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Limited test report

446965-1R2TRFWL

Date of issue: October 8, 2021

Applicant:
Hughes Network Systems

Product:
Wi-Fi Module

Model:
WFI32E01UE

FCC ID:
FCC ID: K3Y-MC-WLAN

IC Number:
N/A

Specifications:

- FCC 47 CFR Part 15, Subpart C – §15.247 – Limited Test
  Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5727 – 5850 MHz
- Industry Canada RSS-247, Issue 2 – Limited Test
  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943 Designation Number: US5058
ISED Test Site	2040B-3

Tested by	Martha Espinoza, Wireless Test Engineer
Reviewed by	James Cunningham, EMC/MIL/WL Supervisor
Review date	October 8, 2021
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.
This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Applicant

Company name	Hughes Network Systems
Address	9605 Scranton Road, Suite 500
City	San Diego
Province/State	CA
Postal/Zip code	92121
Country	United States

1.2 Manufacturer

Company name	Hughes Network Systems
Address	9605 Scranton Road, Suite 500
City	San Diego
Province/State	CA
Postal/Zip code	92121
Country	United States

1.3 Test specifications

FCC 47 CFR Part 15, Subpart C – §15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz
IC RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.4 Test methods

ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 DTS Measurement Guidance v03r02 (June 5, 2014)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.5 Exclusions

None

1.6 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard. 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.

1.7 Test report revision history

Table 1.7-1: *Test report revision history*

Revision #	Details of changes made to test report
446965-1TRFWL	Original report issued
446965-1R1TRFWL	Changes by client request: Title page, product; Page 5, section 2.1, Note 2 erased; Page 6 section 3.2, product name; Page 13, 8.1.3, middle channel power was updated to 20.25 dBm.
446965-1R2TRFWL	Section 8.2 was added.

Notes:

Section 2 Summary of test results

2.1 FCC Part 15 Subpart C, general requirements

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not tested
§15.31(e)	Variation of power source	Not tested
§15.203	Antenna requirement	Not tested

Notes: [1]EUT is DC powered

2.2 FCC Part 15.247

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not tested
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(b)(4)	Transmitting antennas of directional gain greater than 6 dBi	Not applicable
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Not tested
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 IC RSS-247, Issue 2

Part	Test description	Verdict
5.1 (a)	Bandwidth of a frequency hopping channel	Not applicable
5.1 (b)	Minimum channel spacing for frequency hopping systems	Not applicable
5.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
5.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
5.2 (a)	Minimum 6 dB bandwidth	Not tested
5.2 (b)	Maximum power spectral density	Not tested
5.3 (a)	Digital modulation turned off	Not applicable
5.3 (b)	Frequency hopping turned off	Not applicable
5.4 (a)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.4 (b)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
5.4 (c)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
5.4 (d)	Systems employing digital modulation techniques	Not applicable
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Out-of-band emissions	Pass

2.4 IC RSS-GEN, Issue 5

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for License-Exempt Radio Apparatus	Not tested

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	August 5, 2021
Nemko sample ID number	NEx: 446965

3.2 EUT information

Product name	Wi-Fi Module
Model	WFI32E01UE
Serial number	N/A
Part number	N/A

3.3 Technical information

Used IC test site(s) reg. number	N/A
RSS number and issue	RSS-247 issue 2 (February 2017)
Frequency band	2400 – 2483.5 MHz
Minimum frequency (MHz)	2412
Maximum frequency (MHz)	2462
Antenna information	3.5 dBi Antenna gain: Integrated Patch Antenna (Declared by manufacturer)
Minimum output power (dBm)	24.57 (28.07,EIRP) Declared by report: 60359686 001
Maximum output power (dBm)	25.19 (28.69, EIRP) Declared by report: 60359686 001
Antenna information	3.0 dBi Antenna gain: L-Common Rubber Duck Antenna: HG2403RD-RSF (Declared by manufacturer)
Minimum output power (dBm)	24.57 (27.57,EIRP) Declared by report: 60359686 001
Maximum output power (dBm)	25.19 (28.19, EIRP) Declared by report: 60359686 001
Antenna information	0 dBi Antenna gain: Integrated PCB Antenna (Declared by manufacturer)
Minimum output power (dBm)	24.57 (24.57,EIRP) Declared by report: 60359686 001
Maximum output power (dBm)	25.19 (25.19 EIRP) Declared by report: 60359686 001
Measured 6 dB bandwidth	Not tested
Type of modulation	802.11g; 6 MBPS (Tested according to 60359686 002 report)
Emission classification	N/A
Power requirements	USB Port

3.4 EUT exercise and monitoring details

EUT was executed via USB through a serial terminal (using a computer) where some commands provided by client, were applied to transmit with the power declared by manufacturer and the use them on report 60359686 002 using a fixed channel. Values declared at section 3.3 are considered the maximum values getting from report 60359686 001.

Table 3.4-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
N/A	N/A	N/A	N/A	N/A

Table 3.4-2: *EUT interface ports*

Description	Qty.
USB Port	2

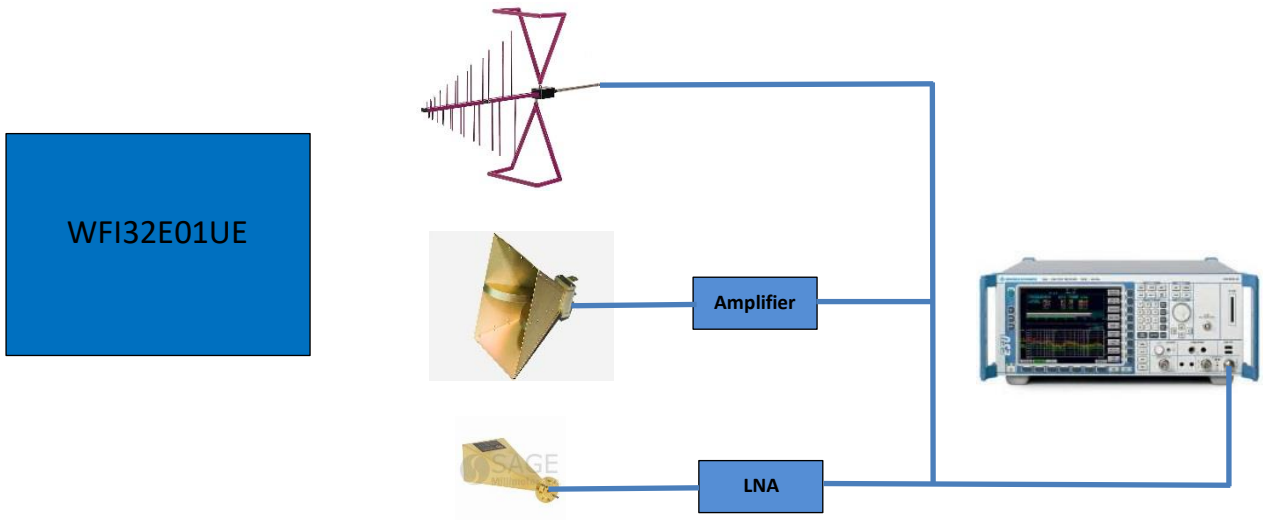
Table 3.4-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Laptop	Acer	V5WE2	NXMHFAA0024211B663400	-
AC Adapter	Chicony	A11-065N1A	F210821351096631	-

Table 3.4-4: *Inter-connection cables*

Cable description	From	To	Length (m)
Micro USB - UBS	EUT	Laptop	1

Figure 3.4-1: *Setup diagram*



Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15-30 °C
Relative humidity	20-75 %
Air pressure	86–106 kPa

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.

5.2 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 ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

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

Test name	Measurement uncertainty, dB
Radiated spurious emissions	3.78
Powerline conducted emissions	1.38
All antenna port measurements	0.55
Conducted spurious emissions	1.13

Section 7 Test Equipment

Table 6.1-1: *Test Equipment List*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Test Receiver	Rohde & Schwarz	ESU40	E1121	19 May 2021	19 May 2022
Bilog Antenna	Schaffner	CBL-6111D	1763	18 Feb 2020	18 Feb 2022
System Controller	Sunol Sciences	SC104V	E1129	NCR	NCR
DRG Horn	ETS-Lindgren	3117-PA	E1160	02 Dec 2020	02 Dec 2021
Pre-Amp as part of DRG Horn	ETS-Lindgren	3117-PA	E1160	02 Dec 2020	02 Dec 2021
Antenna Horn	Sage	SAR-2309-42-S2	E1143	13 Nov 2020	13 Nov 2022
Low Noise Amplifier	Sage	SBL-1834034030-KFKF	E1228	NCR	NCR

Notes: NCR - no calibration required;

Table 6.1-2: *Test Software*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.15 (radiated emissions)

Notes: None

Section 8 Testing data

8.1 FCC 15.247(d) and RSS-247 5.5 Radiated restricted band-edges and spurious emission

8.1.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(d)

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

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.

Table 8.1-1: *FCC §15.209– 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: *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		
Test date	August 5, 2021 August 6, 2021 August 17, 2021 August 18, 2021	Temperature	22 °C 23 °C 21 °C 22 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1002;1005; 1006; 1010 mbar
Test location	3m semi-anechoic chamber (Radiated)	Relative humidity	61%; 63 %; 66%; 64%

8.1.3 Notes

The EUT was configured to transmit continuously on the lowest, middle and highest channels.
The spectrum was search from 30 MHz to 26 GHz (above the 10th harmonic of the highest transmit frequency of 2480 MHz).
Radiated measurements were performed at a 3 m measurement distance.
802.11g; 6 MBPS were selected as worst case, according to reference report provide by client. Three antennas were tested:
1) L-Comm Rubber Duck Antenna: HG2403RD-RSF: Gain = 3.0 dBi.
2) Hughes Integrated Patch antenna: Gain= 3.5 dBi.
3) Hughes Integrated PCB antenna: Gain = 0 dBi.
Three different power were used for making all the measurements, according to table provided it by manufacturer.

For each case, the power approved by client was:

Integrated patch antenna (3.5 dBi)

Mode	Data rate	Channel	Setting power
802.11g	6 MBPS	2412 MHz	16.5 dBm
802.11g	6 MBPS	2437 MHz	20.25 dBm
802.11g	6 MBPS	2462 MHz	16.25 dBm

Integrated PCB antenna (0 dBi)

Mode	Data rate	Channel	Setting power
802.11g	6 MBPS	2412 MHz	16.5 dBm
802.11g	6 MBPS	2437 MHz	20.25 dBm
802.11g	6 MBPS	2462 MHz	16.25 dBm

Comm Rubber Duck Antenna: HG2403RD-RSF (3.0 dBi)

Mode	Data rate	Channel	Setting power
802.11g	6 MBPS	2412 MHz	15 dBm
802.11g	6 MBPS	2437 MHz	20.25 dBm
802.11g	6 MBPS	2462 MHz	14.75 dBm

8.1.4 Setup details

EUT setup configuration	Tabletop
Test facility	3m chamber and 10m chamber
Measurement details	Radiated spurious emissions measurement performed as per C63.10 §11.12

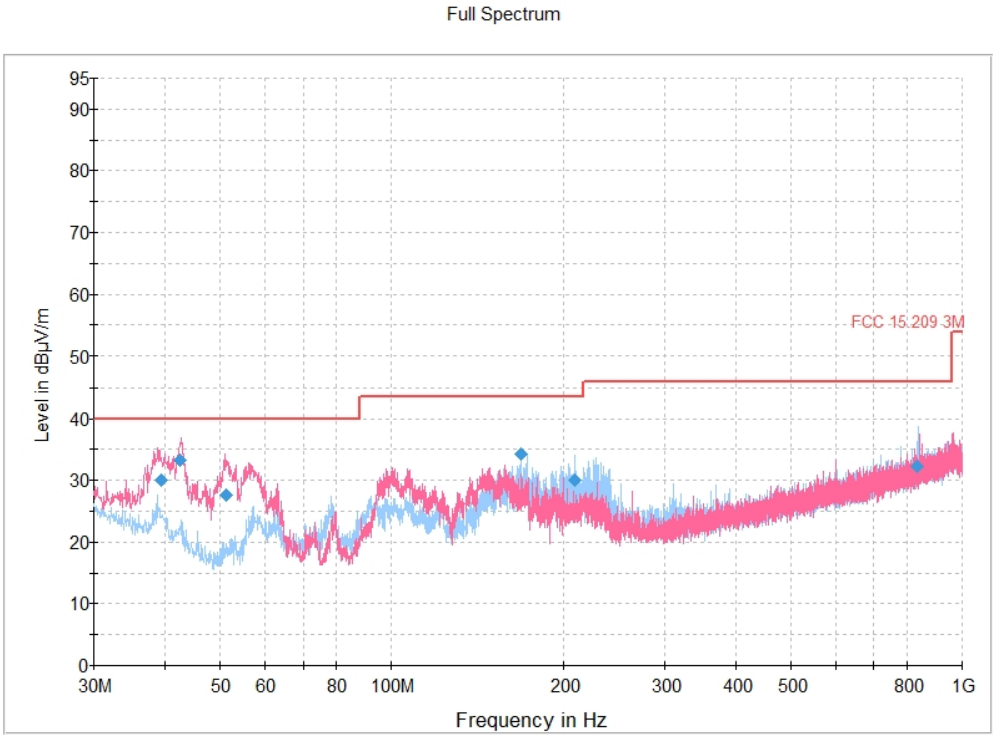
Receiver settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	Peak (preview measurements) Quasi-Peak (final measurements)
Trace mode	Max Hold
Measurement time	5 s (final measurements)

Receiver settings for radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Average and peak (final measurements)
Trace mode	Max Hold
Measurement time	5 s (final measurements)

8.1.5 Test data (Integral patch antenna)



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

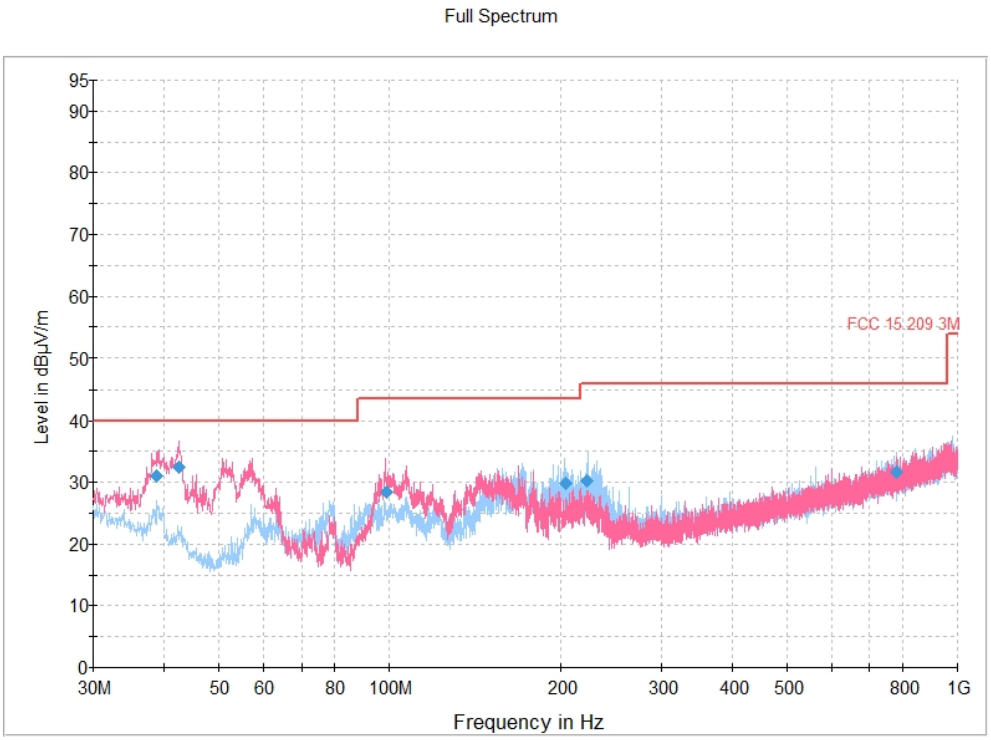
Figure 8.1-1: *Radiated emissions, low channel 2412 MHz, 30 – 1000 MHz spectral plot (16.5 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39.410833	30.03	40.00	9.97	5000.0	120.000	100.0	V	11.0	21.4
42.611667	33.28	40.00	6.72	5000.0	120.000	100.0	V	300.0	19.7
51.336667	27.71	40.00	12.29	5000.0	120.000	100.0	V	38.0	15.4
168.022500	34.35	43.50	9.15	5000.0	120.000	108.0	H	236.0	18.1
208.728333	30.13	43.50	13.37	5000.0	120.000	100.0	H	252.0	18.2
835.593333	32.26	46.00	13.74	5000.0	120.000	281.0	H	0.0	32.4

Table 8.1-3: *Radiated emissions, low channel 2412 MHz, 30 – 1000 MHz results (16.5 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral patch antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

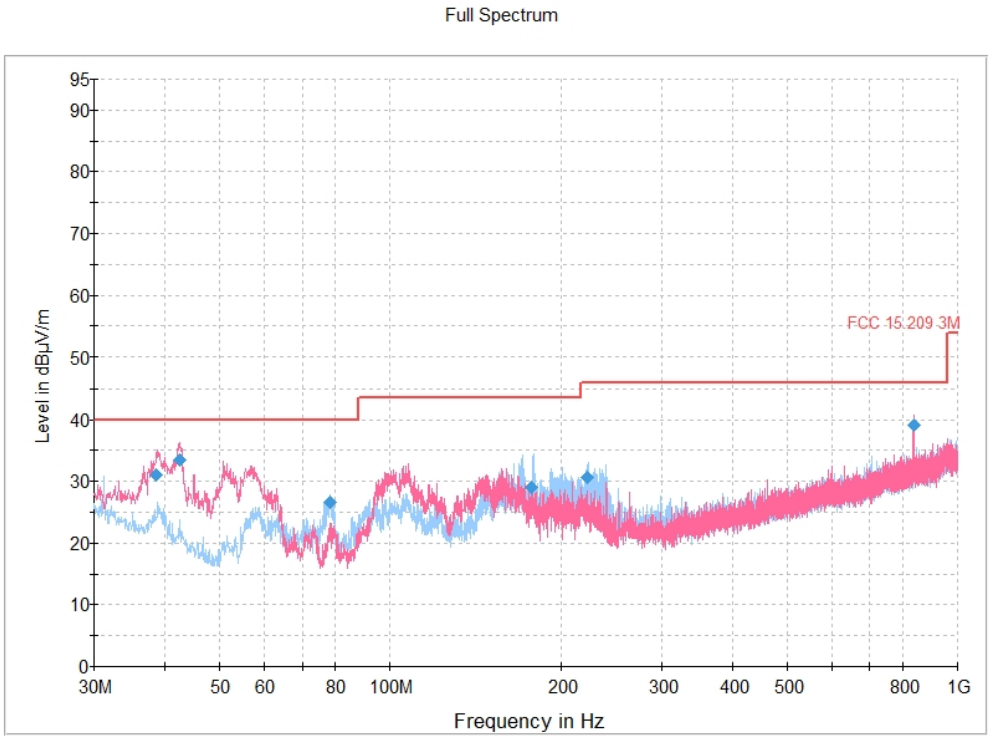
Figure 8.1-2: *Radiated emissions, middle channel 2437 MHz, 30 – 1000 MHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.854167	31.10	40.00	8.90	5000.0	120.000	100.0	V	-1.0	21.7
42.568333	32.42	40.00	7.58	5000.0	120.000	100.0	V	203.0	19.7
98.945000	28.51	43.50	14.99	5000.0	120.000	100.0	V	175.0	17.5
203.374167	29.93	43.50	13.57	5000.0	120.000	110.0	H	246.0	18.0
221.748333	30.15	46.00	15.85	5000.0	120.000	118.0	H	192.0	18.3
779.494167	31.68	46.00	14.32	5000.0	120.000	177.0	H	272.0	31.6

Table 8.1-4: *Radiated emissions, middle channel 2437 MHz, 30 – 1000 MHz results (20.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral patch antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

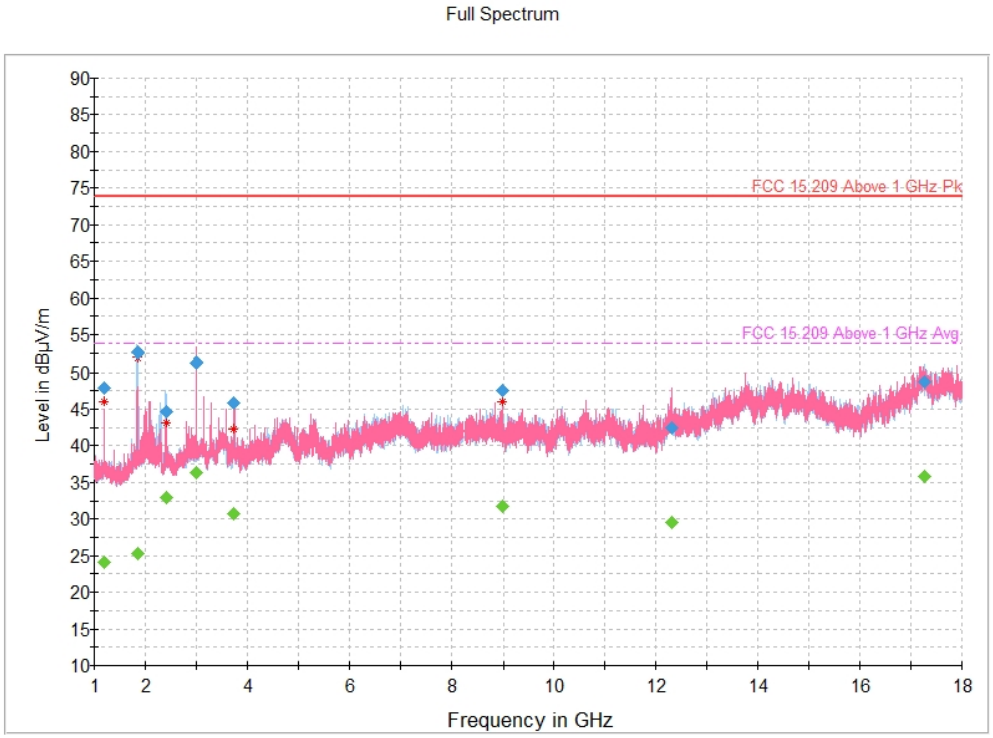
Figure 8.1-3: *Radiated emissions, high channel 2462 MHz, 30 – 1000 MHz spectral plot (16.25 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.610000	31.02	40.00	8.98	5000.0	120.000	100.0	V	38.0	21.8
42.608333	33.40	40.00	6.60	5000.0	120.000	100.0	V	0.0	19.7
78.417500	26.53	40.00	13.47	5000.0	120.000	194.0	H	114.0	14.8
176.566667	29.11	43.50	14.39	5000.0	120.000	100.0	H	222.0	17.3
222.185000	30.67	46.00	15.33	5000.0	120.000	100.0	H	206.0	18.3
836.446667	39.04	46.00	6.96	5000.0	120.000	239.0	V	214.0	32.4

Table 8.1-5: *Radiated emissions, high channel 2462 MHz, 30 – 1000 MHz spectral plot results (16.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral patch antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

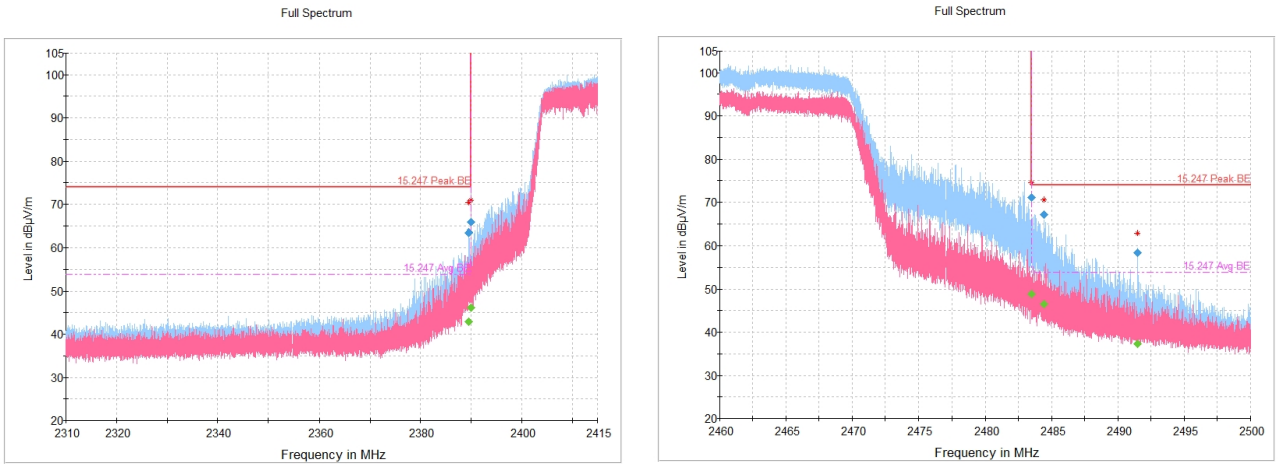
Figure 8.1-4: *Radiated emissions, low channel 2412 MHz, 1 – 18 GHz spectral plot (16.5 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1197.450000	---	24.02	53.90	29.88	5000.0	1000.000	335.0	V	175.0	-13.2
1197.450000	47.90	---	73.90	26.00	5000.0	1000.000	335.0	V	175.0	-13.2
1848.350000	52.69	---	73.90	21.21	5000.0	1000.000	338.0	H	144.0	-10.5
1848.350000	---	25.28	53.90	28.62	5000.0	1000.000	338.0	H	144.0	-10.5
2404.600000	---	32.90	53.90	21.00	5000.0	1000.000	100.0	H	186.0	-9.0
2404.600000	44.68	---	73.90	29.22	5000.0	1000.000	100.0	H	186.0	-9.0
2998.500000	51.24	---	73.90	22.66	5000.0	1000.000	109.0	V	22.0	-7.2
2998.500000	---	36.34	53.90	17.56	5000.0	1000.000	109.0	V	22.0	-7.2
3744.950000	45.88	---	73.90	28.02	5000.0	1000.000	238.0	V	22.0	-4.0
3744.950000	---	30.68	53.90	23.22	5000.0	1000.000	238.0	V	22.0	-4.0
8991.450000	---	31.80	53.90	22.10	5000.0	1000.000	100.0	V	221.0	4.1
8991.450000	47.53	---	73.90	26.37	5000.0	1000.000	100.0	V	221.0	4.1
12305.70000	42.50	---	73.90	31.40	5000.0	1000.000	383.0	V	111.0	8.3
12305.70000	---	29.48	53.90	24.42	5000.0	1000.000	383.0	V	111.0	8.3
17264.75000	---	35.83	53.90	18.07	5000.0	1000.000	341.0	H	11.0	16.4
17264.75000	48.79	---	73.90	25.11	5000.0	1000.000	341.0	H	11.0	16.4

Table 8.1-6: *Radiated emissions, low channel 2412 MHz, 1 – 18 GHz spectral plot, results (16.5 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (Integral patch antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

Figure 8.1-5: *Radiated emissions, Low band edge and high band edge, spectral plot (16.5 dBm and 16.25 dBm of input power, respectively)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2389.555000	---	42.91	53.90	10.99	5000.0	1000.000	111.0	H	21.0	-9.1
2389.555000	63.53	---	73.90	10.37	5000.0	1000.000	111.0	H	21.0	-9.1
2390.000000	---	46.20	53.90	7.70	5000.0	1000.000	113.0	H	134.0	-9.1
2390.000000	65.93	---	73.90	7.97	5000.0	1000.000	113.0	H	134.0	-9.1

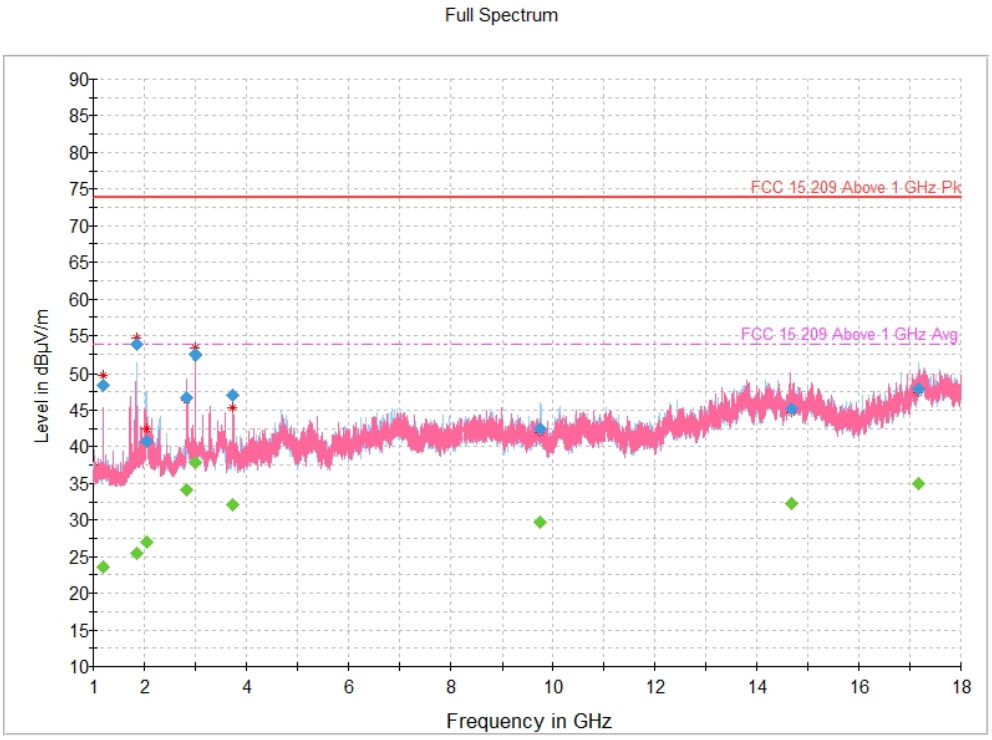
Table 8.1-7: *Radiated emissions, Low band edge results (16.5 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500000	---	48.89	53.90	5.01	5000.0	1000.000	115.0	H	124.0	-8.7
2483.500000	71.13	---	73.90	2.77	5000.0	1000.000	115.0	H	124.0	-8.7
2484.392000	---	46.56	53.90	7.34	5000.0	1000.000	115.0	H	124.0	-8.7
2484.392000	67.17	---	73.90	6.73	5000.0	1000.000	115.0	H	124.0	-8.7
2491.477333	58.46	---	73.90	15.44	5000.0	1000.000	136.0	H	47.0	-8.7
2491.477333	---	37.30	53.90	16.60	5000.0	1000.000	136.0	H	47.0	-8.7

Table 8.1-8: *Radiated emissions, High band edge results (16.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.

8.1.5 Test data (Integral patch antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

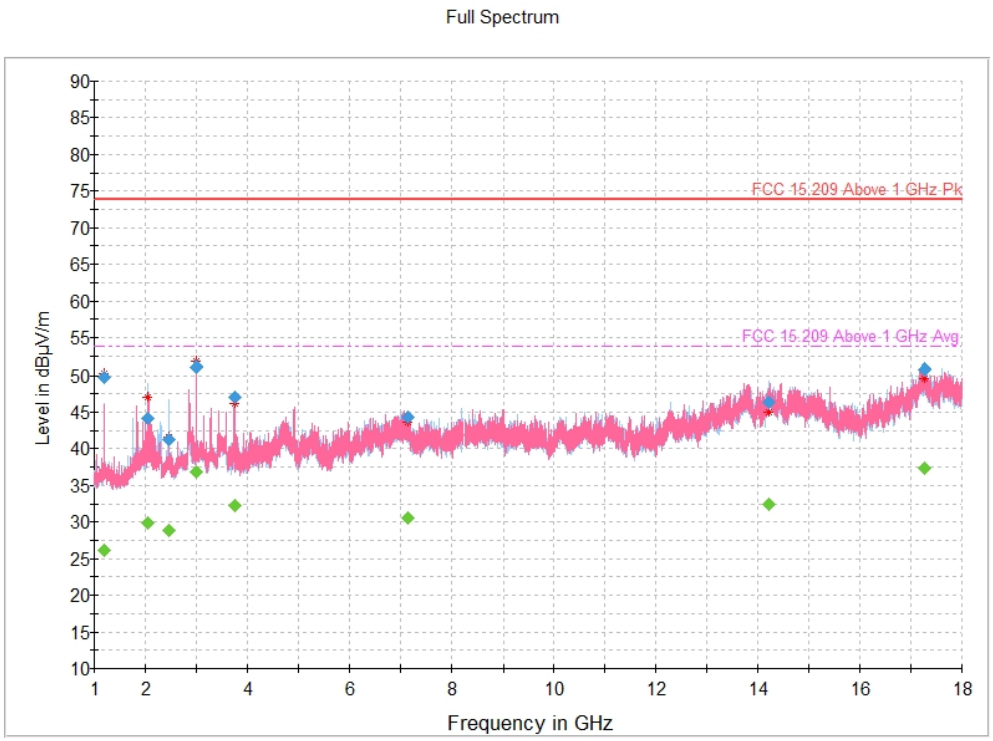
Figure 8.1-6: *Radiated emissions, middle channel 2437 MHz, 1 – 18 GHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1196.800000	---	23.65	53.90	30.25	5000.0	1000.000	108.0	V	176.0	-13.2
1196.800000	48.47	---	73.90	25.43	5000.0	1000.000	108.0	V	176.0	-13.2
1843.350000	53.89	---	73.90	20.01	5000.0	1000.000	184.0	H	249.0	-10.6
1843.350000	---	25.52	53.90	28.38	5000.0	1000.000	184.0	H	249.0	-10.6
2040.300000	40.77	---	73.90	33.13	5000.0	1000.000	201.0	H	318.0	-10.1
2040.300000	---	26.96	53.90	26.94	5000.0	1000.000	201.0	H	318.0	-10.1
2832.700000	---	34.04	53.90	19.86	5000.0	1000.000	201.0	V	247.0	-7.6
2832.700000	46.72	---	73.90	27.18	5000.0	1000.000	201.0	V	247.0	-7.6
2998.800000	52.48	---	73.90	21.42	5000.0	1000.000	164.0	V	222.0	-7.2
2998.800000	---	37.86	53.90	16.04	5000.0	1000.000	164.0	V	222.0	-7.2
3745.450000	46.98	---	73.90	26.92	5000.0	1000.000	100.0	V	-1.0	-4.0
3745.450000	---	32.15	53.90	21.75	5000.0	1000.000	100.0	V	-1.0	-4.0
9744.100000	---	29.63	53.90	24.27	5000.0	1000.000	192.0	H	284.0	5.0
9744.100000	42.47	---	73.90	31.43	5000.0	1000.000	192.0	H	284.0	5.0
14669.800000	---	32.19	53.90	21.71	5000.0	1000.000	318.0	V	113.0	11.6
14669.800000	45.22	---	73.90	28.68	5000.0	1000.000	318.0	V	113.0	11.6
17160.100000	---	34.93	53.90	18.97	5000.0	1000.000	300.0	H	20.0	15.8
17160.100000	47.92	---	73.90	25.98	5000.0	1000.000	300.0	H	20.0	15.8

Table 8.1-9: *Radiated emissions, middle channel 2437 MHz, 1 – 18 GHz results (20.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (Integral patch antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

Figure 8.1-7: *Radiated emissions, high channel 2462 MHz, 1 – 18 GHz spectral plot (16.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1199.900000	49.76	---	73.90	24.14	5000.0	1000.000	135.0	H	234.0	-13.2
1199.900000	---	26.17	53.90	27.74	5000.0	1000.000	135.0	H	234.0	-13.2
2058.500000	---	29.82	53.90	24.08	5000.0	1000.000	192.0	H	321.0	-10.2
2058.500000	44.15	---	73.90	29.75	5000.0	1000.000	192.0	H	321.0	-10.2
2468.150000	41.23	---	73.90	32.67	5000.0	1000.000	118.0	H	22.0	-8.7
2468.150000	---	28.92	53.90	24.98	5000.0	1000.000	118.0	H	22.0	-8.7
2996.900000	51.13	---	73.90	22.77	5000.0	1000.000	116.0	V	159.0	-7.2
2996.900000	---	36.77	53.90	17.13	5000.0	1000.000	116.0	V	159.0	-7.2
3748.750000	---	32.24	53.90	21.66	5000.0	1000.000	100.0	V	0.0	-3.9
3748.750000	47.00	---	73.90	26.90	5000.0	1000.000	100.0	V	0.0	-3.9
7161.850000	---	30.63	53.90	23.27	5000.0	1000.000	128.0	V	-1.0	1.7
7161.850000	44.37	---	73.90	29.53	5000.0	1000.000	128.0	V	-1.0	1.7
14219.85000	---	32.41	53.90	21.49	5000.0	1000.000	319.0	H	178.0	11.8
14219.85000	46.28	---	73.90	27.62	5000.0	1000.000	319.0	H	178.0	11.8
17258.90000	50.74	---	73.90	23.16	5000.0	1000.000	261.0	V	0.0	16.4
17258.90000	---	37.36	53.90	16.54	5000.0	1000.000	261.0	V	0.0	16.4

Table 8.1-10: *Radiated emissions, high channel 2462 MHz, 1 – 18 GHz spectral plot results (16.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (Integral patch antenna), continued

The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

Figure 8.1-8: *Radiated emissions, low channel 2412 MHz, 18 – 26 GHz spectral plot (16.5 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19374.333333	---	29.42	53.90	24.48	5000.0	1000.000	410.0	H	131.0	18.4
19374.333333	43.49	---	73.90	30.41	5000.0	1000.000	410.0	H	131.0	18.4
20697.533333	---	32.02	53.90	21.88	5000.0	1000.000	117.0	V	182.0	20.1
20697.533333	45.84	---	73.90	28.06	5000.0	1000.000	117.0	V	182.0	20.1
21761.666667	---	31.79	53.90	22.11	5000.0	1000.000	254.0	V	225.0	19.5
21761.666667	46.01	---	73.90	27.89	5000.0	1000.000	254.0	V	225.0	19.5
22899.400000	---	31.92	53.90	21.98	5000.0	1000.000	333.0	H	0.0	21.2
22899.400000	45.32	---	73.90	28.58	5000.0	1000.000	333.0	H	0.0	21.2
24030.866667	53.46	---	73.90	20.44	5000.0	1000.000	151.0	V	0.0	29.7
24030.866667	---	40.48	53.90	13.42	5000.0	1000.000	151.0	V	0.0	29.7
24882.733333	48.52	---	73.90	25.38	5000.0	1000.000	100.0	H	85.0	24.7
24882.733333	---	35.16	53.90	18.74	5000.0	1000.000	100.0	H	85.0	24.7

Table 8.1-11: *Radiated emissions, low channel 2412 MHz, 18 – 26 GHz spectral plot results (16.5 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral patch antenna), continued

The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

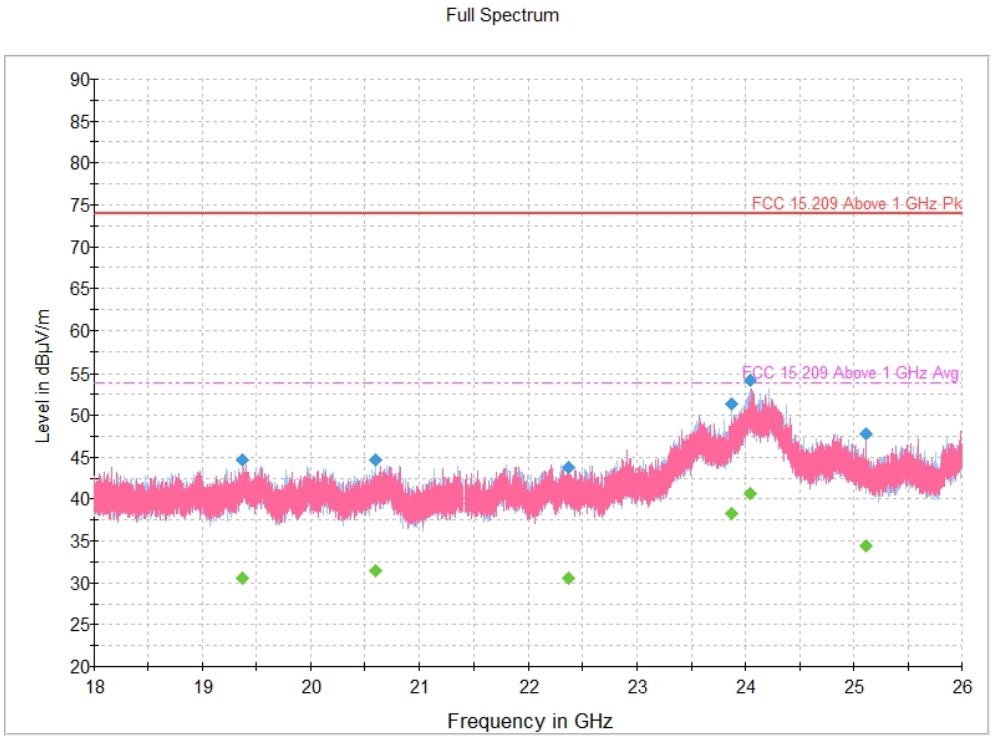
Figure 8.1-9: *Radiated emissions, middle channel 2437 MHz, 18 – 26 GHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19314.600000	43.59	---	73.90	30.31	5000.0	1000.000	108.0	H	285.0	18.5
19314.600000	---	30.54	53.90	23.36	5000.0	1000.000	108.0	H	285.0	18.5
20698.866667	---	32.10	53.90	21.80	5000.0	1000.000	262.0	V	0.0	20.1
20698.866667	45.00	---	73.90	28.90	5000.0	1000.000	262.0	V	0.0	20.1
22189.800000	---	31.59	53.90	22.31	5000.0	1000.000	125.0	H	40.0	19.9
22189.800000	44.67	---	73.90	29.23	5000.0	1000.000	125.0	H	40.0	19.9
23539.666667	---	37.06	53.90	16.84	5000.0	1000.000	175.0	V	54.0	25.6
23539.666667	50.43	---	73.90	23.47	5000.0	1000.000	175.0	V	54.0	25.6
24172.600000	53.27	---	73.90	20.63	5000.0	1000.000	375.0	H	254.0	29.3
24172.600000	---	39.81	53.90	14.09	5000.0	1000.000	375.0	H	254.0	29.3
24824.200000	---	35.13	53.90	18.77	5000.0	1000.000	365.0	V	117.0	24.6
24824.200000	48.69	---	73.90	25.21	5000.0	1000.000	365.0	V	117.0	24.6

Table 8.1-12: *Radiated emissions, middle channel 2437 MHz, 18 – 26 GHz spectral plot results (20.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral Patch antenna)



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

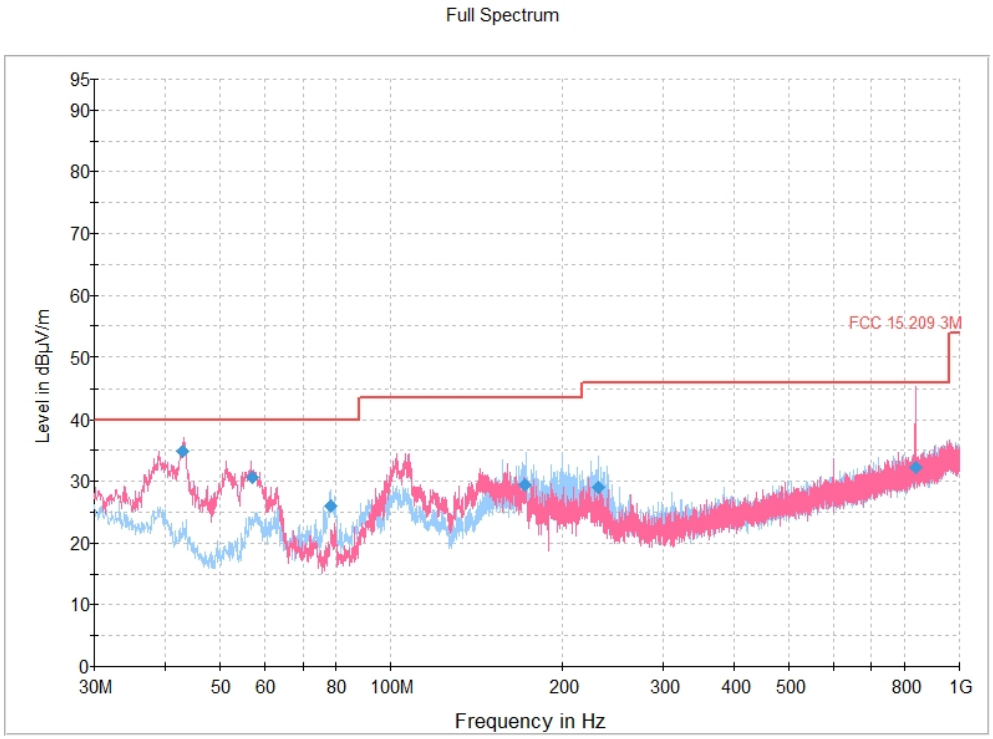
Figure 8.1-10: *Radiated emissions, high channel 2462 MHz, 18 – 26 GHz spectral plot (16.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19368.066667	44.62	---	73.90	29.28	5000.0	1000.000	205.0	H	0.0	18.5
19368.066667	---	30.62	53.90	23.28	5000.0	1000.000	205.0	H	0.0	18.5
20599.400000	---	31.45	53.90	22.45	5000.0	1000.000	305.0	H	331.0	19.3
20599.400000	44.71	---	73.90	29.19	5000.0	1000.000	305.0	H	331.0	19.3
22363.133333	43.81	---	73.90	30.09	5000.0	1000.000	190.0	V	0.0	19.4
22363.133333	---	30.62	53.90	23.28	5000.0	1000.000	190.0	V	0.0	19.4
23876.866667	51.42	---	73.90	22.48	5000.0	1000.000	216.0	H	134.0	26.9
23876.866667	---	38.26	53.90	15.64	5000.0	1000.000	216.0	H	134.0	26.9
24043.133333	---	40.59	53.90	13.31	5000.0	1000.000	312.0	H	223.0	29.7
24043.133333	54.21	---	73.90	19.69	5000.0	1000.000	312.0	H	223.0	29.7
25117.000000	47.72	---	73.90	26.18	5000.0	1000.000	402.0	V	241.0	24.2
25117.000000	---	34.45	53.90	19.45	5000.0	1000.000	402.0	V	241.0	24.2

Table 8.1-13: *Radiated emissions, high channel 2462 MHz, 18 – 26 GHz spectral plot results (16.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral PCB antenna)



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

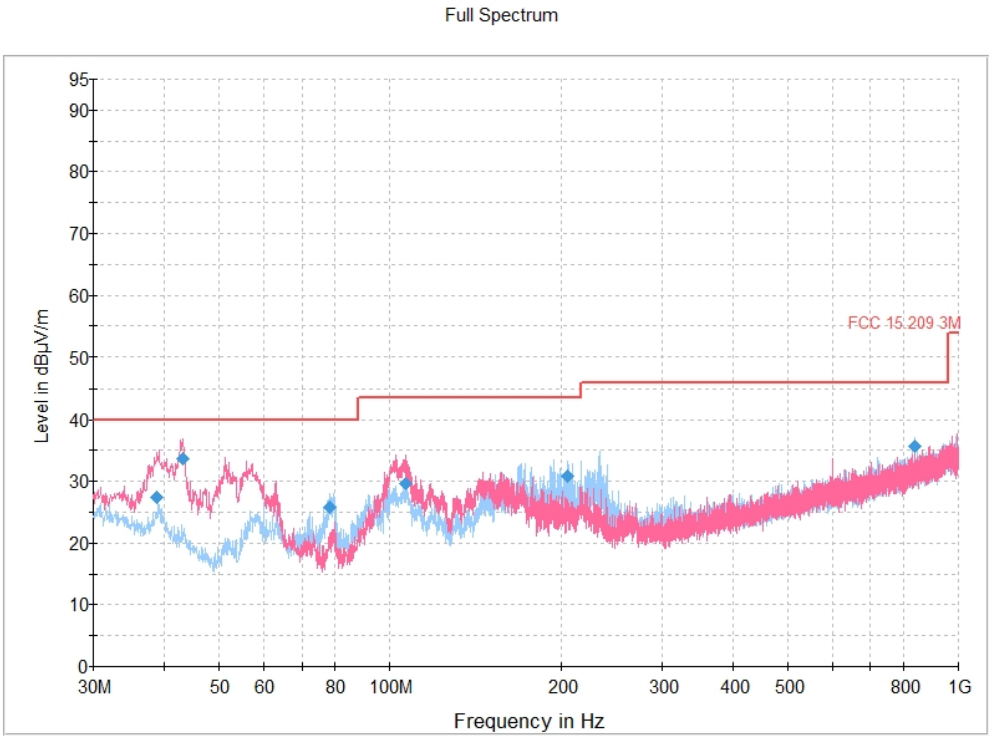
Figure 8.1-11: *Radiated emissions, low channel 2412 MHz, 30 – 1000 MHz spectral plot (16.5 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
42.975000	34.81	40.00	5.19	5000.0	120.000	100.0	V	53.0	19.5
57.035000	30.63	40.00	9.37	5000.0	120.000	100.0	V	0.0	13.2
78.540000	26.01	40.00	13.99	5000.0	120.000	243.0	H	252.0	14.8
171.666667	29.38	43.50	14.12	5000.0	120.000	157.0	H	218.0	17.7
230.755000	29.02	46.00	16.98	5000.0	120.000	118.0	H	178.0	18.9
835.832500	32.24	46.00	13.76	5000.0	120.000	296.0	V	11.0	32.4

Table 8.1-14: *Radiated emissions, low channel 2412 MHz, 30 – 1000 MHz spectral plot (16.5 dBm input power) results.*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral PCB antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

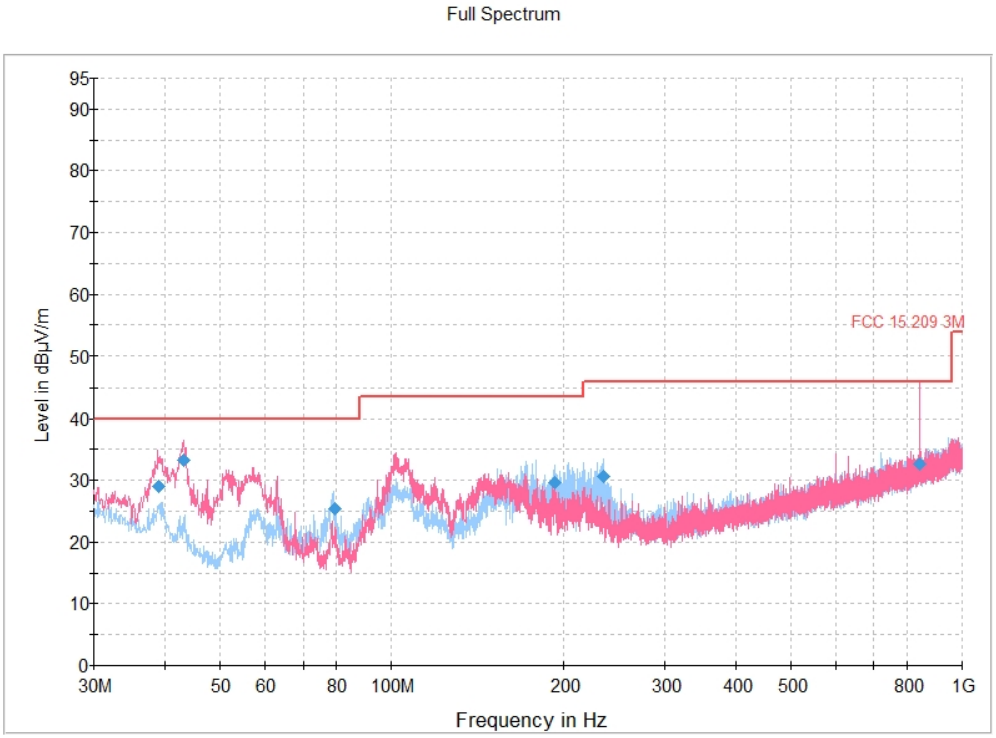
Figure 8.1-12: *Radiated emissions, middle channel 2437 MHz, 30 – 1000 MHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.895000	27.42	40.00	12.58	5000.0	120.000	110.0	V	269.0	21.7
43.055833	33.68	40.00	6.32	5000.0	120.000	100.0	V	337.0	19.5
78.471667	25.78	40.00	14.22	5000.0	120.000	203.0	H	266.0	14.8
106.551667	29.67	43.50	13.83	5000.0	120.000	118.0	V	144.0	18.5
204.277500	30.82	43.50	12.68	5000.0	120.000	100.0	H	241.0	18.0
836.550833	35.72	46.00	10.28	5000.0	120.000	147.0	H	144.0	32.4

Table 8.1-15: *Radiated emissions, middle channel 2437 MHz, 30 – 1000 MHz spectral plot (20.25 dBm input power) results.*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral PCB antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

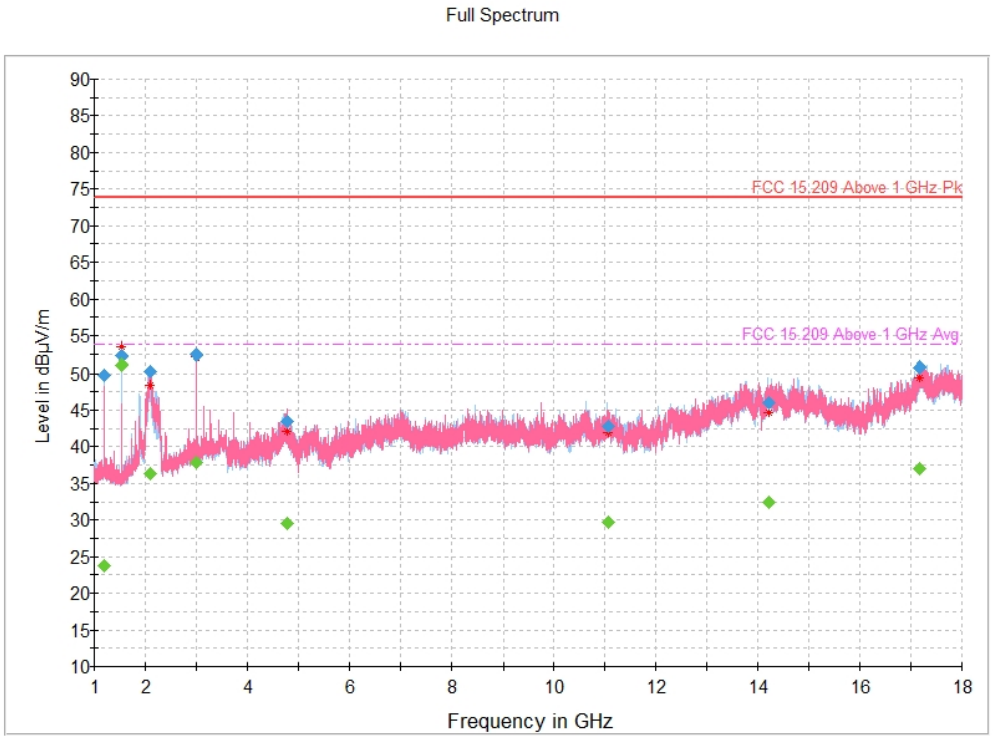
Figure 8.1-13: *Radiated emissions, high channel 2462 MHz, 30 – 1000 MHz spectral plot (16.25 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.930833	29.12	40.00	10.88	5000.0	120.000	100.0	V	315.0	21.6
43.255000	33.33	40.00	6.67	5000.0	120.000	100.0	V	12.0	19.4
79.625000	25.47	40.00	14.53	5000.0	120.000	216.0	H	97.0	14.9
192.954167	29.61	43.50	13.89	5000.0	120.000	116.0	H	234.0	17.4
234.343333	30.57	46.00	15.43	5000.0	120.000	100.0	H	194.0	19.3
840.039167	32.63	46.00	13.37	5000.0	120.000	368.0	V	314.0	32.7

Table 8.1-16: *Radiated emissions, high channel 2462 MHz, 30 – 1000 MHz spectral plot (16.25 dBm input power) results.*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral PCB antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

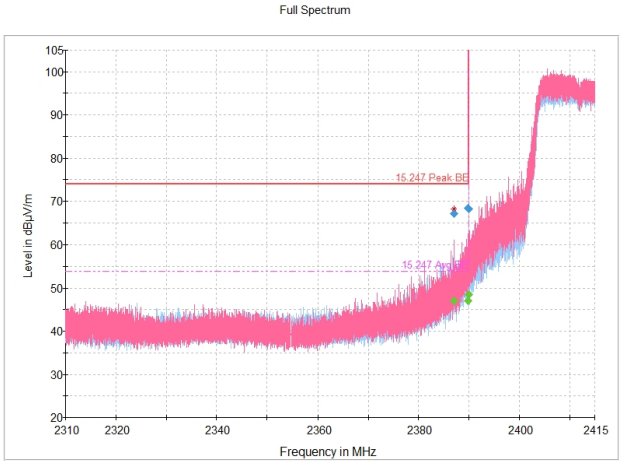
Figure 8.1-14: *Radiated emissions, low channel 2412 MHz, 1 – 18 GHz spectral plot (16.5 dBm input power).*

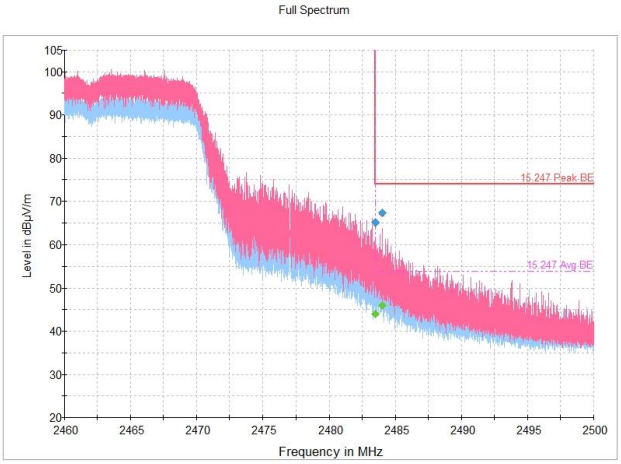
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1196.000000	49.80	---	73.90	24.10	5000.0	1000.000	196.0	H	235.0	-13.2
1196.000000	---	23.82	53.90	30.08	5000.0	1000.000	196.0	H	235.0	-13.2
1540.550000	---	51.09	53.90	2.81	5000.0	1000.000	288.0	H	69.0	-13.5
1540.550000	52.25	---	73.90	21.65	5000.0	1000.000	288.0	H	69.0	-13.5
2104.650000	50.18	---	73.90	23.72	5000.0	1000.000	195.0	V	245.0	-10.0
2104.650000	---	36.29	53.90	17.61	5000.0	1000.000	195.0	V	245.0	-10.0
2996.200000	52.45	---	73.90	21.45	5000.0	1000.000	100.0	V	0.0	-7.2
2996.200000	---	37.82	53.90	16.08	5000.0	1000.000	100.0	V	0.0	-7.2
4782.700000	---	29.58	53.90	24.32	5000.0	1000.000	250.0	V	70.0	-0.8
4782.700000	43.42	---	73.90	30.48	5000.0	1000.000	250.0	V	70.0	-0.8
11056.25000	---	29.66	53.90	24.24	5000.0	1000.000	233.0	H	315.0	5.2
11056.25000	42.78	---	73.90	31.12	5000.0	1000.000	233.0	H	315.0	5.2
14208.95000	45.93	---	73.90	27.97	5000.0	1000.000	212.0	H	242.0	11.7
14208.95000	---	32.36	53.90	21.54	5000.0	1000.000	212.0	H	242.0	11.7
17173.70000	---	36.98	53.90	16.92	5000.0	1000.000	402.0	V	264.0	16.1
17173.70000	50.69	---	73.90	23.21	5000.0	1000.000	402.0	V	264.0	16.1

Table 8.1-17: *Radiated emissions, low channel 2412 MHz, 1 – 18 GHz spectral plot, results (16.5 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (Integral PCB antenna), continued





The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

Figure 8.1-15: *Radiated emissions, Low band edge and high band edge, spectral plot (16.5 dBm and 16.25 dBm of input power, respectively)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2387.059500	---	47.10	53.90	6.80	5000.0	1000.000	173.0	V	237.0	-9.1
2387.059500	67.02	---	73.90	6.88	5000.0	1000.000	173.0	V	237.0	-9.1
2389.775500	---	47.15	53.90	6.75	5000.0	1000.000	162.0	V	0.0	-9.1
2389.775500	68.35	---	73.90	5.55	5000.0	1000.000	162.0	V	0.0	-9.1
2390.000000	---	48.57	53.90	5.33	5000.0	1000.000	98.0	V	281.0	-9.1
2390.000000	68.18	---	73.90	5.72	5000.0	1000.000	98.0	V	281.0	-9.1

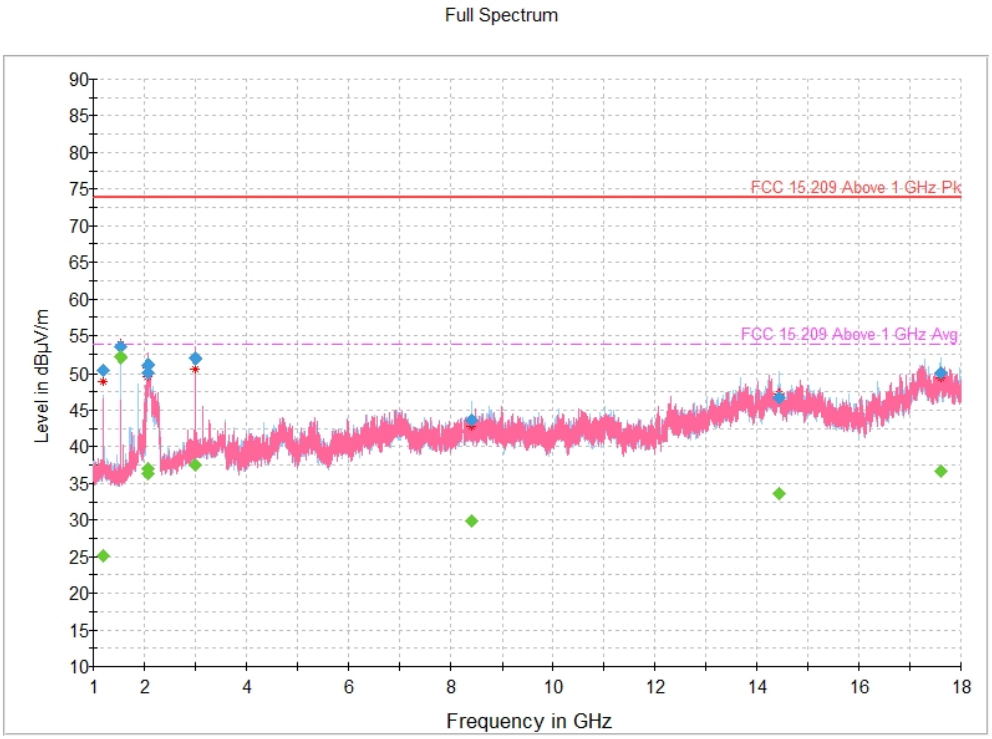
Table 8.1-18: *Radiated emissions, Low band edge results (16.5 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500000	---	44.03	53.90	9.87	5000.0	1000.000	294.0	H	177.0	-8.7
2483.500000	65.14	---	73.90	8.76	5000.0	1000.000	294.0	H	177.0	-8.7
2483.980000	---	45.93	53.90	7.97	5000.0	1000.000	166.0	V	257.0	-8.7
2483.980000	67.29	---	73.90	6.61	5000.0	1000.000	166.0	V	257.0	-8.7

Table 8.1-19: *Radiated emissions, High band edge results (16.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.

8.1.5 Test data (Integral PCB antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

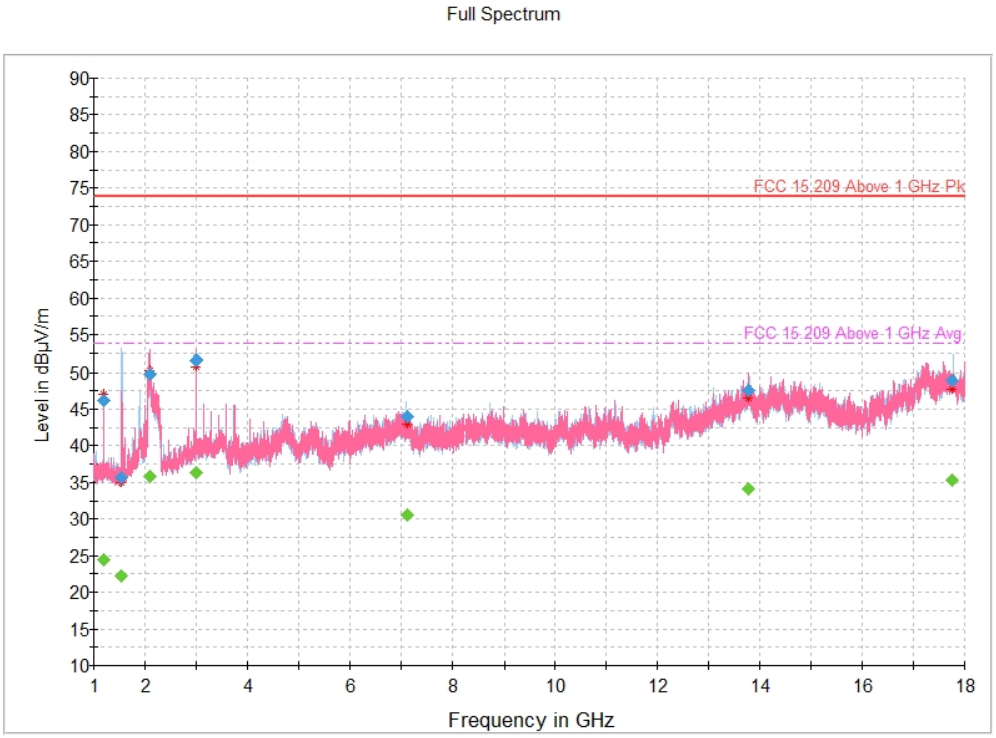
Figure 8.1-16: *Radiated emissions, middle channel 2437 MHz, 1 – 18 GHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1199.300000	50.36	---	73.90	23.54	5000.0	1000.000	145.0	H	234.0	-13.2
1199.300000	---	25.14	53.90	28.76	5000.0	1000.000	145.0	H	234.0	-13.2
1540.200000	53.51	---	73.90	20.39	5000.0	1000.000	201.0	H	52.0	-13.5
1540.200000	---	52.17	53.90	1.73	5000.0	1000.000	201.0	H	52.0	-13.5
2073.500000	---	36.96	53.90	16.94	5000.0	1000.000	246.0	V	264.0	-10.1
2073.500000	51.10	---	73.90	22.80	5000.0	1000.000	246.0	V	264.0	-10.1
2074.700000	---	36.32	53.90	17.58	5000.0	1000.000	183.0	V	266.0	-10.1
2074.700000	50.07	---	73.90	23.83	5000.0	1000.000	183.0	V	266.0	-10.1
2997.700000	51.91	---	73.90	21.99	5000.0	1000.000	109.0	V	357.0	-7.2
2997.700000	---	37.44	53.90	16.46	5000.0	1000.000	109.0	V	357.0	-7.2
8402.600000	---	29.84	53.90	24.06	5000.0	1000.000	147.0	H	52.0	3.6
8402.600000	43.63	---	73.90	30.27	5000.0	1000.000	147.0	H	52.0	3.6
14433.250000	---	33.65	53.90	20.25	5000.0	1000.000	119.0	H	206.0	12.2
14433.250000	46.70	---	73.90	27.20	5000.0	1000.000	119.0	H	206.0	12.2
17617.850000	50.15	---	73.90	23.75	5000.0	1000.000	259.0	H	11.0	15.5
17617.850000	---	36.73	53.90	17.17	5000.0	1000.000	259.0	H	11.0	15.5

Table 8.1-20: *Radiated emissions, middle channel 2437 MHz, 1 – 18 GHz results (20.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (Integral PCB antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

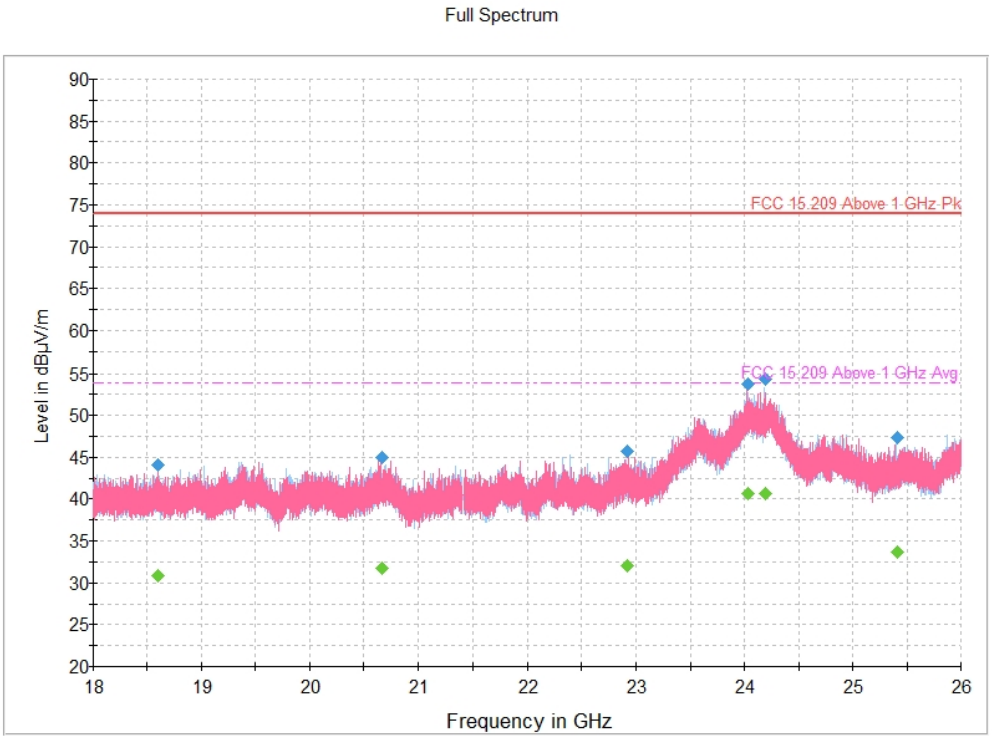
Figure 8.1-17: *Radiated emissions, high channel 2462 MHz, 1 – 18 GHz spectral plot (16.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1198.650000	46.25	---	73.90	27.65	5000.0	1000.000	250.0	H	226.0	-13.2
1198.650000	---	24.43	53.90	29.47	5000.0	1000.000	250.0	H	226.0	-13.2
1530.500000	---	22.30	53.90	31.60	5000.0	1000.000	252.0	H	98.0	-13.6
1530.500000	35.61	---	73.90	38.29	5000.0	1000.000	252.0	H	98.0	-13.6
2106.000000	49.76	---	73.90	24.14	5000.0	1000.000	145.0	V	257.0	-10.0
2106.000000	---	35.86	53.90	18.04	5000.0	1000.000	145.0	V	257.0	-10.0
2994.550000	51.63	---	73.90	22.27	5000.0	1000.000	110.0	V	357.0	-7.2
2994.550000	---	36.26	53.90	17.64	5000.0	1000.000	110.0	V	357.0	-7.2
7120.300000	---	30.48	53.90	23.42	5000.0	1000.000	213.0	H	36.0	1.8
7120.300000	44.02	---	73.90	29.88	5000.0	1000.000	213.0	H	36.0	1.8
13783.35000	47.58	---	73.90	26.32	5000.0	1000.000	388.0	V	11.0	13.1
13783.35000	---	34.10	53.90	19.80	5000.0	1000.000	388.0	V	11.0	13.1
17765.75000	---	35.28	53.90	18.62	5000.0	1000.000	398.0	H	38.0	16.9
17765.75000	48.93	---	73.90	24.97	5000.0	1000.000	398.0	H	38.0	16.9

Table 8.1-21: *Radiated emissions, high channel 2462 MHz, 1 – 18 GHz spectral plot results (16.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (Integral PCB antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

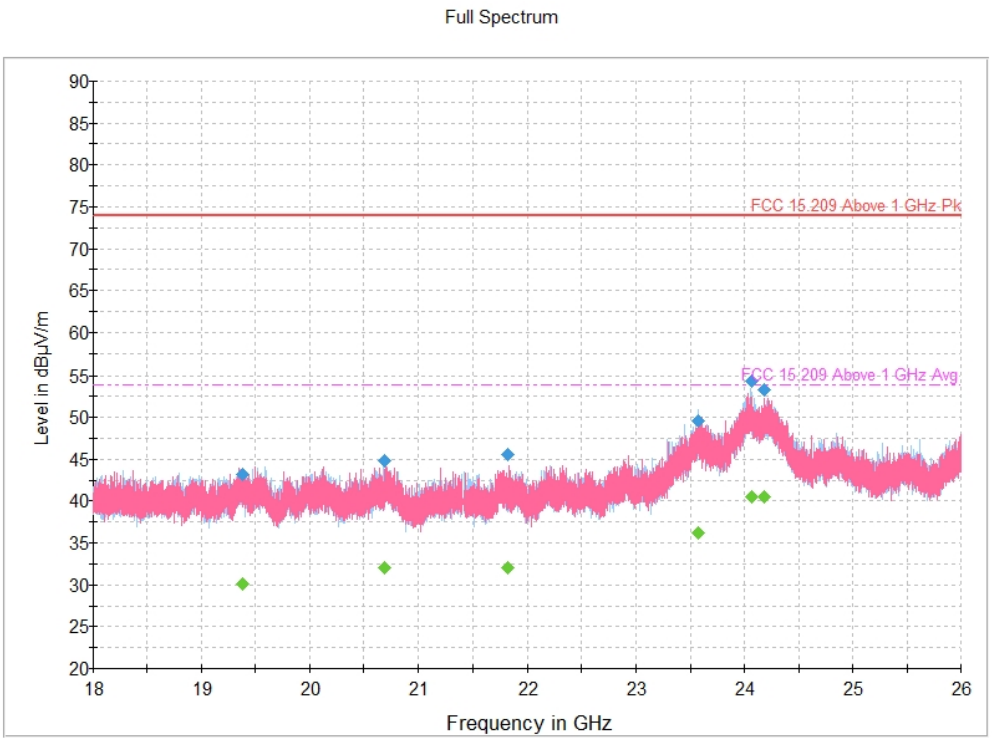
Figure 8.1-18: *Radiated emissions, low channel 2412 MHz, 18 – 26 GHz spectral plot (16.5 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18602.066667	---	30.90	53.90	23.00	5000.0	1000.000	402.0	V	333.0	17.9
18602.066667	44.07	---	73.90	29.83	5000.0	1000.000	402.0	V	333.0	17.9
20663.933333	45.03	---	73.90	28.87	5000.0	1000.000	374.0	V	0.0	19.8
20663.933333	---	31.79	53.90	22.11	5000.0	1000.000	374.0	V	0.0	19.8
22920.733333	45.73	---	73.90	28.17	5000.0	1000.000	362.0	V	0.0	21.2
22920.733333	---	32.09	53.90	21.81	5000.0	1000.000	362.0	V	0.0	21.2
24037.000000	---	40.65	53.90	13.25	5000.0	1000.000	164.0	H	0.0	29.7
24037.000000	53.80	---	73.90	20.10	5000.0	1000.000	164.0	H	0.0	29.7
24191.266667	54.34	---	73.90	19.56	5000.0	1000.000	410.0	H	198.0	29.2
24191.266667	---	40.64	53.90	13.26	5000.0	1000.000	410.0	H	198.0	29.2
25409.266667	47.32	---	73.90	26.58	5000.0	1000.000	217.0	H	291.0	23.8
25409.266667	---	33.70	53.90	20.20	5000.0	1000.000	217.0	H	291.0	23.8

Table 8.1-22: *Radiated emissions, low channel 2412 MHz, 18 – 26 GHz spectral plot results (16.5 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral PCB antenna), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

Figure 8.1-19: *Radiated emissions, middle channel 2437 MHz, 18 – 26 GHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19380.466667	43.12	---	73.90	30.78	5000.0	1000.000	98.0	V	83.0	18.4
19380.466667	---	30.14	53.90	23.76	5000.0	1000.000	98.0	V	83.0	18.4
20686.200000	44.75	---	73.90	29.15	5000.0	1000.000	234.0	H	55.0	20.0
20686.200000	---	31.97	53.90	21.93	5000.0	1000.000	234.0	H	55.0	20.0
21815.000000	45.56	---	73.90	28.34	5000.0	1000.000	391.0	V	177.0	19.4
21815.000000	---	32.00	53.90	21.90	5000.0	1000.000	391.0	V	177.0	19.4
23569.000000	---	36.23	53.90	17.67	5000.0	1000.000	256.0	H	293.0	25.9
23569.000000	49.53	---	73.90	24.37	5000.0	1000.000	256.0	H	293.0	25.9
24063.533333	54.34	---	73.90	19.56	5000.0	1000.000	354.0	H	195.0	29.7
24063.533333	---	40.57	53.90	13.33	5000.0	1000.000	354.0	H	195.0	29.7
24188.733333	---	40.55	53.90	13.35	5000.0	1000.000	137.0	V	0.0	29.2
24188.733333	53.30	---	73.90	20.60	5000.0	1000.000	137.0	V	0.0	29.2

Table 8.1-23: *Radiated emissions, middle channel 2437 MHz, 18 – 26 GHz spectral plot results (20.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (Integral PCB antenna)

The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

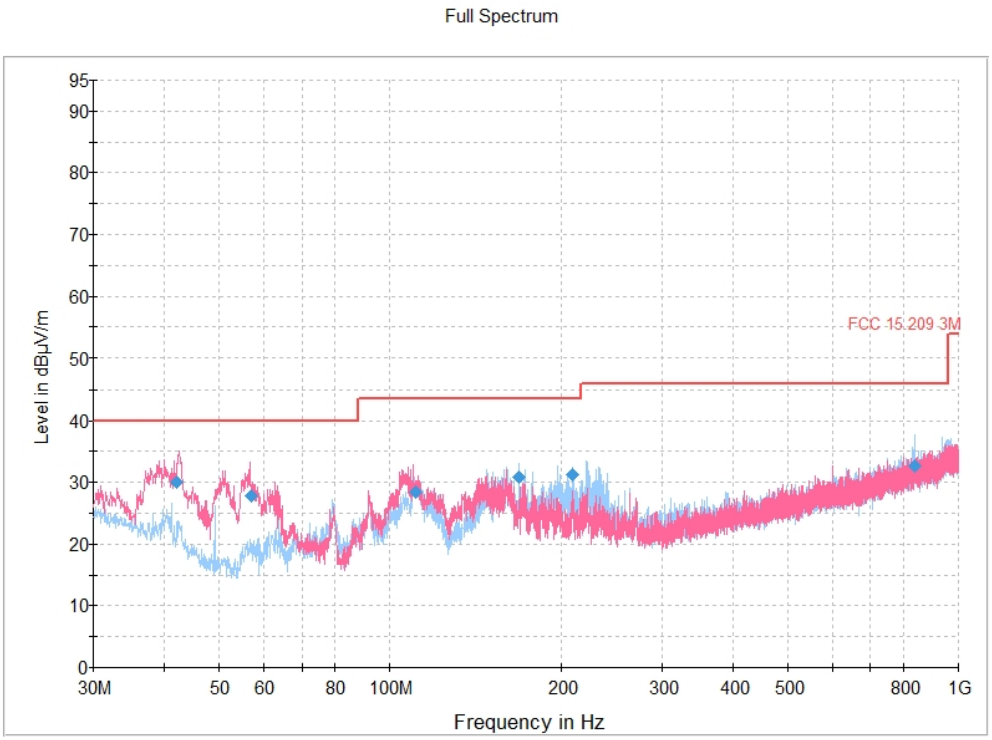
Figure 8.1-20: *Radiated emissions, high channel 2462 MHz, 18 – 26 GHz spectral plot (16.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19351.266667	---	30.12	53.90	23.78	5000.0	1000.000	343.0	V	118.0	18.5
19351.266667	43.41	---	73.90	30.49	5000.0	1000.000	343.0	V	118.0	18.5
21209.133333	---	30.83	53.90	23.07	5000.0	1000.000	255.0	H	0.0	18.8
21209.133333	43.80	---	73.90	30.10	5000.0	1000.000	255.0	H	0.0	18.8
22191.000000	---	31.58	53.90	22.32	5000.0	1000.000	208.0	V	0.0	19.9
22191.000000	45.06	---	73.90	28.84	5000.0	1000.000	208.0	V	0.0	19.9
22859.133333	---	31.38	53.90	22.52	5000.0	1000.000	227.0	H	118.0	21.1
22859.133333	44.55	---	73.90	29.35	5000.0	1000.000	227.0	H	118.0	21.1
24033.666667	---	40.83	53.90	13.07	5000.0	1000.000	348.0	H	318.0	29.7
24033.666667	54.65	---	73.90	19.25	5000.0	1000.000	348.0	H	318.0	29.7
25139.000000	---	34.22	53.90	19.68	5000.0	1000.000	157.0	V	292.0	24.0
25139.000000	47.35	---	73.90	26.55	5000.0	1000.000	157.0	V	292.0	24.0

Table 8.1-24: *Radiated emissions, high channel 2462 MHz, 18 – 26 GHz spectral plot results (16.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF)



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

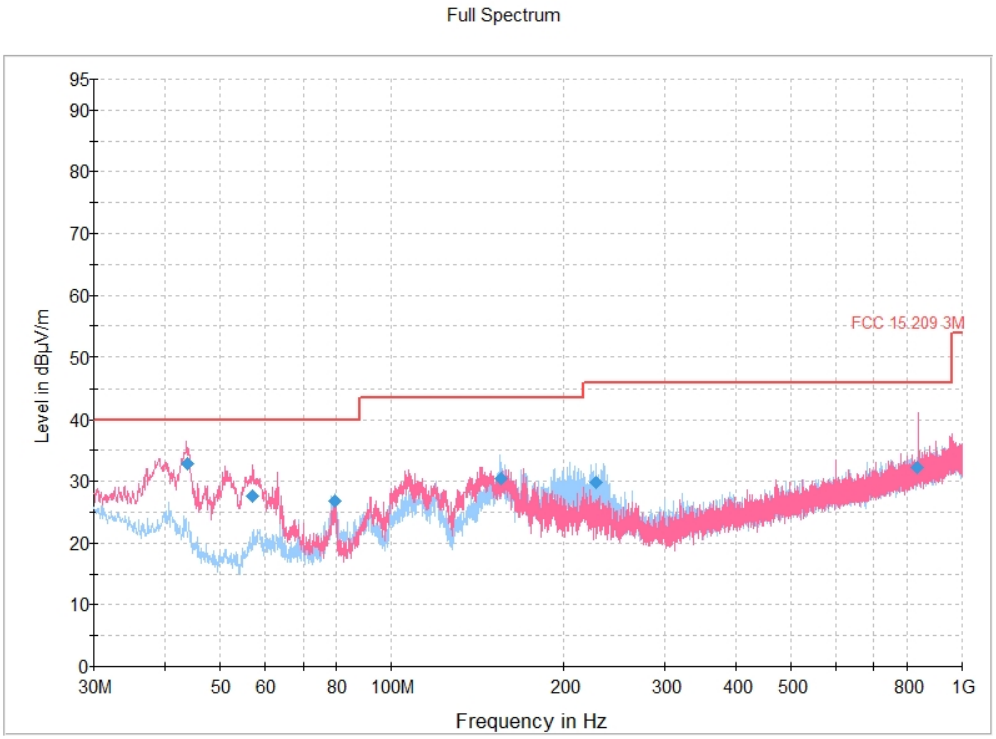
Figure 8.1-21: *Radiated emissions, low channel 2412 MHz, 30 – 1000 MHz spectral plot (15 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
42.089167	30.06	40.00	9.94	5000.0	120.000	100.0	V	84.0	20.0
56.874167	27.83	40.00	12.17	5000.0	120.000	116.0	V	353.0	13.2
111.105833	28.48	43.50	15.02	5000.0	120.000	100.0	V	158.0	18.8
167.982500	30.84	43.50	12.66	5000.0	120.000	137.0	H	209.0	18.1
209.205833	31.36	43.50	12.14	5000.0	120.000	100.0	H	224.0	18.1
840.025000	32.73	46.00	13.27	5000.0	120.000	223.0	H	190.0	32.7

Table 8.1-25: *Radiated emissions, low channel 2412 MHz, 30 – 1000 MHz spectral plot (15 dBm input power) results.*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

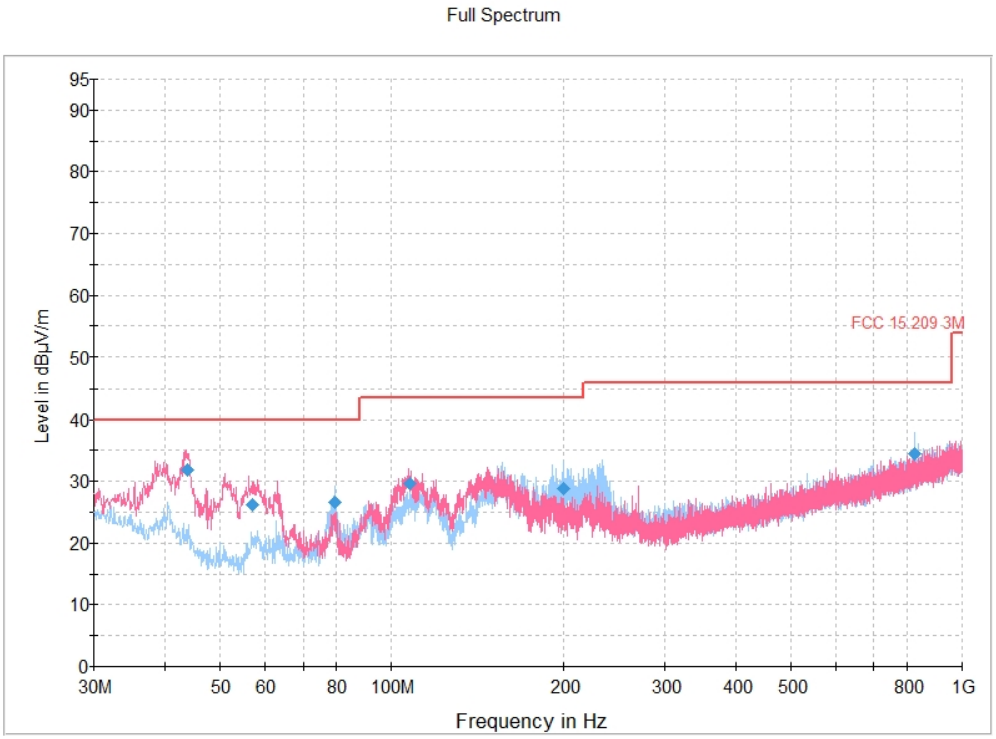
Figure 8.1-22: *Radiated emissions, middle channel 2437 MHz, 30 – 1000 MHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
43.740000	32.79	40.00	7.21	5000.0	120.000	100.0	V	351.0	19.1
57.038333	27.70	40.00	12.30	5000.0	120.000	100.0	V	22.0	13.2
79.590000	26.80	40.00	13.20	5000.0	120.000	221.0	H	256.0	14.9
155.161667	30.42	43.50	13.08	5000.0	120.000	132.0	H	227.0	19.0
227.960833	29.79	46.00	16.21	5000.0	120.000	127.0	H	206.0	18.7
835.270833	32.22	46.00	13.78	5000.0	120.000	164.0	V	129.0	32.4

Table 8.1-26: *Radiated emissions, middle channel 2437 MHz, 30 – 1000 MHz spectral plot (20.25 dBm input power) results.*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

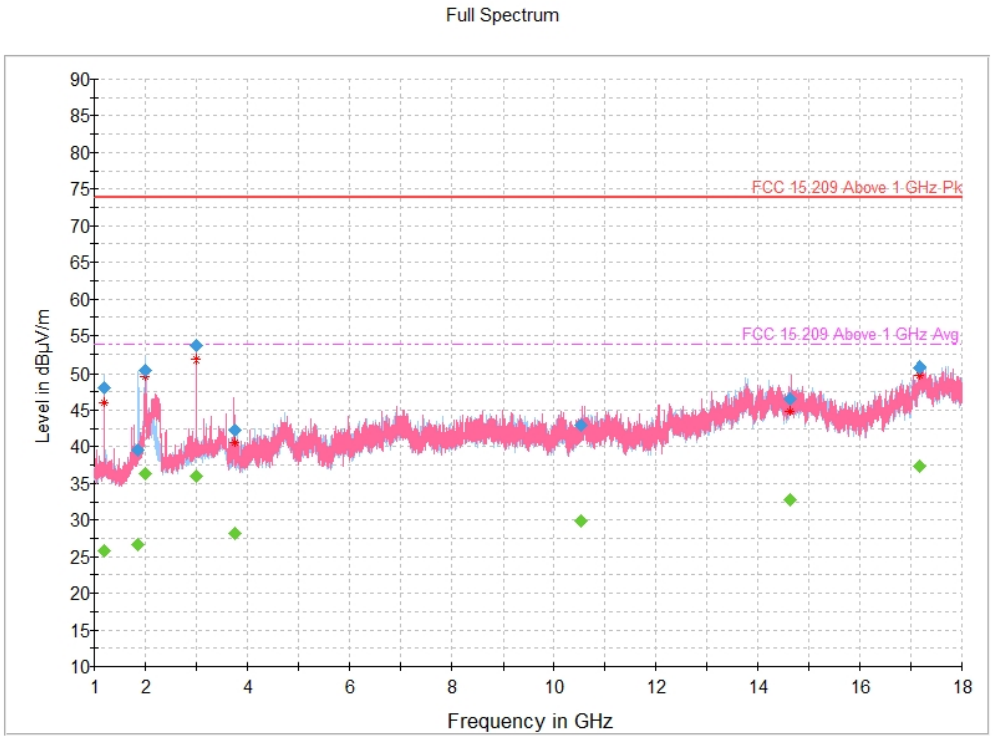
Figure 8.1-23: *Radiated emissions, high channel 2462 MHz, 30 – 1000 MHz spectral plot (14.75 dBm input power).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
43.780000	31.85	40.00	8.15	5000.0	120.000	100.0	V	326.0	19.1
57.109167	26.20	40.00	13.80	5000.0	120.000	164.0	V	11.0	13.1
79.552500	26.67	40.00	13.33	5000.0	120.000	248.0	H	252.0	14.9
107.516667	29.63	43.50	13.87	5000.0	120.000	100.0	V	146.0	18.5
199.745833	28.93	43.50	14.57	5000.0	120.000	118.0	H	227.0	17.8
824.994167	34.50	46.00	11.50	5000.0	120.000	281.0	H	344.0	32.5

Table 8.1-27: *Radiated emissions, high channel 2462 MHz, 30 – 1000 MHz spectral plot (14.75 dBm input power) results.*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

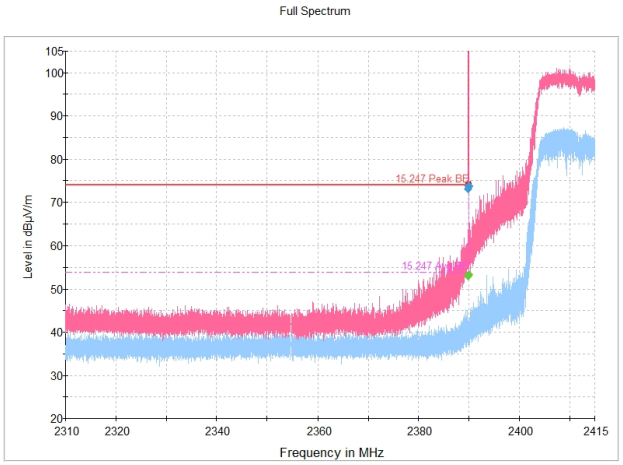
Figure 8.1-24: *Radiated emissions, low channel 2412 MHz, 1 – 18 GHz spectral plot (15 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1199.600000	48.08	---	73.90	25.82	5000.0	1000.000	251.0	H	219.0	-13.2
1199.600000	---	25.77	53.90	28.13	5000.0	1000.000	251.0	H	219.0	-13.2
1852.300000	---	26.69	53.90	27.21	5000.0	1000.000	222.0	H	232.0	-10.5
1852.300000	39.60	---	73.90	34.30	5000.0	1000.000	222.0	H	232.0	-10.5
2005.200000	---	36.36	53.90	17.54	5000.0	1000.000	234.0	H	236.0	-9.8
2005.200000	50.42	---	73.90	23.48	5000.0	1000.000	234.0	H	236.0	-9.8
2994.250000	53.58	---	73.90	20.32	5000.0	1000.000	100.0	V	-1.0	-7.2
2994.250000	---	36.06	53.90	17.84	5000.0	1000.000	100.0	V	-1.0	-7.2
3749.150000	42.19	---	73.90	31.71	5000.0	1000.000	110.0	V	52.0	-3.9
3749.150000	---	28.21	53.90	25.69	5000.0	1000.000	110.0	V	52.0	-3.9
10537.95000	43.00	---	73.90	30.90	5000.0	1000.000	338.0	H	278.0	5.8
10537.95000	---	29.85	53.90	24.05	5000.0	1000.000	338.0	H	278.0	5.8
14636.95000	---	32.79	53.90	21.11	5000.0	1000.000	402.0	V	0.0	11.3
14636.95000	46.45	---	73.90	27.45	5000.0	1000.000	402.0	V	0.0	11.3
17181.50000	---	37.38	53.90	16.52	5000.0	1000.000	300.0	V	189.0	16.3
17181.50000	50.76	---	73.90	23.14	5000.0	1000.000	300.0	V	189.0	16.3

Table 8.1-28: *Radiated emissions, low channel 2412 MHz, 1 – 18 GHz spectral plot, results (15 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued



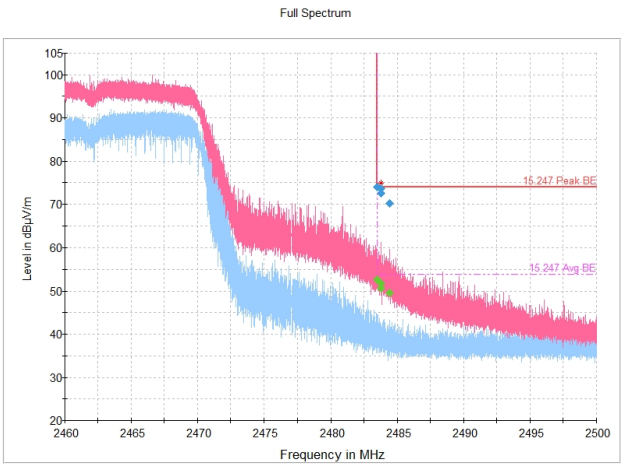


Figure 8.1-25: *Radiated emissions, Low band edge and high band edge, spectral plot (15 dBm and 14.75 dBm of input power, respectively)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2389.821000	---	52.98	53.90	0.92	5000.0	1000.000	207.0	V	335.0	-9.1
2389.821000	73.02	---	73.90	0.88	5000.0	1000.000	207.0	V	335.0	-9.1
2389.971500	---	53.44	53.90	0.46	5000.0	1000.000	207.0	V	335.0	-9.1
2389.971500	73.69	---	73.90	0.21	5000.0	1000.000	207.0	V	335.0	-9.1
2390.000000	---	53.47	53.90	0.43	5000.0	1000.000	207.0	V	337.0	-9.1
2390.000000	73.85	---	73.90	0.05	5000.0	1000.000	207.0	V	337.0	-9.1

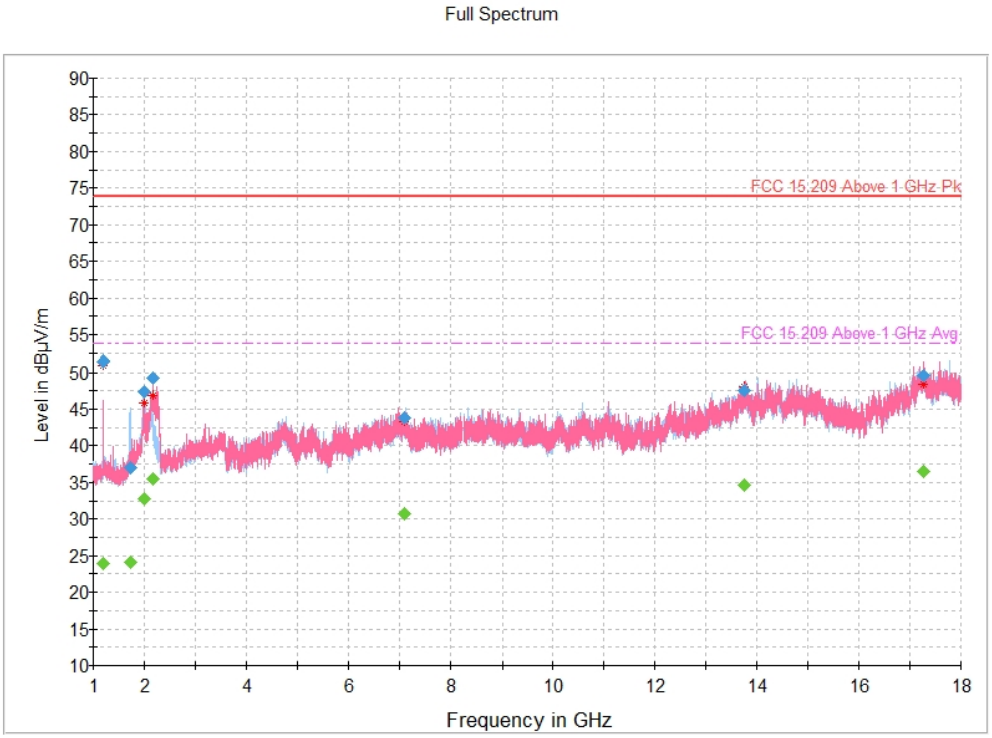
Table 8.1-29: *Radiated emissions, Low band edge results (15 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500000	73.87	---	73.90	0.03	5000.0	1000.000	172.0	V	88.0	-8.7
2483.500000	---	52.62	53.90	1.28	5000.0	1000.000	172.0	V	88.0	-8.7
2483.741333	73.63	---	73.90	0.27	5000.0	1000.000	173.0	V	77.0	-8.7
2483.741333	---	51.82	53.90	2.08	5000.0	1000.000	173.0	V	77.0	-8.7
2483.741333	72.53	---	73.90	1.37	5000.0	1000.000	213.0	V	109.0	-8.7
2483.741333	---	50.70	53.90	3.20	5000.0	1000.000	213.0	V	109.0	-8.7
2484.388000	70.26	---	73.90	3.64	5000.0	1000.000	172.0	V	96.0	-8.7
2484.388000	---	49.59	53.90	4.31	5000.0	1000.000	172.0	V	96.0	-8.7

Table 8.1-30: *Radiated emissions, High band edge results (14.75 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

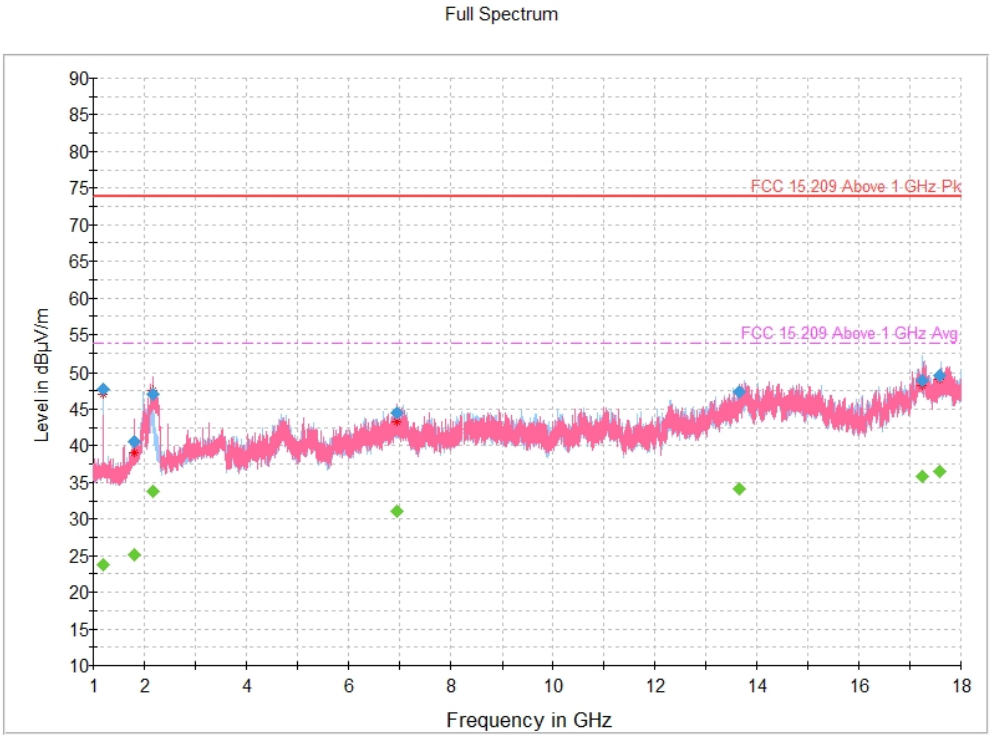
Figure 8.1-26: *Radiated emissions, middle channel 2437 MHz, 1 – 18 GHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1198.250000	51.48	---	73.90	22.42	5000.0	1000.000	249.0	V	192.0	-13.2
1198.250000	---	23.91	53.90	29.99	5000.0	1000.000	249.0	V	192.0	-13.2
1729.900000	36.93	---	73.90	36.97	5000.0	1000.000	369.0	H	98.0	-11.6
1729.900000	---	24.07	53.90	29.83	5000.0	1000.000	369.0	H	98.0	-11.6
1996.800000	---	32.70	53.90	21.20	5000.0	1000.000	214.0	H	235.0	-9.8
1996.800000	47.44	---	73.90	26.46	5000.0	1000.000	214.0	H	235.0	-9.8
2171.800000	49.19	---	73.90	24.71	5000.0	1000.000	194.0	V	157.0	-10.0
2171.800000	---	35.43	53.90	18.47	5000.0	1000.000	194.0	V	157.0	-10.0
7117.150000	43.78	---	73.90	30.12	5000.0	1000.000	361.0	H	284.0	1.8
7117.150000	---	30.64	53.90	23.26	5000.0	1000.000	361.0	H	284.0	1.8
13755.600000	---	34.71	53.90	19.19	5000.0	1000.000	328.0	H	126.0	12.9
13755.600000	47.55	---	73.90	26.35	5000.0	1000.000	328.0	H	126.0	12.9
17266.100000	---	36.51	53.90	17.39	5000.0	1000.000	315.0	V	288.0	16.5
17266.100000	49.65	---	73.90	24.25	5000.0	1000.000	315.0	V	288.0	16.5

Table 8.1-31: *Radiated emissions, middle channel 2437 MHz, 1 – 18 GHz results (20.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

Figure 8.1-27: *Radiated emissions, high channel 2462 MHz, 1 – 18 GHz spectral plot (14.75 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1197.100000	---	23.82	53.90	30.08	5000.0	1000.000	233.0	H	216.0	-13.2
1197.100000	47.72	---	73.90	26.18	5000.0	1000.000	233.0	H	216.0	-13.2
1794.200000	---	25.13	53.90	28.77	5000.0	1000.000	347.0	V	253.0	-10.8
1794.200000	40.63	---	73.90	33.27	5000.0	1000.000	347.0	V	253.0	-10.8
2168.150000	47.04	---	73.90	26.86	5000.0	1000.000	155.0	V	190.0	-10.1
2168.150000	---	33.80	53.90	20.10	5000.0	1000.000	155.0	V	190.0	-10.1
6963.950000	---	31.00	53.90	22.90	5000.0	1000.000	126.0	V	112.0	1.8
6963.950000	44.47	---	73.90	29.43	5000.0	1000.000	126.0	V	112.0	1.8
13655.25000	47.38	---	73.90	26.52	5000.0	1000.000	370.0	V	0.0	12.3
13655.25000	---	34.16	53.90	19.74	5000.0	1000.000	370.0	V	0.0	12.3
17235.55000	---	35.76	53.90	18.14	5000.0	1000.000	410.0	H	277.0	16.3
17235.55000	48.98	---	73.90	24.92	5000.0	1000.000	410.0	H	277.0	16.3
17593.25000	---	36.56	53.90	17.34	5000.0	1000.000	270.0	H	23.0	15.4
17593.25000	49.62	---	73.90	24.28	5000.0	1000.000	270.0	H	23.0	15.4

Table 8.1-32: *Radiated emissions, high channel 2462 MHz, 1 – 18 GHz spectral plot results (14.75 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.
[5] A 2.4 GHz Notch filter was used to avoid damage or saturation of the LNA.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued

The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

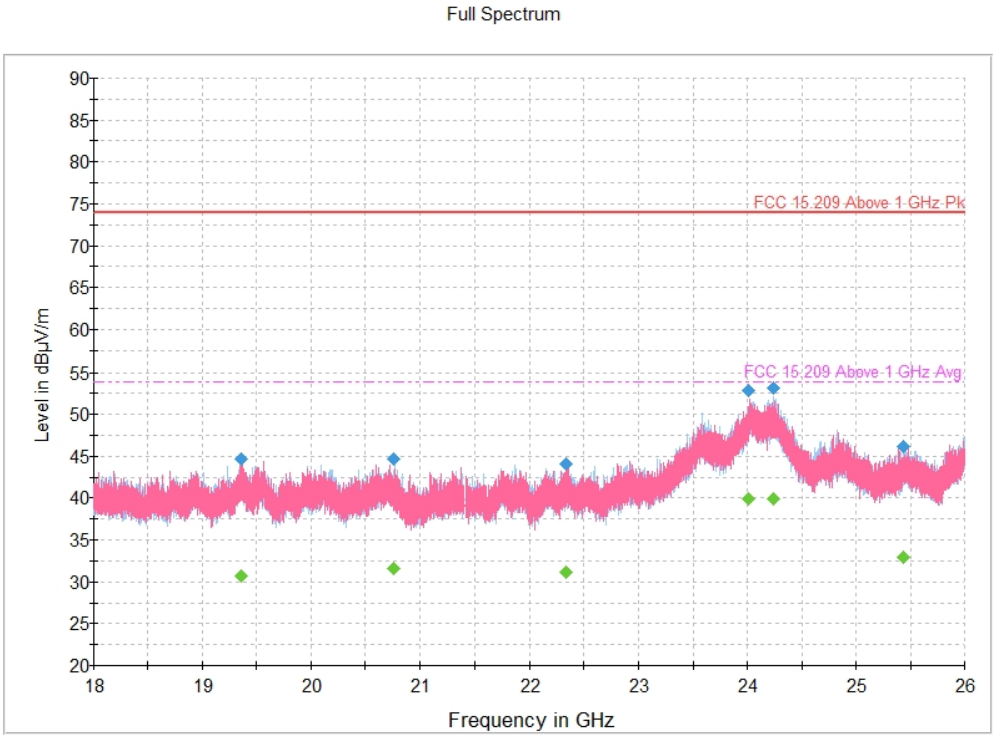
Figure 8.1-28: *Radiated emissions, low channel 2412 MHz, 18 – 26 GHz spectral plot (15 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18372.200000	43.71	---	73.90	30.19	5000.0	1000.000	234.0	H	69.0	17.2
18372.200000	---	29.89	53.90	24.01	5000.0	1000.000	234.0	H	69.0	17.2
19561.533333	44.40	---	73.90	29.50	5000.0	1000.000	284.0	V	258.0	18.1
19561.533333	---	31.02	53.90	22.88	5000.0	1000.000	284.0	V	258.0	18.1
20671.266667	45.46	---	73.90	28.44	5000.0	1000.000	410.0	H	70.0	19.8
20671.266667	---	31.77	53.90	22.13	5000.0	1000.000	410.0	H	70.0	19.8
22465.000000	43.99	---	73.90	29.91	5000.0	1000.000	352.0	V	244.0	19.3
22465.000000	---	30.58	53.90	23.32	5000.0	1000.000	352.0	V	244.0	19.3
24053.266667	---	40.40	53.90	13.50	5000.0	1000.000	118.0	V	11.0	29.7
24053.266667	54.32	---	73.90	19.58	5000.0	1000.000	118.0	V	11.0	29.7
24217.533333	53.40	---	73.90	20.50	5000.0	1000.000	315.0	H	101.0	29.1
24217.533333	---	40.21	53.90	13.69	5000.0	1000.000	315.0	H	101.0	29.1
25868.200000	48.20	---	73.90	25.70	5000.0	1000.000	214.0	V	0.0	24.4
25868.200000	---	34.85	53.90	19.05	5000.0	1000.000	214.0	V	0.0	24.4

Table 8.1-33: *Radiated emissions, low channel 2412 MHz, 18 – 26 GHz spectral plot results (15 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued



The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

Figure 8.1-29: *Radiated emissions, middle channel 2437 MHz, 18 – 26 GHz spectral plot (20.25 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19353.000000	44.60	---	73.90	29.30	5000.0	1000.000	402.0	V	257.0	18.5
19353.000000	---	30.72	53.90	23.18	5000.0	1000.000	402.0	V	257.0	18.5
20762.866667	44.70	---	73.90	29.20	5000.0	1000.000	231.0	H	0.0	19.7
20762.866667	---	31.66	53.90	22.24	5000.0	1000.000	231.0	H	0.0	19.7
22337.666667	44.08	---	73.90	29.82	5000.0	1000.000	118.0	V	182.0	19.5
22337.666667	---	31.14	53.90	22.76	5000.0	1000.000	118.0	V	182.0	19.5
24016.466667	52.82	---	73.90	21.08	5000.0	1000.000	277.0	V	115.0	29.6
24016.466667	---	39.97	53.90	13.93	5000.0	1000.000	277.0	V	115.0	29.6
24246.466667	---	39.90	53.90	14.00	5000.0	1000.000	125.0	H	306.0	29.0
24246.466667	53.11	---	73.90	20.79	5000.0	1000.000	125.0	H	306.0	29.0
25438.066667	---	32.87	53.90	21.03	5000.0	1000.000	204.0	H	86.0	23.9
25438.066667	46.10	---	73.90	27.80	5000.0	1000.000	204.0	H	86.0	23.9

Table 8.1-34: *Radiated emissions, middle channel 2437 MHz, 18 – 26 GHz spectral plot results (20.25 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.1.5 Test data (L-Comm Rubber Duck Antenna: HG2403RD-RSF), continued

The spectral plot shows separate the vertical (red) and horizontal (blue) scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators

Figure 8.1-30: *Radiated emissions, high channel 2462 MHz, 18 – 26 GHz spectral plot (14.75 dBm input power).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19326.866667	43.97	---	73.90	29.93	5000.0	1000.000	362.0	V	336.0	18.5
19326.866667	---	30.89	53.90	23.01	5000.0	1000.000	362.0	V	336.0	18.5
20688.866667	44.82	---	73.90	29.08	5000.0	1000.000	207.0	H	309.0	20.0
20688.866667	---	31.55	53.90	22.35	5000.0	1000.000	207.0	H	309.0	20.0
22330.200000	---	30.70	53.90	23.20	5000.0	1000.000	242.0	V	302.0	19.5
22330.200000	43.51	---	73.90	30.39	5000.0	1000.000	242.0	V	302.0	19.5
24027.933333	53.81	---	73.90	20.09	5000.0	1000.000	108.0	H	300.0	29.7
24027.933333	---	40.37	53.90	13.53	5000.0	1000.000	108.0	H	300.0	29.7
24276.466667	---	39.63	53.90	14.27	5000.0	1000.000	184.0	V	319.0	28.7
24276.466667	52.70	---	73.90	21.20	5000.0	1000.000	184.0	V	319.0	28.7
25468.466667	47.19	---	73.90	26.71	5000.0	1000.000	146.0	H	54.0	24.0
25468.466667	---	34.06	53.90	19.84	5000.0	1000.000	146.0	H	54.0	24.0

Table 8.1-35: *Radiated emissions, high channel 2462 MHz, 18 – 26 GHz spectral plot results (14.75 dBm input power).*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) - pre amp (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.
[4] FCC 15.209 limits are equivalent to FCC 15.247 limits.

8.2 FCC 15.247(b) and RSS-247 5.4 (d) Transmitter output power and EIRP requirements

FCC:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W (30 dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(c) Operation with directional antenna gains greater than 6 dBi.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

15.31(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

ISED:

d. For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

e. Fixed point-to-point systems in the bands 2400-2483.5 MHz and 5725-5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems, Footnote 2 omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W

8.2.1 Test summary

Verdict	Pass		
Test date	Not tested*	Temperature	N/A
Test engineer	N/A	Air pressure	N/A
Test location	N/A	Relative humidity	N/A

8.2.2 Notes

*Important note: Maximum transmitter conducted power was taken of the measurements done to the Microchip Wi-Fi module (Report number: 60359686 001) with FCC number 2ADHKWI32E01 and IC number 20266-WFI32E01. Only maximum conducted output power was considered in this report. Antenna gain was declared by manufacturer.

Note 1: Three antennas were considered:
3.5 dBi Antenna gain: Integrated Patch Antenna (Declared by manufacturer)
3.0 dBi Antenna gain: L-Common Rubber Duck Antenna: HG2403RD-RSF (Declared by manufacturer)
0 dBi Antenna gain: Integrated PCB Antenna (Declared by manufacturer)

8.2.3 Data

Maximum conducted	Maximum conducted output power	Limit	Antenna gain	EIRP	Limit	Antenna type
CH: 2437 MHz; 802.11g	25.19 dBm	30 dBm	3.5 dBi	28.69 dBm	36 dBm	Integrated Patch Antenna
CH: 2437 MHz; 802.11g	25.19 dBm	30 dBm	3.0 dBi	28.19 dBm	36 dBm	L-Common Rubber Duck Antenna
CH: 2437 MHz; 802.11g	25.19 dBm	30 dBm	0 dBi	25.19 dBm	36 dBm	Integrated PCB Antenna

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up

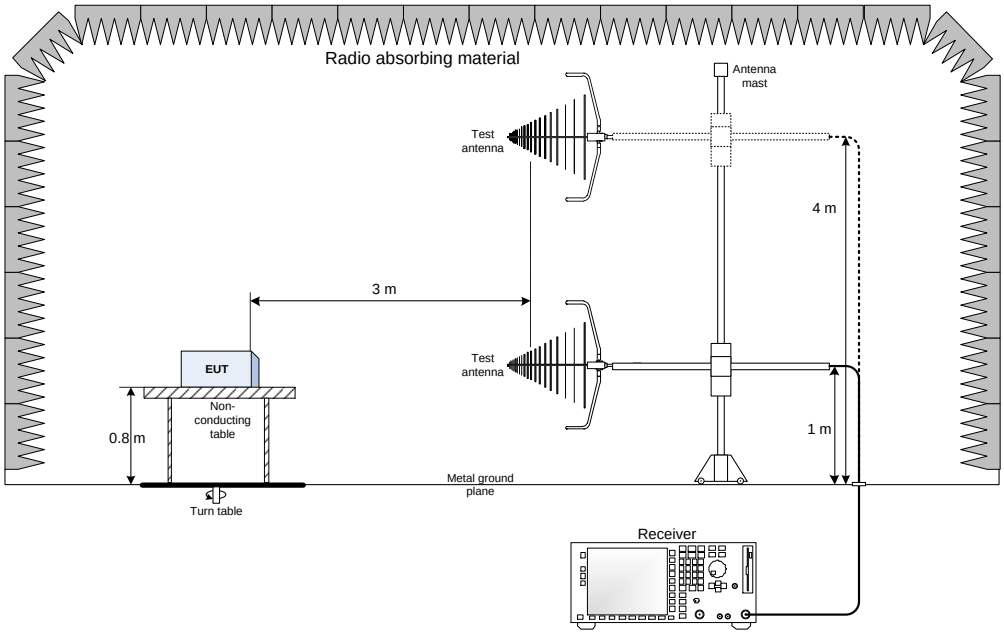


Figure 9.1-1: *30 MHz - 1000 MHz Setup*

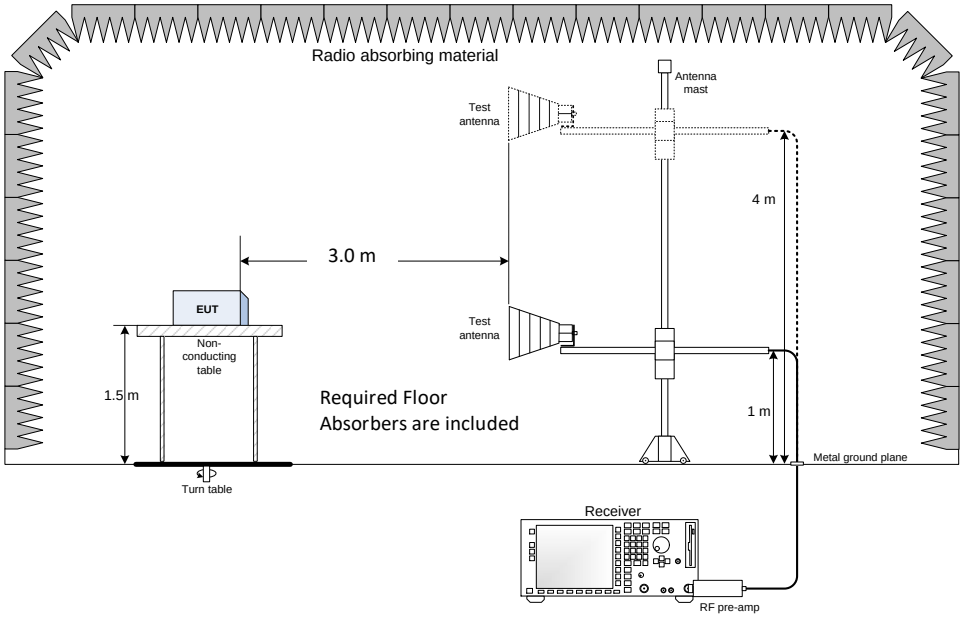


Figure 9.1-2: *1 GHz - 26 GHz Setup*

Thank you for choosing