

RADIO TEST REPORT – 400858-1TRFWL

Type of assessment:

Transmitters co-location

Applicant:

Kontron America

Product:

IoT Gateway

Model:

WPEB-263ACNI(BT)

Includes FCC ID's:

S3I-WPEB263ACNIBT

N7NEM75

Includes IC Registration numbers:

9927A-EB263ACNIBT

2417C-EM75

Specifications:

- ◆ Digital Transmission Systems (DTSS)
- ◆ Unlicensed National Information Infrastructure Devices
- ◆ Cellular Radiotelephone Service
- ◆ Miscellaneous Wireless Communications Services
- ◆ Broadband Personal Communications Services

Date of issue: November 25, 2020

Andrey Adelberg, Senior EMC/RF Specialist

Tested by

Signature



David Duchesne, EMC/RF Lab Manager

Reviewed by

Signature

Lab locations

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Test site registration	Organization	Recognition numbers and location		
	FCC/ISED	FCC: CA2040; IC: 2040A-4 (Ottawa/Almonte); FCC: CA2041; IC: 2040G-5 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

Limits of responsibility

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

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

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Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
FCC 47 CFR Part 15, Subpart E, Clause 15.407(h)	Unlicensed National Information Infrastructure Devices.
FCC 47 CFR Part 27, Subpart C	Miscellaneous wireless communications services
FCC Part 22 Subpart H	Cellular radiotelephone service.
FCC Part 24 Subpart E	Personal communications services
RSS-132, Issue 3, January 2013	Cellular Telephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz
RSS-133, Issue 6, A1, January 2018	2 GHz Personal Communications Services
RSS-139, Issue 3, July 2015	Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz
RSS-247, Issue 2, Feb 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-130 Issue 2, February 2019	Equipment Operating in the Frequency Bands 617–652 MHz, 663–698 MHz, 698–756 MHz and 777–787 MHz

1.2 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.26 v2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

1.3 Exclusions

The evaluation was done to ensure there are no additional radiated spurious emissions generated due to simultaneous-transmission operations compared to single transmitter operations testing, and to ensure compliance with the applicable FCC/ISED rules for the transmitters operating individually and simultaneously. This includes compliance for the summation of all emissions from all outputs occupying the same or overlapping frequency ranges, as defined by the applicable rules.

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	November 25, 2020	Original report issued

Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

Section 2

2.2 Technical judgment

The EUT consists of two RF modules. Sierra Wireless EM7565 LTE modem, FCC ID N7NEM75 and SparkLAN WPEB-263ACNI(BT) WiFi / Bluetooth module, FCC ID RYK-WPEB263ACNIBT. LTE module can operate in multiple Cellular bands. Those Cellular bands were split into groups. From each group one representative band was selected for transmitters co-location test with either of Wi-Fi bands.

Group	Band number	Frequency range
700	B12	698–716 MHz
700	B28	703–748 MHz
700	B13	777–787 MHz
800	B26	814–849 MHz
800	B5	824–849 MHz
800	B19	829–844 MHz
1700	B3	1710–1785 MHz
1700	B4	1710–1755 MHz
1700	B66	1710–1780 MHz
1700	B9	1749.9–1784.9 MHz
1900	B2	1850–1910 MHz
1900	B1	1920–1980 MHz
2400	B30	2305–2315 MHz
2400	B41	2496–2690 MHz
2400	B7	2500–2570 MHz

The sampled transmitter frequencies combinations were as follows.

2.4 or 5 GHz Wi-Fi on the middle channel, modulated with 802.11b transmitting simultaneously with 700 group LTE Cellular Band 28 on the middle channel.
2.4 or 5 GHz Wi-Fi on the middle channel, modulated with 802.11b transmitting simultaneously with 800 group LTE Cellular Band 5 on the middle channel.
2.4 or 5 GHz Wi-Fi on the middle channel, modulated with 802.11b transmitting simultaneously with 1700 group LTE Cellular Band 3 on the middle channel.
2.4 or 5 GHz Wi-Fi on the middle channel, modulated with 802.11b transmitting simultaneously with 1900 group LTE Cellular Band 1 on the middle channel.
2.4 or 5 GHz Wi-Fi on the middle channel, modulated with 802.11b transmitting simultaneously with 2500 group LTE Cellular Band 30 on the middle channel.

EUT comes in two model variants. Both models have the same RF module and are identical electrically. 001-0156-03 is a metal box in a plastic box intended for outdoor use, 2-A0CW-20SLB-M2 is a metal box. It was verified, that the radiated RF spurious emissions are similar, the 001-0156-03 is considered representative of both models and all the tests were performed on that model.

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (1060 mbar)

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

3.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Measurement uncertainty

4.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Table 4.1-1: Measurement uncertainty calculations

Test name	Measurement uncertainty, $\pm$ dB
Radiated spurious emissions	3.78

Information provided by the applicant

5.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

5.2 Applicant/Manufacture

Name	Kontron America
Address	9477 Waples Street, Suite 150, San Diego, CA 92121-2937

5.3 EUT information

Product	IoT Gateway
Model	001-0156-03
Model variant(s)	2-A0CW-20SLB-M2
Serial number	448440008 (001-0156-03), 449977005 (2-A0CW-20SLB-M2)
Power supply requirements	(001-0156-03) 100–240 V _{AC} , 50/60 Hz or 24 V _{DC} (2-A0CW-20SLB-M2) 24 V _{DC}
Product description and theory of operation	System based on a SMARC computing module, provides cell and Wi-Fi connectivity. Module with Intel Atom x5-E3930 or E3950, up to 8GB DDR3L RAM, up to 32GB eMMC flash storage. Both models are identical electrically. 001-0156-03 is a metal box in a plastic box intended for outdoor use, 2-A0CW-20SLB-M2 is a metal box. 001-0156-03 is considered representative of both models.
Antenna information	Wi-Fi: PCTEL, PCTMI2458-RPC: 3 dBi (2.4 GHz range), 5 dBi (5 GHz range) LTE: PCTEL, PCTP/4GLTE: 2 dBi typical gain

5.4 EUT setup details

5.4.1 Radio exercise details

Operating conditions	Windows 10 with Sparklan software WL356_PCIE_RF_wifi_win10_v1.1; hardware version is “prototype”. EUT was boot up from SSD drive with Windows OS and controlled using CLI and PuttY.
Transmitter state	Transmitters were set to transmit continuously at their maximum power at desired channel with selected modulation, channel bandwidth, and operational band.

5.4.2 EUT setup configuration

Table 5.4-1: EUT sub assemblies

Description	Brand name	Model, Part number, Serial number, Revision level
EUT1	Kontron	"Gateway", PN 001-0156-03, SN 448440008
Main PCB	Kontron	PN 801-0128-07, SN 00200C7D2BC0, PCB P2-00538-1 Rev B0
LTE Module	Sierra	Model EM7565, SN 353533100616609, Rev A
Wi-Fi Module	Sparklan	Model WPEB-263ACNI (BT), SN 18B60S2002782, Rev G312B02F
AC-DC Power Supply	Recom	Model RACM40-24S/0F, SN RACM40-24S/OF19210379
EUT2	Kontron	"KBox", PN 2-A0CW-20SLB-M2SN, SN 449977005,
Main PCB	Kontron	PN 801-0128-07, SN 00200C7D2BCB, PCB P2-00538-1 Rev B0
LTE Module	Sierra	Model EM7565, SN 353533100616478, Rev.A
Wi-Fi Module	Sparklan	Model WPEB-263ACNI (BT), SN 18B60S2002793, Rev G312B02F

Table 5.4-2: EUT interface ports

Description	Qty.
RS-232, RS-485	2
GbE Ethernet	2
USB	2
Display port	1
AC input (EUT1 only)	1
RS-232, RS-485	2
DC input	1

Table 5.4-3: Inter-connection cables

Cable description	From	To	Length (m)
STP Cat V	Ethernet port 2	Unterminated	4
DB9-DB9 shielded	COM2	Unterminated	2
Display Port Cable shielded	Display Port	Display	2
USB shielded	USB1	USB HUB	2
USB shielded	USB2	SSD Drive	2
STP Cat V	Ethernet port 2	Unterminated	4

EUT setup configuration, continued

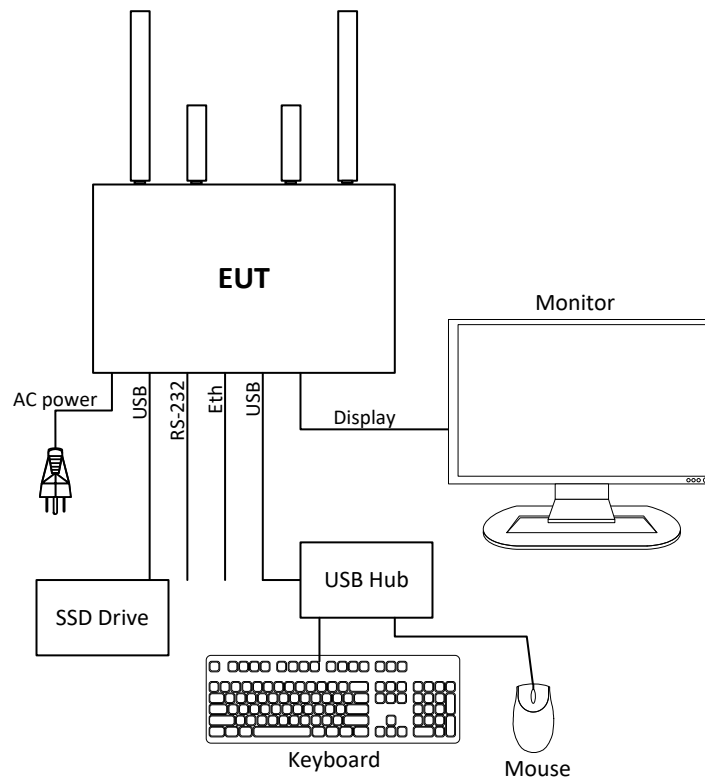


Figure 5.4-1: Radiated testing block diagram

Summary of test results

6.1 Testing location

Test location (s)	Ottawa
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Section 6

6.2 Testing period

Test start date	November 3, 2020	Test end date	November 4, 2020
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6.3 Sample information

Receipt date	November 3, 2020	Nemko sample ID number(s)	1, 2
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6.4 Test results

Table 6.4-1: Test results

Test description	Verdict
Radiated Spurious emissions (multiple standards)	Pass

Notes: Only radiated spurious emissions assessment was done as part of transmitter co-location assessment.

Test equipment

7.1 Test equipment list

Section 7

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	January 24, 2021
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	November 8, 2020
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	April 31, 2021
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002877	1 year	October 13, 2021
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	January 14, 2021
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	April 31, 2021
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	1 year	May 7, 2021
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
Pre-amplifier (26–40 GHz)	Narda	DBL-2640N610	FA001556	—	VOU

Notes: NCR - no calibration required, VOU - verify on use

Testing data

8.1 Radiated spurious (unwanted) emissions

Section 8.1.18 References, definitions and limits

FCC §15.247:

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

FCC §15.407:

- (b) All emissions outside of the allocated band shall not exceed an e.i.r.p. of -27 dBm/MHz. Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. The provisions of §15.205 apply to intentional radiators operating under this section.

FCC §22.359:

- (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

FCC §24.238:

- (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

FCC §27.53:

The power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

RSS-130:

4.7.1 General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

RSS-139:

- 6.6 The emission power shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

RSS-132:

- 5.5 The power of emissions shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).

RSS-133:

- 6.5 The emission power shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).

RSS-247:

- 5.5 In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.
- 6.2 All emissions outside the allocated band shall not exceed -27 dBm/MHz e.i.r.p.

References, definitions and limits, continued

Table 8.1-1: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

Table 8.1-2: ISED restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	Above 38.6
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in Table 8.1-2 and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

References, definitions and limits, continued

Table 8.1-3: FCC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.1.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	November 3, 2020

8.1.3 Observations, settings and special notes

- As part of the current assessment, the test range of 9 kHz to 10th harmonic has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the GHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.
- EUT was set to transmit with 100 % duty cycle. The EUT was transmitting on both MIMO chains simultaneously
- Radiated measurements were performed at a distance of 3 m.
- Licensed bands' limit of -13 dBm EIRP was converted to a theoretical field strength equivalent of 82.23 dBμV/m. It was decided that the more stringent unlicensed bands limit applies for the product of simultaneous transmission of two transmitters, therefore only one limit line (unlicensed) appears on the spectral plots. UNII bands limit of -27 dBm EIRP or theoretical field strength equivalent of 68.23 dBμV/m was considered but wasn't shown on the plots below.

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data

Table 8.1-4: Radiated field strength worst case measurement results

Details	Frequency, MHz	Peak Field strength, dBμV/m	Limit, dBμV/m	Margin, dB
Wi-Fi: 2.4 GHz, LTE Band 30	2563.2	57.98	82.23	24.25
Wi-Fi: 5 GHz, LTE Band 3	1996.1	57.55	82.23	24.68
Wi-Fi: 5 GHz, LTE Band 30	5000.0	49.81	54.00	4.19
Wi-Fi: 2.4 GHz, LTE Band 30	6933.2	53.76	82.23	28.47

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Test data, continued

Frequency range
30–1000 MHz

Transmitter 1
2.4 GHz Wi-Fi

Transmitter 2
LTE band 1

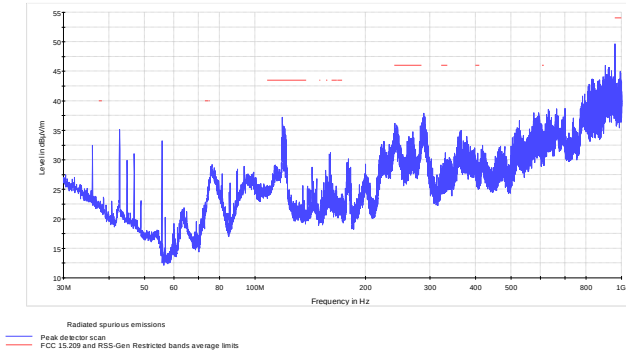


Figure 8.1-1: Radiated spurious emissions

Frequency range
30–1000 MHz

Transmitter 1
2.4 GHz Wi-Fi

Transmitter 2
LTE band 3

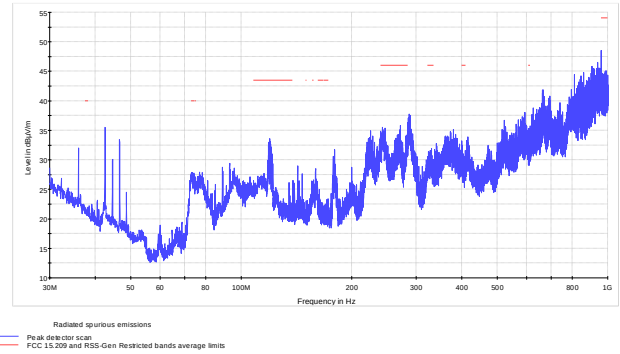


Figure 8.1-2: Radiated spurious emissions

Frequency range
30–1000 MHz

Transmitter 1
2.4 GHz Wi-Fi

Transmitter 2
LTE band 5

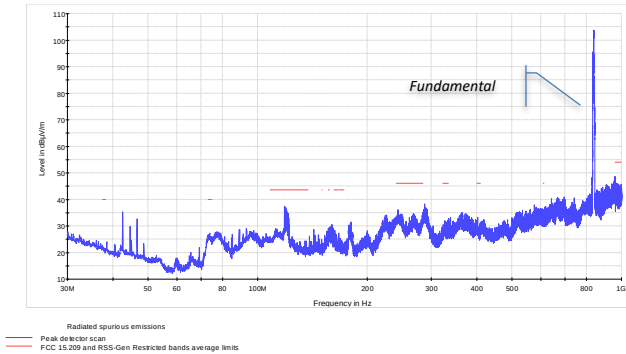


Figure 8.1-3: Radiated spurious emissions

Frequency range
30–1000 MHz

Transmitter 1
2.4 GHz Wi-Fi

Transmitter 2
LTE band 28

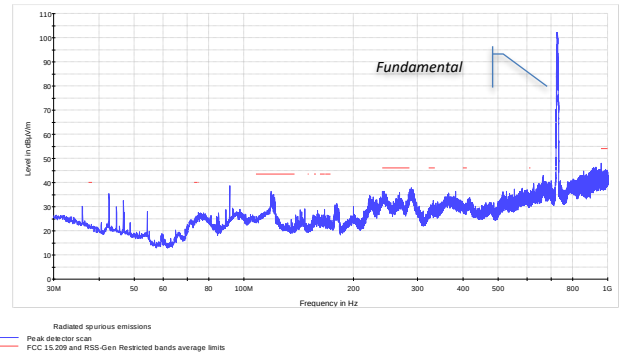


Figure 8.1-4: Radiated spurious emissions

Frequency range
30–1000 MHz

Transmitter 1
2.4 GHz Wi-Fi

Transmitter 2
LTE band 30

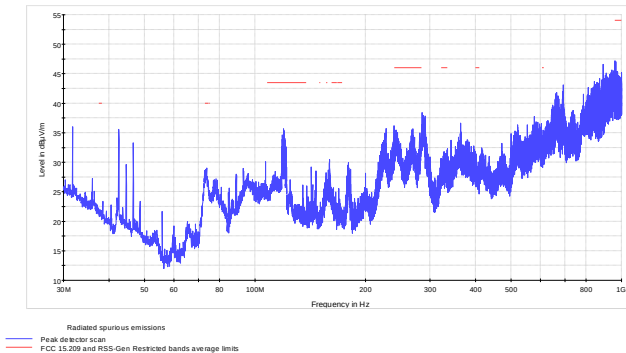


Figure 8.1-5: Radiated spurious emissions

Frequency range
30–1000 MHz

Transmitter 1
5 GHz Wi-Fi

Transmitter 2
LTE band 1

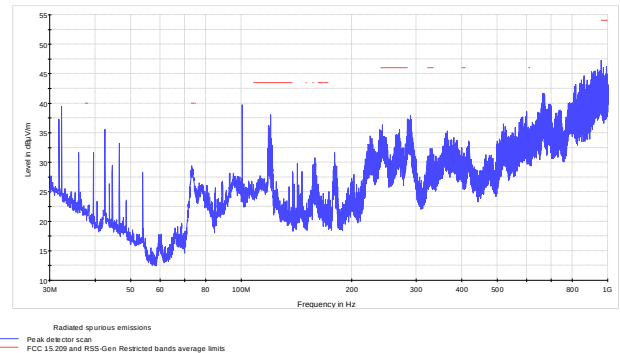


Figure 8.1-6: Radiated spurious emissions

Test data, continued

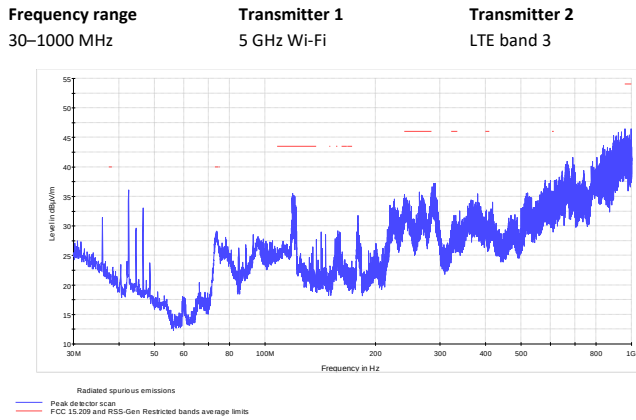


Figure 8.1-7: Radiated spurious emissions

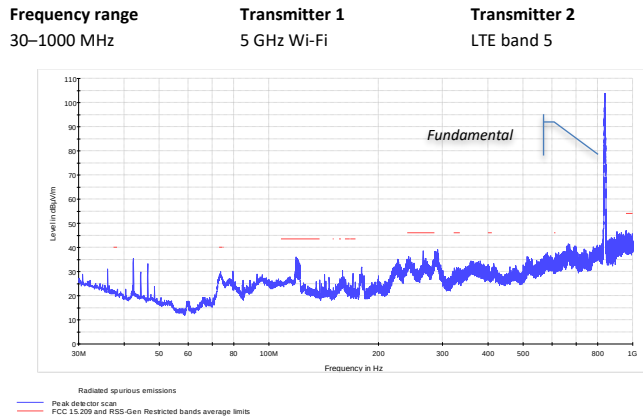


Figure 8.1-8: Radiated spurious emissions

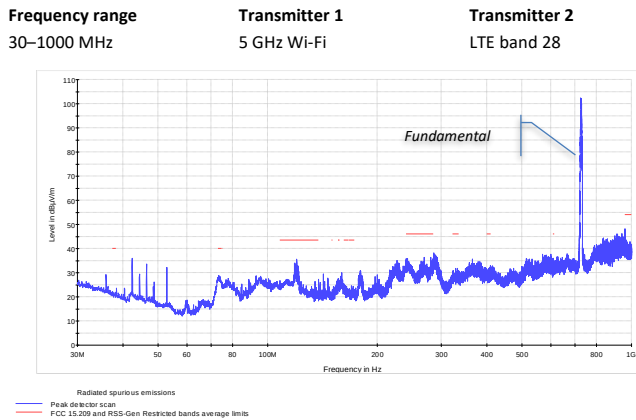


Figure 8.1-9: Radiated spurious emissions

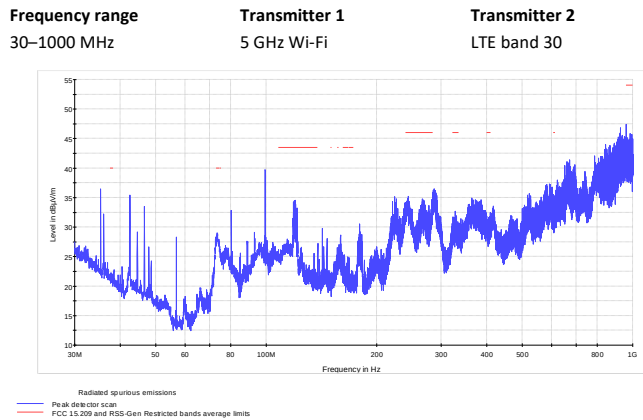


Figure 8.1-10: Radiated spurious emissions

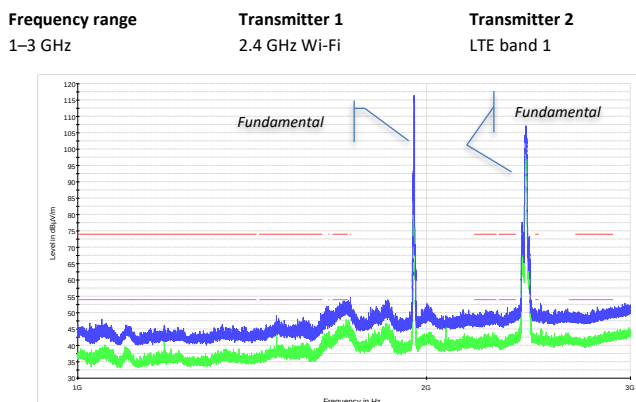


Figure 8.1-11: Radiated spurious emissions

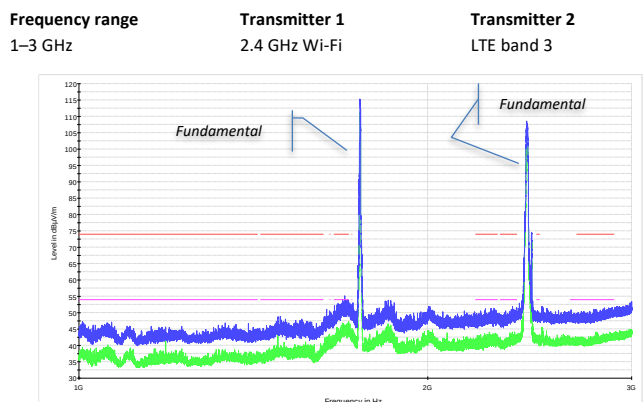


Figure 8.1-12: Radiated spurious emissions

Test data, continued

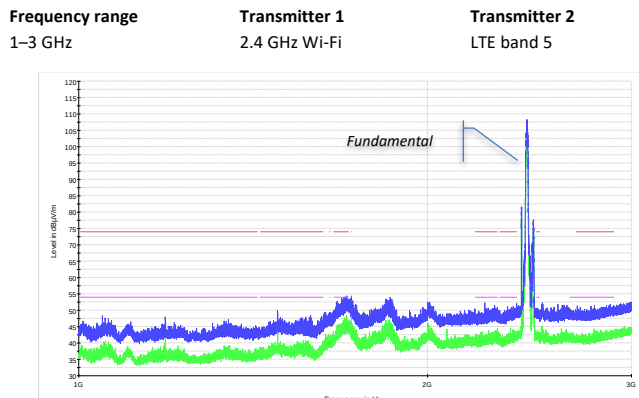


Figure 8.1-13: Radiated spurious emissions

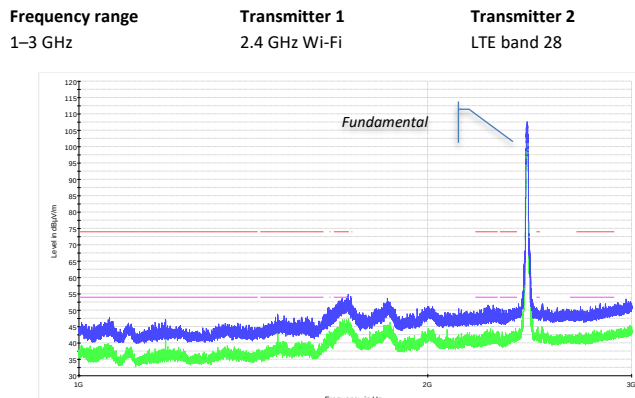


Figure 8.1-14: Radiated spurious emissions

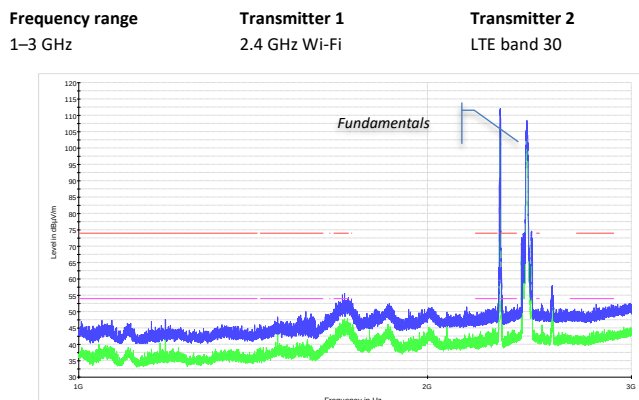


Figure 8.1-15: Radiated spurious emissions

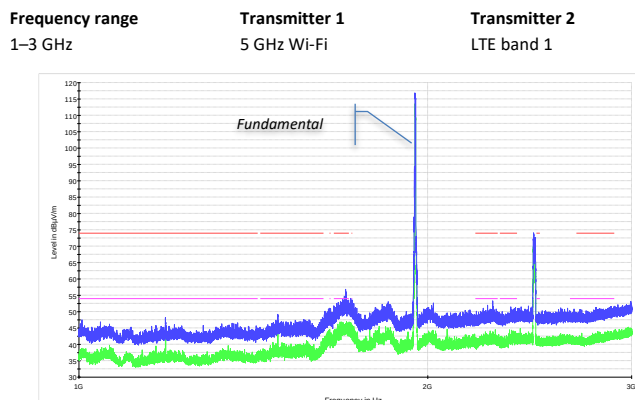


Figure 8.1-16: Radiated spurious emissions

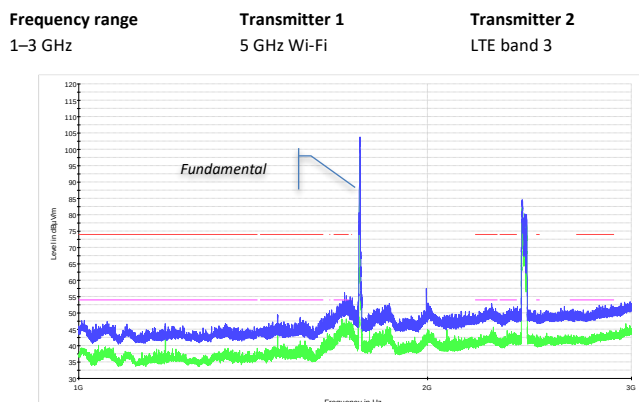


Figure 8.1-17: Radiated spurious emissions

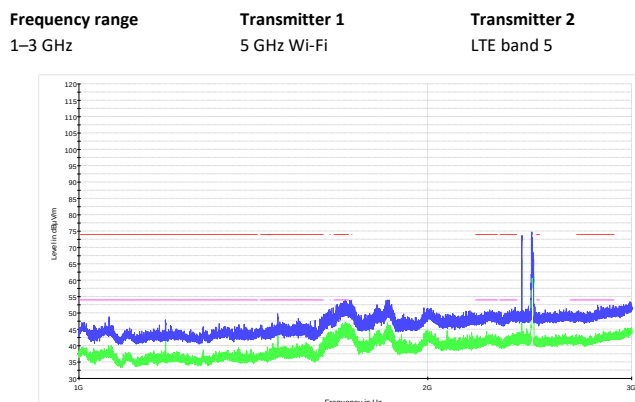


Figure 8.1-18: Radiated spurious emissions

Test data, continued

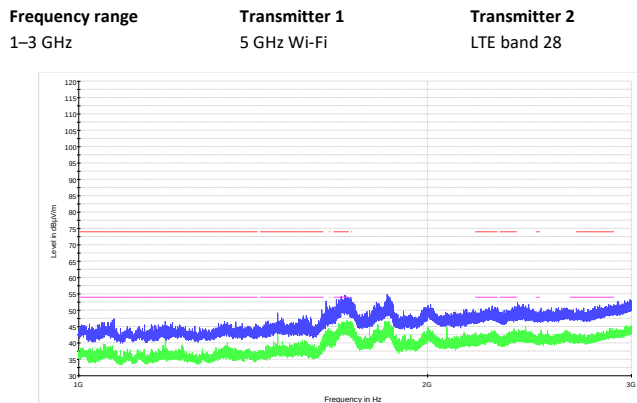


Figure 8.1-19: Radiated spurious emissions

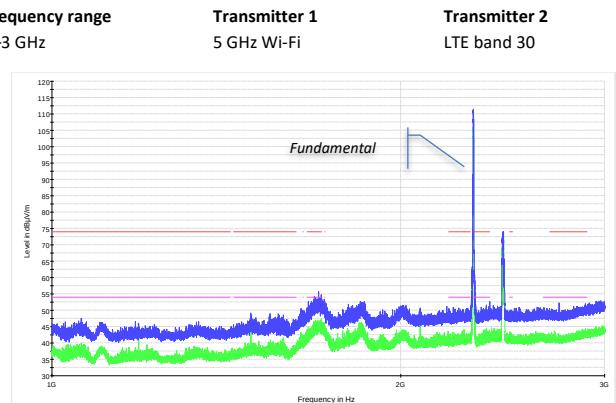


Figure 8.1-20: Radiated spurious emissions

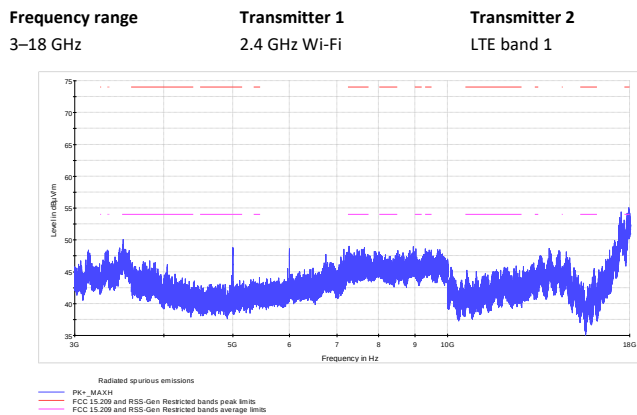


Figure 8.1-21: Radiated spurious emissions

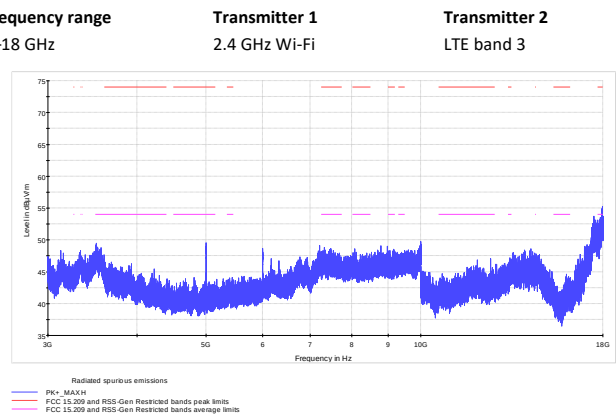


Figure 8.1-22: Radiated spurious emissions

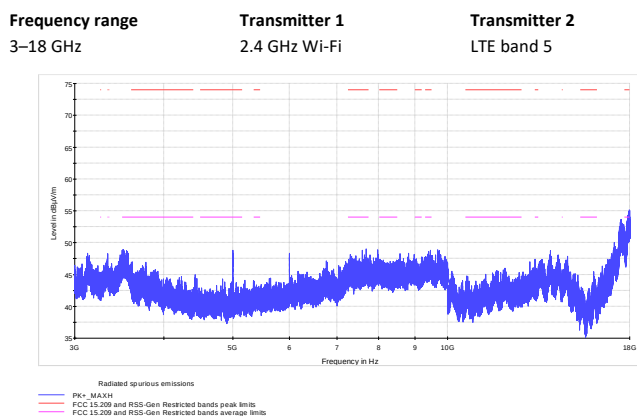


Figure 8.1-23: Radiated spurious emissions

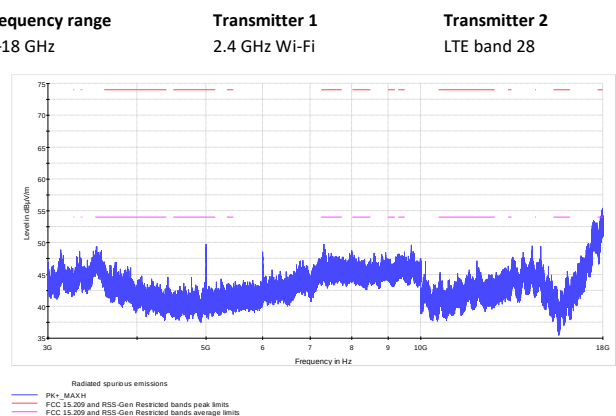


Figure 8.1-24: Radiated spurious emissions