Coaxial Cable	Huber & Suhner	ST18/Nm/Nm/36	SSG012785	2021-01-06	2022-01-06
Coaxial Cable	Micro-Coax	UFA 210B-1-1500-504504	SSG012376	2021-01-06	2022-01-06
Pre-Amplifier	Hp	8447D	LAVE04346	2020-09-10	2021-09-10
Pre-Amplifier	BNR	LNA	SSG012360	2020-11-16	2021-11-16
Power Supply	Hewlett Packard	6216A	SSG013063	not required	not required

3.2.10 Test conclusion

The LPRU 4410 B5B13 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 32: CE test requirements on AC power leads

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

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

Table 33: CE test limits on AC power leads for Class B

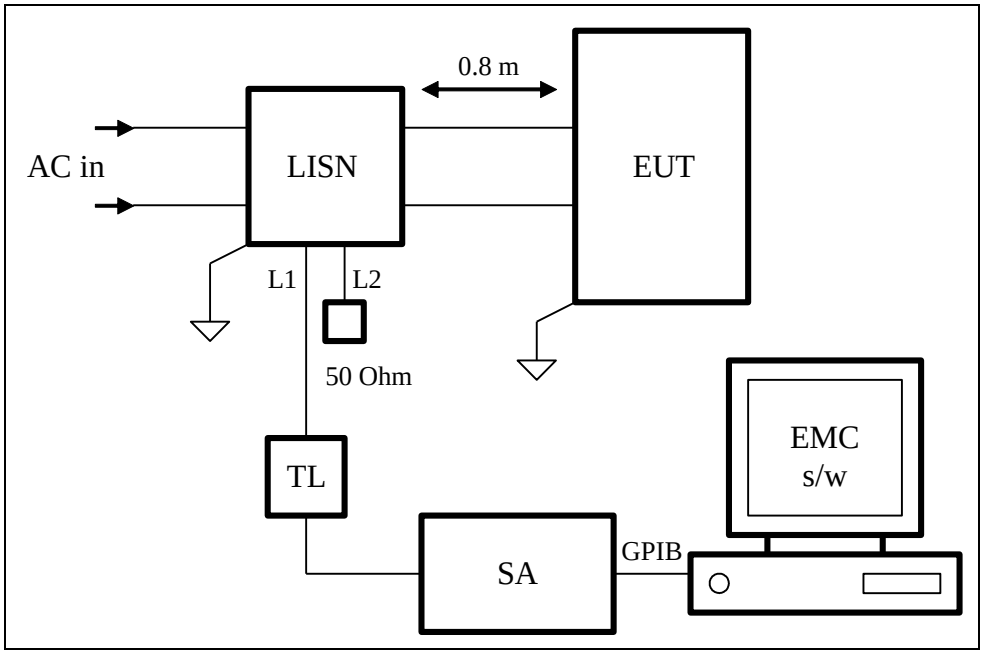
Frequency range (MHz)	**FCC Part 15 Average** (dBμV)	**FCC Part 15 Quasi-peak** (dBμV)
0.15 to 0.5	56 to 46	66 to 56
0.5 to 5	46	56
5 to 30	50	60

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 32.

Figure 24 shows the test method for regulatory CE measurements on AC Leads.

Figure 24: 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

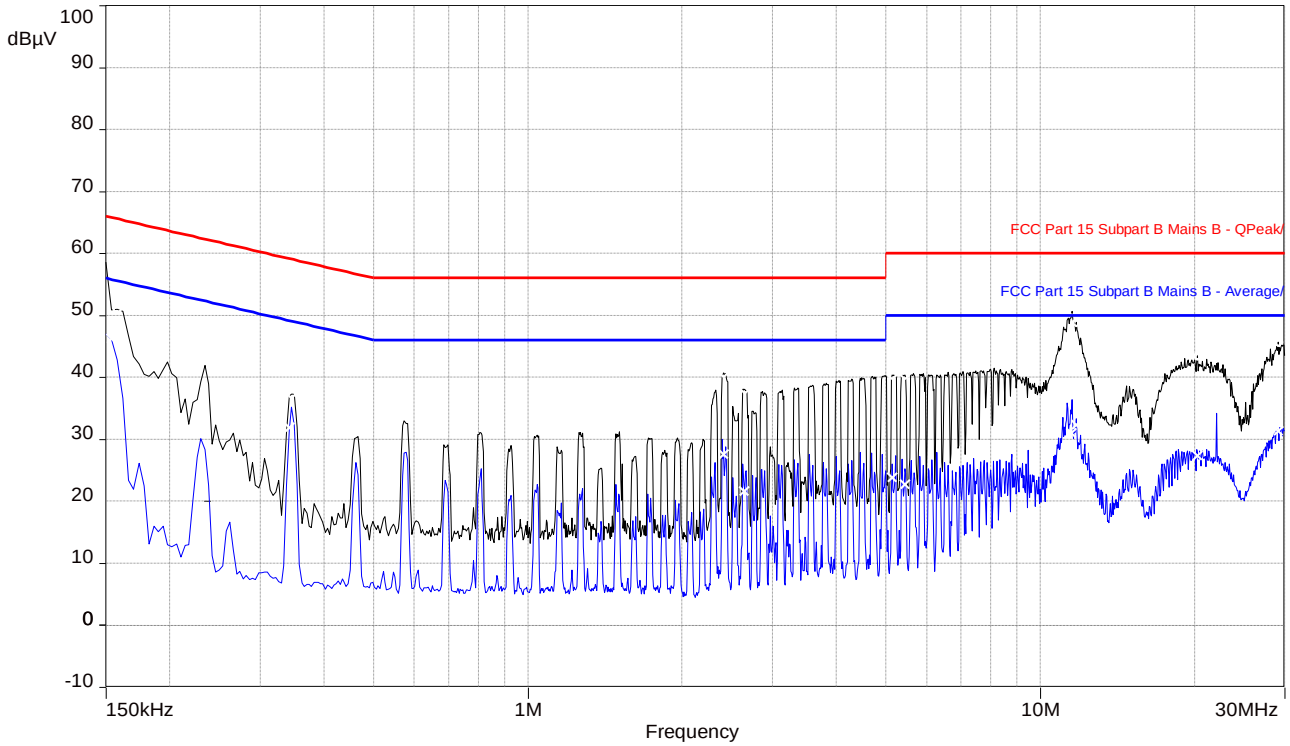
Date tested: 8 June, 2021

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.

Figure 25: Plot of CE on AC port, line L1 for FCC Part 15 class B

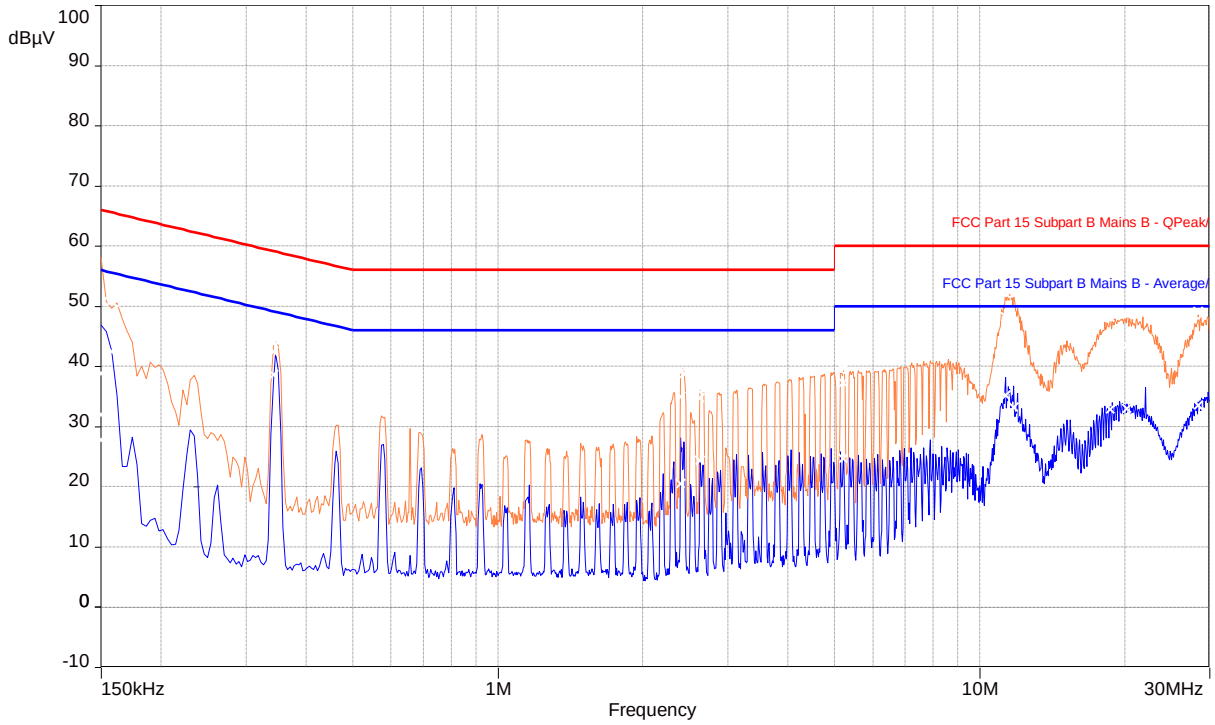


Black= Peak pre-scan, Blue = Average scan

Table 34: 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)
0.1535	46.28	49.42	-9.51	-16.36	55.78	65.78	19.79
0.3415	31.81	35.79	-17.34	-23.36	49.15	59.15	19.87
2.4055	27.51	39.24	-18.49	-16.76	46.00	56.00	19.98
2.6455	21.56	36.56	-24.44	-19.44	46.00	56.00	20.00
11.5215	31.03	44.65	-18.97	-15.35	50.00	60.00	20.33
11.7615	32.30	45.66	-17.70	-14.34	50.00	60.00	20.33
20.2815	27.37	37.37	-22.63	-22.63	50.00	60.00	20.47
29.1215	31.27	38.79	-18.73	-21.21	50.00	60.00	20.61

Figure 26: Plot of CE on AC port, line L2 for FCC Part 15 class B



Orange= Peak pre-scan, Blue = Average scan

Table 35: 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)
0.1495	27.78	32.03	-28.22	-33.97	56.00	66.00	19.87
0.1575	42.42	47.29	-13.15	-18.28	55.57	65.57	19.87
0.3415	38.56	42.48	-10.59	-16.67	49.15	59.15	19.88
2.3935	20.54	34.97	-25.46	-21.03	46.00	56.00	19.98
2.6295	24.37	34.75	-21.63	-21.25	46.00	56.00	19.99
5.2135	24.68	37.33	-25.32	-22.67	50.00	60.00	20.11
11.3175	35.16	48.25	-14.84	-11.75	50.00	60.00	20.32
11.7495	33.21	46.83	-16.79	-13.17	50.00	60.00	20.33
18.6375	32.82	43.23	-17.18	-16.77	50.00	60.00	20.45
20.2375	33.01	43.47	-16.99	-16.53	50.00	60.00	20.47
28.4295	33.51	41.44	-16.49	-18.56	50.00	60.00	20.57

Figure 27: Setup for CE tests on AC power cables

3.3.6 Test equipment

The equipment used for CE testing was as follows.

Table 36: 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
Coaxial Cable	Huber & Suhner	104PEA	SSG013080	2020-10-09	2021-10-09
Transient Limiter	Hewlett Packard	11947A	SSG012143	2021-01-05	2022-01-05
Line Impedance Stabilization Network	Teseq	NNB 51	SSG013880	2020-08-11	2021-08-11
EMI Receiver	Rohde & Schwarz	ESCI	SSG013727	2020-10-26	2021-10-26
Coaxial Cable	Huber & Suhner	104PEA	SSG013080	2020-10-09	2021-10-09

3.3.7 Test conclusion

The LPRU 4410 B5B13 has passed the Conducted Emissions (CE) test on AC power leads with respect to class B limit of FCC Part 15 Subpart B.

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 C63.26-2015, American National Standard for Compliance Testing of Transmitters Used in Licensed radio Services.
3. 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.
4. 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.
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.

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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