Test report

356782-1TRFWL

Date of issue: October 22, 2018

Applicant:F
CalAmp

Product:
Vehicle Device

Model:
TTU4530LAW

FCC ID: APV-4530LAW
IC: 5843C-4530LAW

Specifications:

- FCC 47 CFR Part 15, Subpart C – §15.207 Conducted limits.
- FCC 47 CFR Part 15, Subpart C – §15.209 Radiated emission; general requirements.

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
Reviewed by	Juan Manuel Gonzalez/Business Development Manager
Review date	10/22/18
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.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C – §15.207	Conducted limits.
FCC 47 CFR Part 15, Subpart C – §15.209	Radiated emission; general requirements.

1.2 Test methods

ANSI C64.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.3 Exclusions

None

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. 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 #	Details of changes made to test report
362578-1TRFWL	Original report issued

Notes:

Section 2 Summary of test results

2.1 Radiated Emissions in simultaneous transmission.

Table 2.1-1: *FCC 47 CFR Part 15, Subpart C §15.207 & §15.209*

Test description	Verdict
FCC 15.209 - Radiated disturbance	Pass
FCC 15.207 - Conducted disturbance	Pass

Notes:

Section 3 Equipment under test (EUT) details

3.1 Applicant

Company name	CalAmp
Address	2177 Salk Avenue, Suite 200
City	Carlsbad
Province/State	CA
Postal/Zip code	92008
Country	USA

3.2 Manufacturer

Company name	CalAmp
Address	2177 Salk Avenue, Suite 200
City	Carlsbad
Province/State	CA
Postal/Zip code	92008
Country	USA

3.3 Sample information

Receipt date	October 12, 2018
Nemko sample ID number	362578

3.4 EUT information

Product name	Vehicle device
Model	TTU4530LAW
Model variant	N/A
Serial number	IMEI: 123456789012345
Power requirements	12 VDC
Description/theory of operation	This telematic gateway provide various connectivity options (Wi-fi, LTE, W-CDMA, GPS) for different applications, including expanded access into vehicle networks. EUT contains FCC ID #1: QIPELS61-US & FCC ID #2: PVH0965 .
Operational frequencies	Wi-fi 2432 GHz & 5.2 GHz, W-CDMA 1852.4 MHz, LTE 1850-1910 MHz
Software details	N/A

3.5 EUT exercise and monitoring details

For this test the telematic gateway (EUT) was set to transmit in a continuous with Wi-Fi (2.4GHZ or 5 GHz) and cellular (LTE or W-CDMA).
The Wi-Fi signal was enabled by Ublox tool while the cellular was controlled with a R&S wideband radio communication tester(CMW500). LTE, W-CDMA and Wi-fi signals were monitoring through a spectrum analyzer.

3.6 EUT setup details

Table 3.6-1: *EUT interface ports*

Description	Qty.
Serial port	2

Table 3.6-2: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Laptop	Dell	Inspiron	15-5548	N/A
AC Adapter	Dell	LA90PE1-01	N/A	N/A
Switching mode DC regulated power Supply	BK Precision	1697	260G13306	N/A

Table 3.6-3: *Inter-connection cables*

Cable description	From	To	Length (m)
Serial cable	EUT	Laptop	0.5
AC-DC Cable	Laptop	AC Main Network	1.5

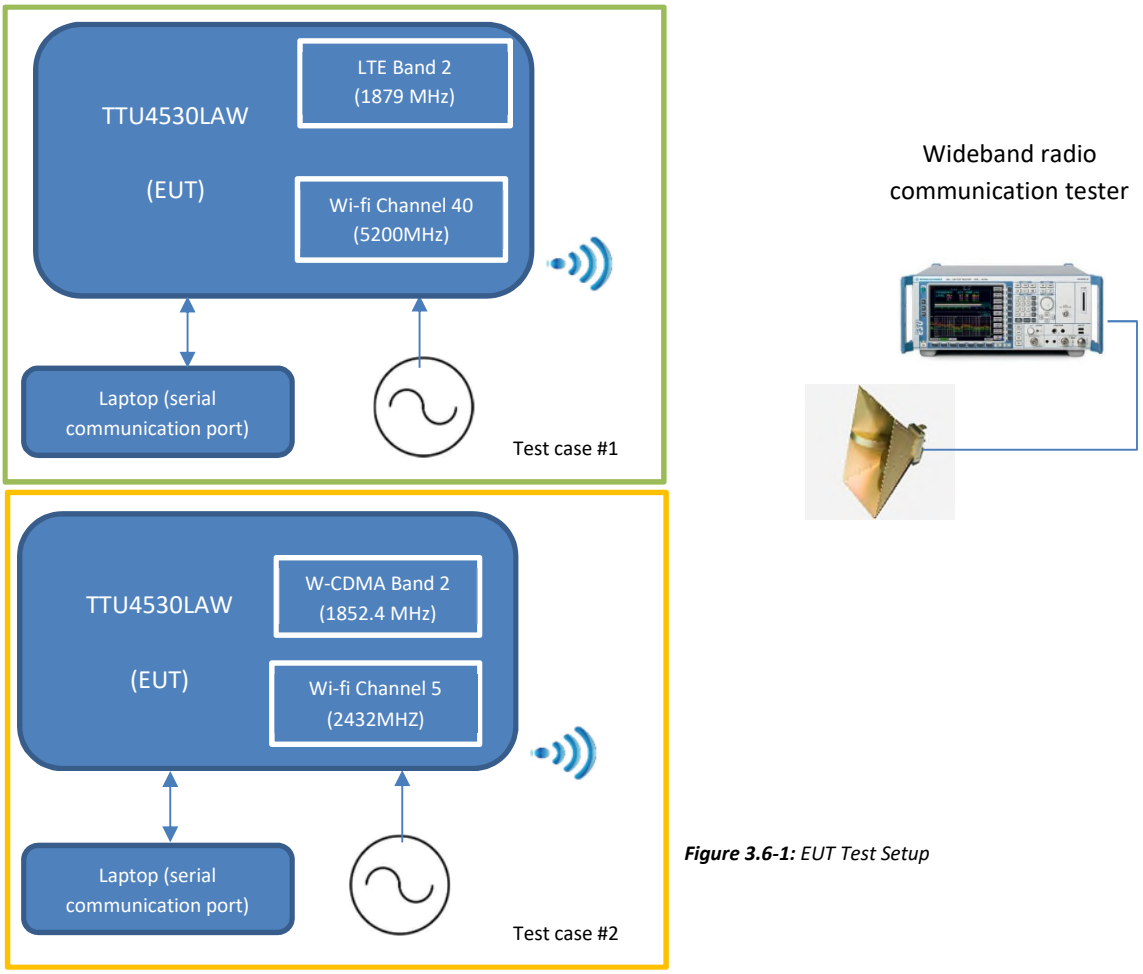


Figure 3.6-1: *EUT Test Setup*

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

None

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	21.4 °C
Relative humidity	55.7 %
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
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7 Terms and definitions

7.1.1 Equipment type

Multimedia Equipment (MME)	Equipment that is information technology equipment, audio equipment, video equipment, broadcast receiver equipment, entertainment lighting control equipment or combinations of these.
Information technology equipment [ITE]	Equipment having a primary function of either (or a combination of) entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer. - Examples include data processing equipment, office machines, electronic business equipment and telecommunication equipment.
Audio equipment	Equipment which has a primary function of either (or a combination of) generation, input, storage, play, retrieval, transmission, reception, amplification, processing, switching or control of audio signals
Video equipment	Equipment which has a primary function of either (or a combination of) generation, input, storage, display, play, retrieval, transmission, reception, amplification, processing, switching, or control of video signals.
Broadcast receiver equipment	Equipment containing a tuner that is intended for the reception of broadcast services - These broadcast services are typically television and radio services, including terrestrial broadcast, satellite broadcast and/or cable transmission.
Entertainment lighting control equipment	Equipment generating or processing electrical signals for controlling the intensity, color, nature or direction of the light from a luminaire, where the intention is to create artistic effects in theatrical, televisual or musical productions and visual presentations.

7.2 General definitions, continued

7.1.2 Port type

AC mains power port	Port used to connect to the mains supply network - Equipment with a DC power port which is powered by a dedicated AC/DC power converter is defined as AC mains powered equipment
Antenna port	Port, other than a broadcast receiver tuner port (3.1.8), for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.
Broadcast receiver tuner port	Port intended for the reception of a modulated RF signal carrying terrestrial, satellite and/or cable transmissions of audio and/or video broadcast and similar services - This port may be connected to an antenna, a cable distribution system, a VCR or similar device.
DC network power port	Port, not powered by a dedicated AC/DC power converter and not supporting communication, that connects to a DC supply network. - Equipment with a DC power port which is powered by a dedicated AC/DC power converter is considered to be AC mains powered equipment. - DC power ports supporting communications are considered to be wired networks ports, for example Ethernet ports which include Power Over Ethernet (POE).
Enclosure port	Physical boundary of the EUT through which electromagnetic fields may radiate.
Optical fiber port	Port at which an optical fiber is connected to an equipment.
RF modulator output port	Port intended to be connected to a broadcast receiver tuner port to transmit a signal to the broadcast receiver.
Signal/control port	Port intended for the interconnection of components of an equipment under test, or between an equipment under test and local associated equipment and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it) - Examples include RS-232, Universal Serial Bus (USB), High-Definition Multimedia Interface (HDMI), IEEE Standard 1394 (“Fire Wire”)
Wired network port	Point of connection for voice, data and signaling transfers intended to interconnect widely-dispersed systems by direct connection to a single-user of multi-user communication network (for example CATV, PSTN, ISDN, xDSL, LAN and similar networks) - These ports may support screened or unscreened cables and may also carry AC or DC power where this is an integral part of the telecommunication specification.

Section 8 Testing data

8.1 Radiated emission limits; Intentional Radiators.

8.1.1 References

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.209 / ANSI C63.4: 2014

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

(b)

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz, however, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

(f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device.

8.1.2 Test summary

Verdict	Pass		
Test date	October 15, 2016	Temperature	22- 23°C
Test engineer	Martha Espinoza	Air pressure	1005 - 1004 mbar
Test location	10m semi anechoic chamber	Relative humidity	33 – 26 %

8.1.3 Notes

The spectrum was searched from 30 MHz to the 10th harmonic. No considerable EUT emissions were observed above 18 GHz (when the LTE and Wi-Fi 5.2 GHz signals were transmitting at same time), so, the measurement until 26 GHz in the case when the W-CDMA and Wi-Fi signal at 2.432 GHz were transmitting at same time was not done.

8.1.4 Setup details

EUT setup configuration	Table top
Test facility	10 m Semi anechoic chamber
Measuring distance	3 m
Antenna height variation	1–4 m
Turn table position	0–360°
Measurement details	A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver/spectrum analyzer settings for frequencies below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	– Peak (Preview measurement) – Quasi-peak (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 1000 ms (Quasi-peak final measurement)

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak (Preview measurement) Peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 100 ms (Peak and CAverage final measurement)

8.1.5 Setup details, continued

Table 8.1-1: *Radiated disturbance equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 yr.	4/28/2019
Antenna, Bilog	Schaffner-Chase	CBL6111C	1763	2 yr.	11/28/2018
Antenna, Horn	ETS	3117-PA	E1139	2 yr.	1/25/2020
Antenna, Horn	Sage	SAR-2309-42-S2	E1143	2 yr.	03/05/2020
Antenna, Horn	Sage	SAR-2309-28-S2	E1148	2 yr.	03/13/2020

Notes: None

Table 8.1-2: *Radiated disturbance test software details*

Manufacturer of Software	Details
R&S	EMC32 V10.00.00

Notes: None

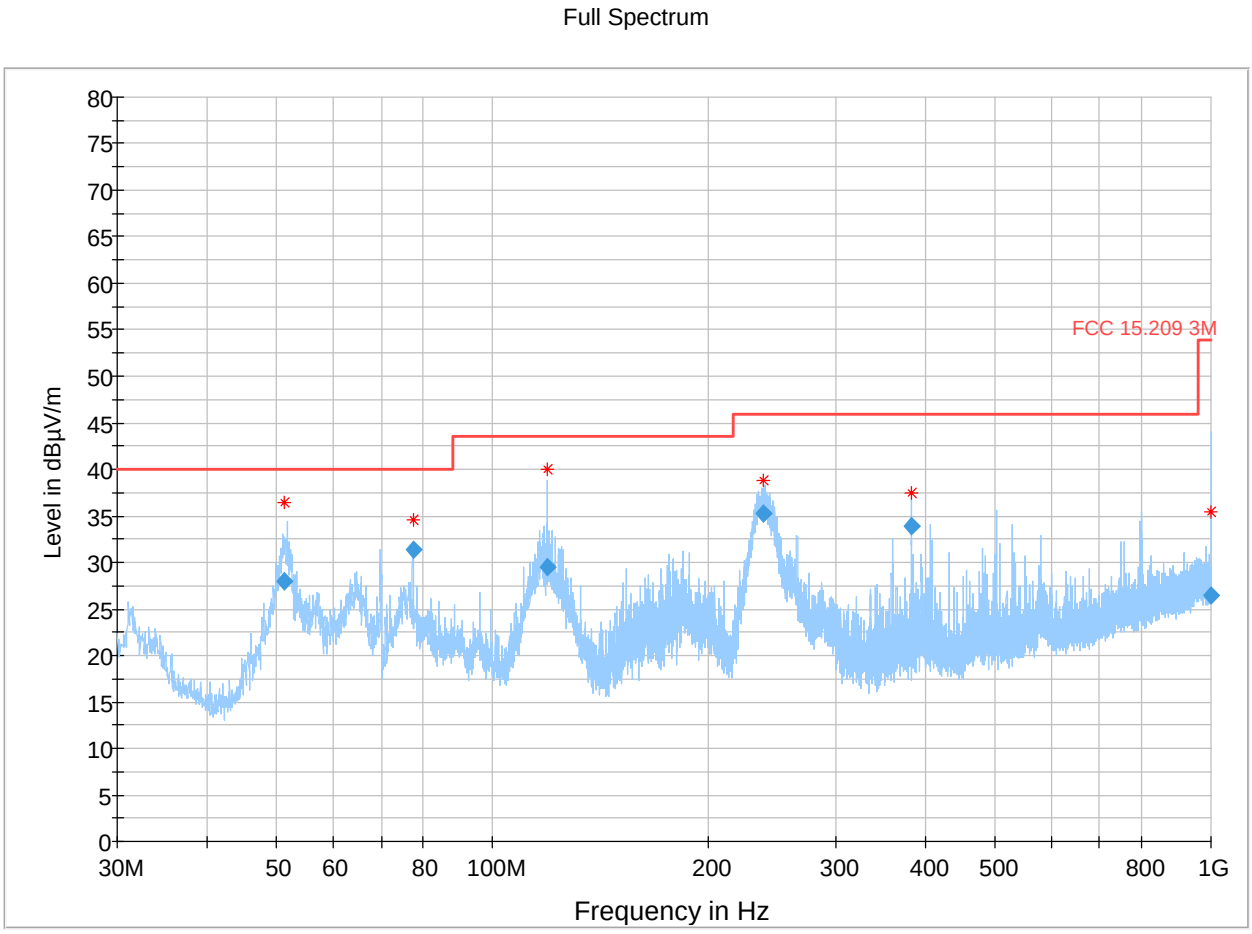


Figure 8.1.1: *Radiated spurious emissions, from 30 to 1000 MHz*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
51.228000	27.95	40.00	12.05	5000.0	120.000	124.6	V	161.0	9.3
77.424500	31.30	40.00	8.70	5000.0	120.000	136.0	V	218.0	8.8
119.271500	29.47	43.50	14.03	5000.0	120.000	127.4	V	204.0	13.4
238.489500	35.28	46.00	10.72	5000.0	120.000	100.0	V	356.0	13.7
383.565000	33.91	46.00	12.09	5000.0	120.000	134.7	V	162.0	18.6
999.920000	26.52	53.90	27.38	5000.0	120.000	176.2	V	312.0	28.3

Table 8.1.3: *Radiated field strength measurement results (30 MHz -1000 MHz)*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.
[4] The spectral plot is a summation of a vertical and horizontal scan.

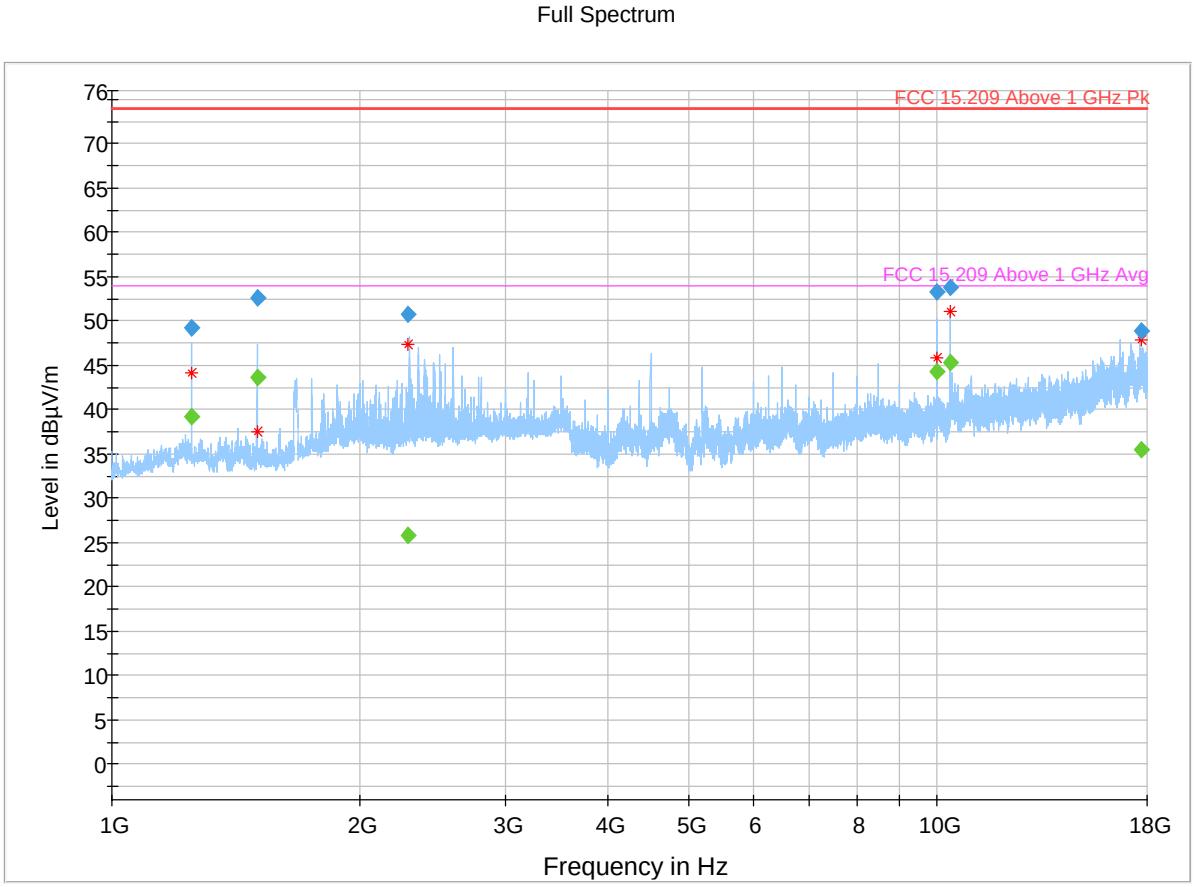


Figure 8.1.2: *Radiated spurious emissions, from 1 to 18 GHz*

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)
1249.933333	---	39.16	53.90	14.74	5000.0	1000.000	111.0	V	206.0	-13.5
1249.933333	49.18	---	73.90	24.72	5000.0	1000.000	111.0	V	206.0	-13.5
1500.000000	52.56	---	73.90	21.34	5000.0	1000.000	170.8	H	55.0	-14.4
1500.000000	---	43.66	53.90	10.24	5000.0	1000.000	170.8	H	55.0	-14.4
2285.266667	50.74	---	73.90	23.16	5000.0	1000.000	111.2	V	94.0	-10.3
2285.266667	---	25.83	53.90	28.07	5000.0	1000.000	111.2	V	94.0	-10.3
10000.000000	---	44.24	53.90	9.66	5000.0	1000.000	100.0	H	41.0	3.1
10000.000000	53.32	---	73.90	20.58	5000.0	1000.000	100.0	H	41.0	3.1
10400.066667	53.83	---	73.90	20.07	5000.0	1000.000	195.7	H	26.0	3.4
10400.066667	---	45.27	53.90	8.63	5000.0	1000.000	195.7	H	26.0	3.4
17670.433333	48.92	---	73.90	24.98	5000.0	1000.000	184.7	H	351.0	12.3
17670.433333	---	35.48	53.90	18.42	5000.0	1000.000	184.7	H	351.0	12.3

Table 8.1.4: *Radiated field strength measurement results (1 - 18 GHz)*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.
[4] The spectral plot is a summation of a vertical and horizontal scan.
A notch Filter was used for this test

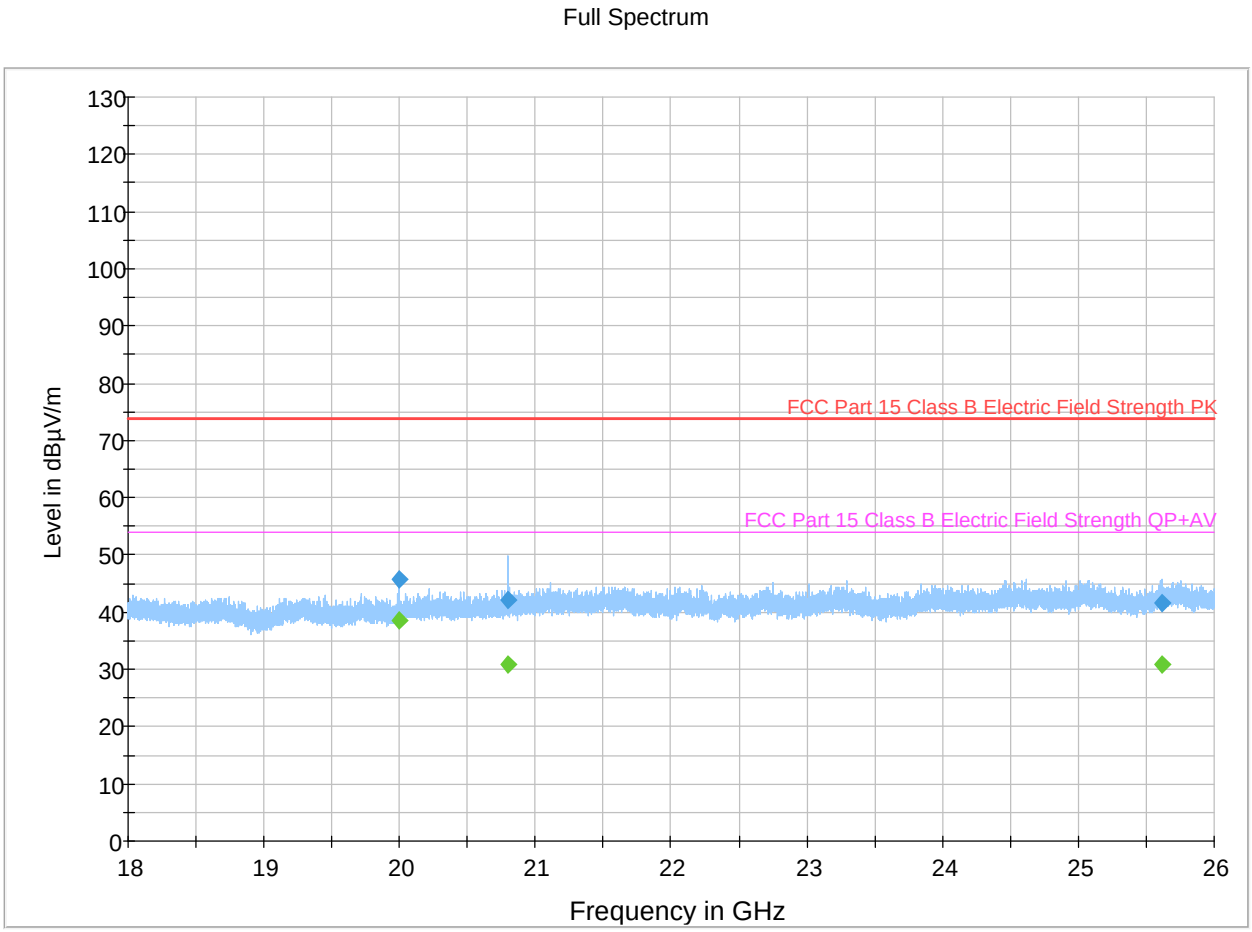


Figure 8.1.3: *Radiated spurious emissions, from 18 to 26 GHz*

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
20000.266667	45.74	---	73.90	28.16	10.0	1000.000	168.2	V	91.0	1.7
20000.266667	---	38.68	53.90	15.22	10.0	1000.000	168.2	V	91.0	1.7
20800.000000	42.08	---	73.90	31.82	10.0	1000.000	155.8	V	289.0	2.1
20800.000000	---	30.90	53.90	23.00	10.0	1000.000	155.8	V	289.0	2.1
25620.000000	---	30.97	53.90	22.93	10.0	1000.000	175.3	H	10.0	3.6
25620.000000	41.70	---	73.90	32.20	10.0	1000.000	175.3	H	10.0	3.6

Table 8.1.5: *Radiated field strength measurement results (18 - 26 GHz)*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.
[4] The spectral plot is a summation of a vertical and horizontal scan.

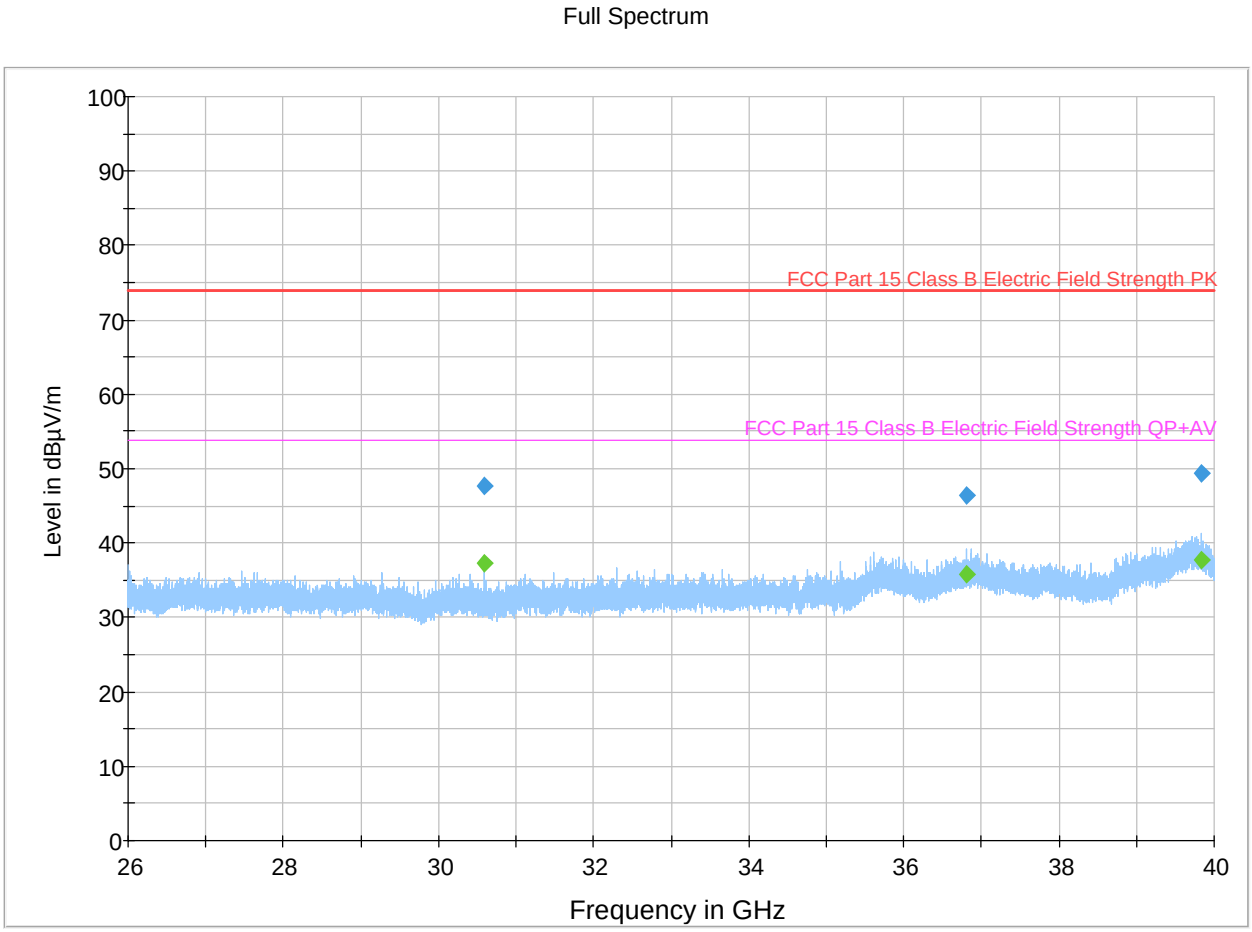


Figure 8.1.4: *Radiated spurious emissions, from 26 to 40 GHz*

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30599.933333	47.76	---	73.90	26.14	10.0	1000.000	132.6	V	283.0	8.1
30599.933333	---	37.35	53.90	16.55	10.0	1000.000	132.6	V	283.0	8.1
36813.133333	46.42	---	73.90	27.48	10.0	1000.000	175.0	V	144.0	12.9
36813.133333	---	35.86	53.90	18.04	10.0	1000.000	175.0	V	144.0	12.9
39832.000000	---	37.78	53.90	16.13	10.0	1000.000	175.0	V	14.0	15.7
39832.000000	49.40	---	73.90	24.50	10.0	1000.000	175.0	V	14.0	15.7

Table 8.1.6: *Radiated field strength measurement results (26 - 40 GHz)*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.
[4] The spectral plot is a summation of a vertical and horizontal scan.

8.1.7 Test data Radiated Emissions 30 MHz-26 GHz (W-CDMA & Wi-Fi 2.432 GHz signals)

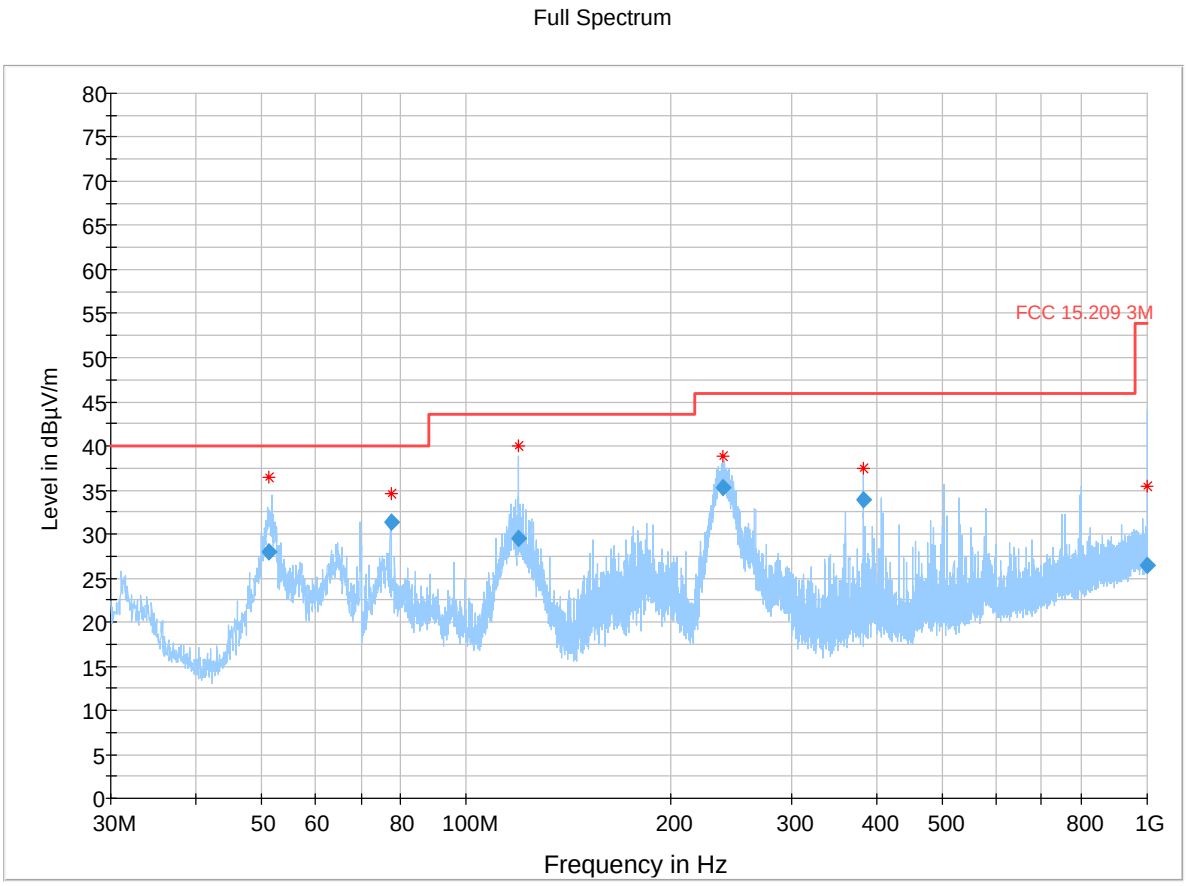


Table 8.1.5: *Radiated field strength measurement results (30 MHz -1000 MHz)*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
51.228000	27.95	40.00	12.05	5000.0	120.000	124.6	V	161.0	9.3
77.424500	31.30	40.00	8.70	5000.0	120.000	136.0	V	218.0	8.8
119.271500	29.47	43.50	14.03	5000.0	120.000	127.4	V	204.0	13.4
238.489500	35.28	46.00	10.72	5000.0	120.000	100.0	V	356.0	13.7
383.565000	33.91	46.00	12.09	5000.0	120.000	134.7	V	162.0	18.6
999.920000	26.52	53.90	27.38	5000.0	120.000	176.2	V	312.0	28.3

Table 8.1.7: *Radiated field strength measurement results (30 - 1000 MHz)*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.
[4] The spectral plot is a summation of a vertical and horizontal scan.

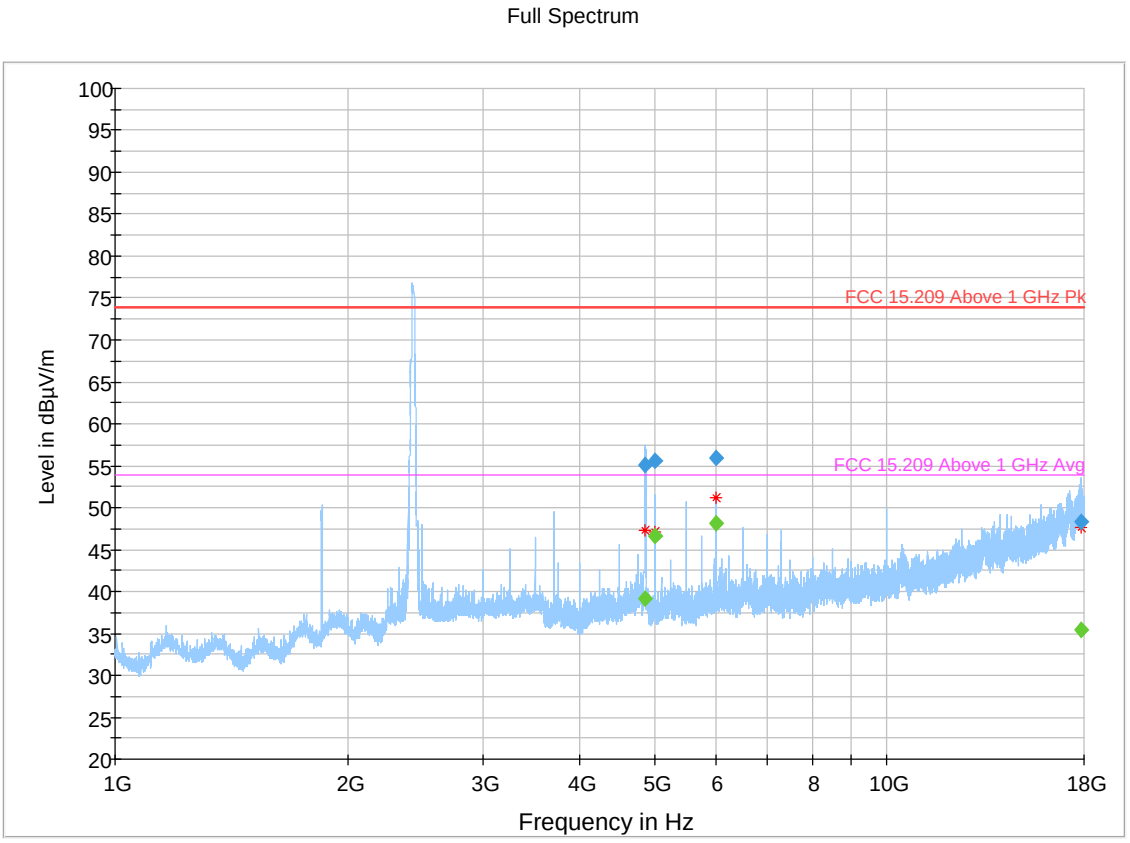


Figure 8.1.6: *Radiated spurious emissions, 1-18 GHz*

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)
4861.566667	---	39.07	53.90	14.83	5000.0	1000.000	218.6	H	0.0	-2.2
4861.566667	55.04	---	73.90	18.86	5000.0	1000.000	218.6	H	0.0	-2.2
5000.133333	55.55	---	73.90	18.35	5000.0	1000.000	100.0	V	342.0	-2.5
5000.133333	---	46.65	53.90	7.25	5000.0	1000.000	100.0	V	342.0	-2.5
5999.900000	---	48.18	53.90	5.72	5000.0	1000.000	142.3	V	60.0	-1.2
5999.900000	55.93	---	73.90	17.97	5000.0	1000.000	142.3	V	60.0	-1.2
17828.633333	48.29	---	73.90	25.61	5000.0	1000.000	114.7	V	242.0	13.2
17828.633333	---	35.36	53.90	18.54	5000.0	1000.000	114.7	V	242.0	13.2

Table 8.1.8: *Radiated field strength measurement results (1 -18 GHz)*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.
[4] The spectral plot is a summation of a vertical and horizontal scan.
[5] A 2.7 GHz High pass filter was used for the scan of 1-18GHz to avoid an PA overload.

8.1.7 Test data Radiated Emissions 30 MHz-26 GHz (W-CDMA & Wi-Fi 2.432 GHz signals), continued

Full Spectrum

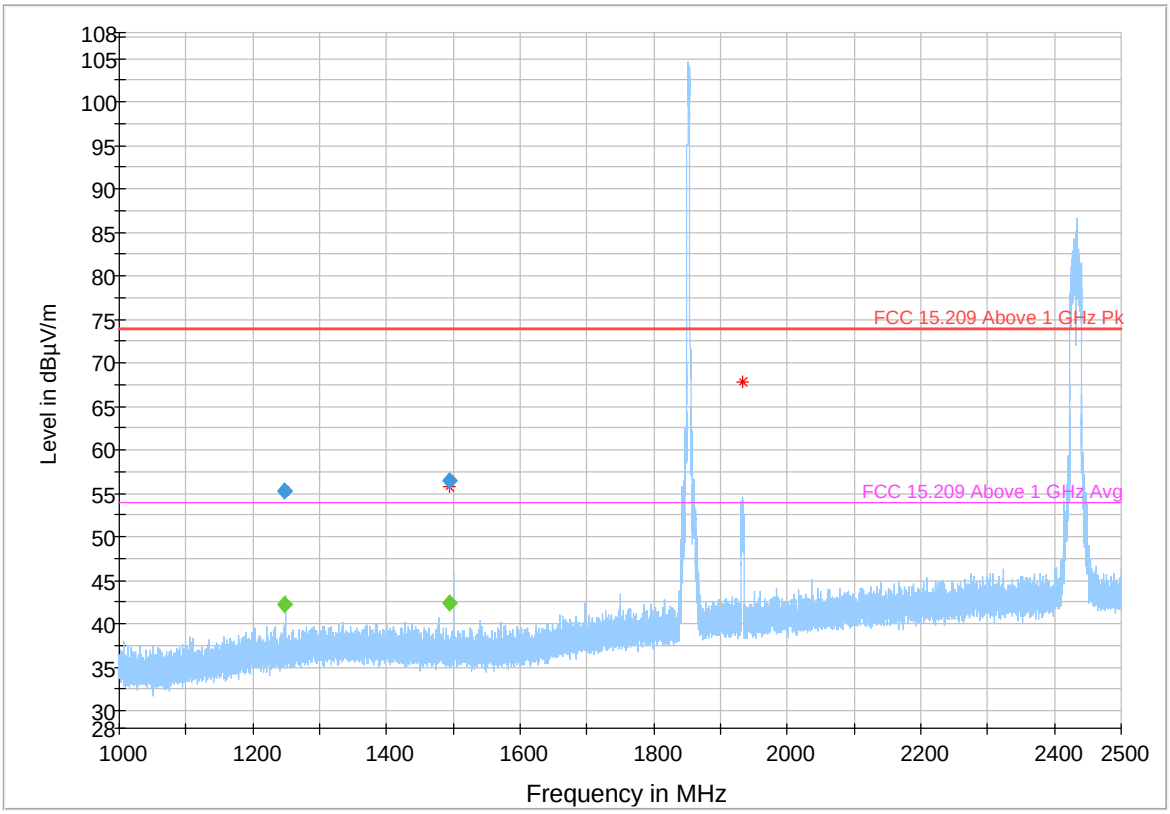


Figure 8.1.7: *Radiated spurious emissions, 1-2.5 GHz without power amplifier/high pass filter*

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)
1246.150000	---	42.26	53.90	11.64	5000.0	1000.000	214.2	H	310.0	33.0
1246.150000	55.32	---	73.90	18.58	5000.0	1000.000	214.2	H	310.0	33.0
1494.950000	---	42.46	53.90	11.44	5000.0	1000.000	211.8	H	252.0	33.0
1494.950000	56.55	---	73.90	17.35	5000.0	1000.000	211.8	H	252.0	33.0

Table 8.1.9: *Radiated field strength measurement results (1-2.5 GHz)*

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.
[4] The spectral plot is a summation of a vertical and horizontal scan.
[5] A 2.7 GHz high pass filter/PA were eliminated for the scan of 1-2.5 GHz.

Figure 8.1.10 *Radiated emissions setup from 30-1000 MHz*

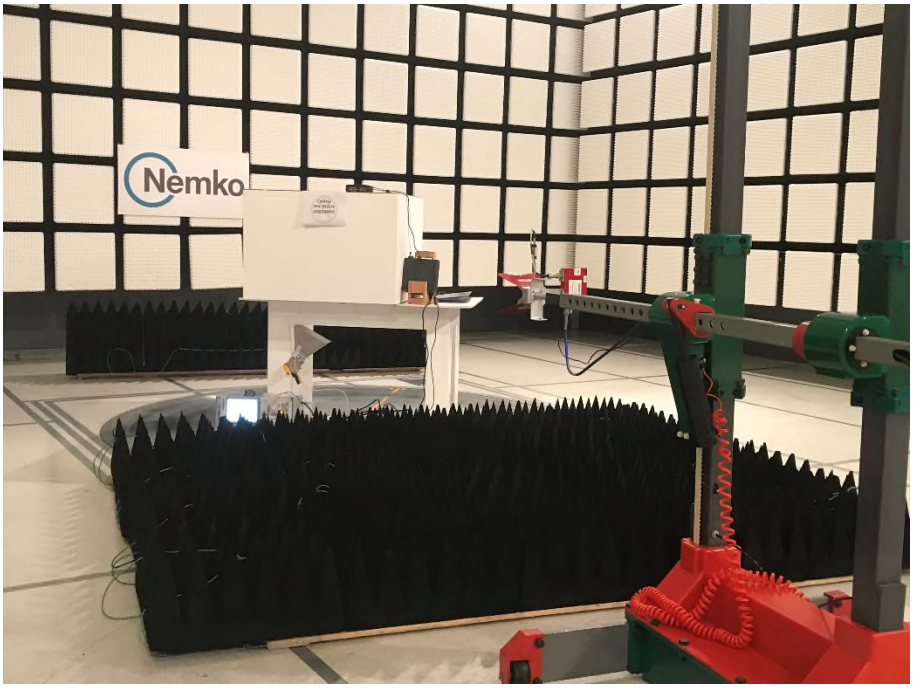


Figure 8.1.11 *Radiated emissions setup from 1-18 GHz*

8.1.8 Radiated Emissions Setup photos, continued

Figure 8.1.12 *Radiated emissions setup from 18 - 40 GHz*

8.2 Conducted limits.

8.2.1 References

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.207 / ANSI C63.4: 2014

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 µV within the frequency band 535-1705 kHz, as measured using a 50 µH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

8.2.2 8.2.2 Conducted Emissions Test summary

Verdict	Pass		
Test date	October 17, 2018	Temperature	23 °C
Test engineer	Martha Espinoza	Air pressure	1007 mbar
Test location	Ground Plane	Relative humidity	28 %

8.2.3 Notes

Two cases were object of study:
Case one. - LTE (Band 2) and Wi-fi (channel 40, 5.2 GHz).
Case two. - W-CDMA (Band 2) and Wi-fi (channel 5, 2.432 GHz) s
L1 and N measurements were done by separately for both cases.

8.2.4 Setup details

Port under test	DC Mains Input
EUT setup configuration	Table top
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver settings:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	– Peak and Average (Preview measurement) – Quasi-peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak and Average preview measurement) – 1000 ms (Quasi-peak final measurement) – 160 ms (CAverage final measurement)

Table 8.2-1: *Conducted disturbance at mains port equipment list*

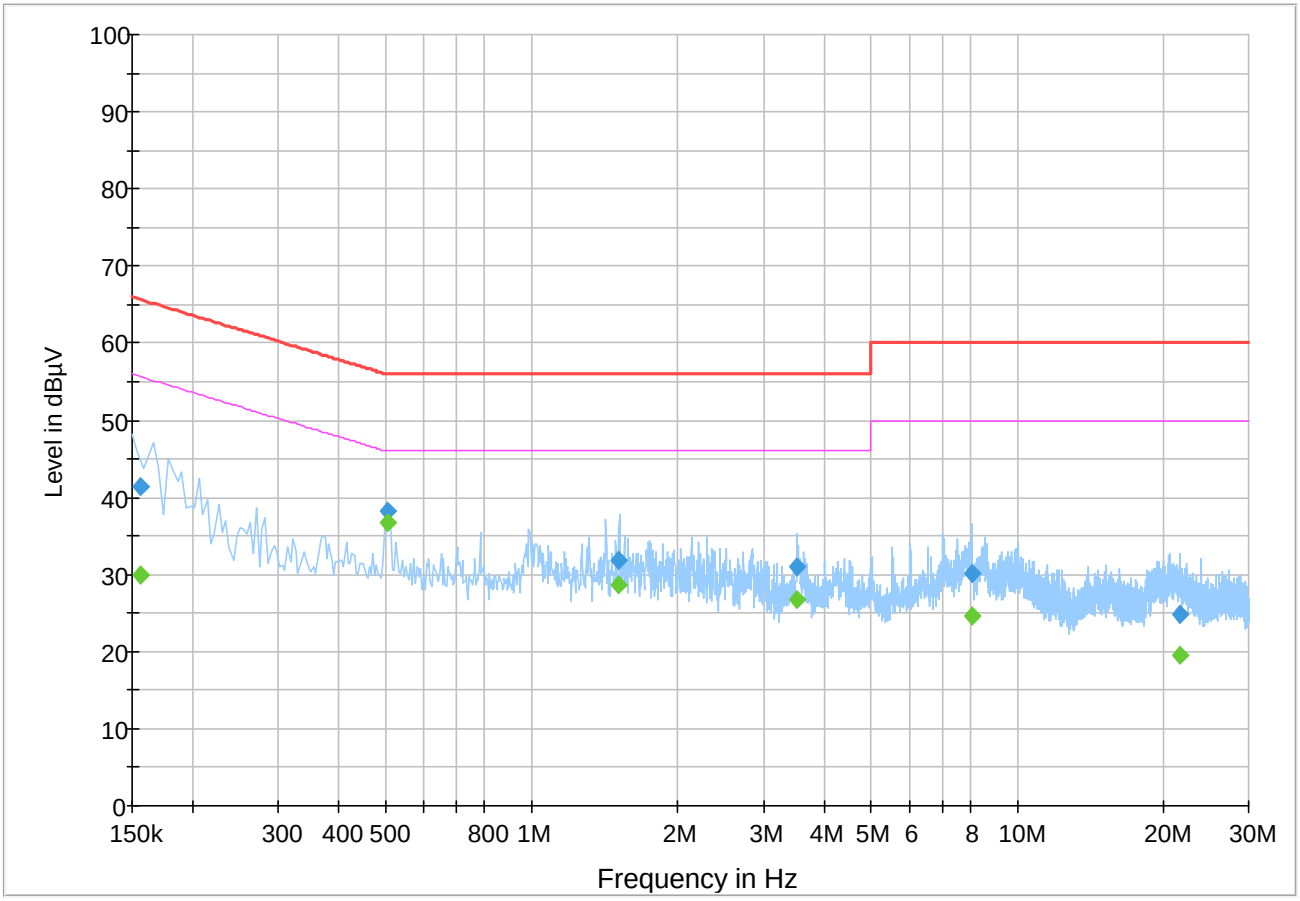
Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Test Receiver 9kHz to 7GHz	Rohde & Schwarz	ESCI 7	E1026	5/23/2017	5/23/2019
Two Line V-Network	Rohde & Schwarz	ENV216	E1019	6/27/2017	6/27/2019

Notes: None

Table 8.2-2: *Conducted disturbance at mains port test software details*

Manufacturer of Software	Details
Rohde-Schwarz	EMC 32 V10.0

Notes: None



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.2.1: *Conducted spurious emissions, from 0.150 – 30 MHz. Signals activates: LTE (Band 2) and Wi-Fi 5.2 GHz. Line 1 plot (L1)*

Table 8.2-3: *Conducted disturbance at DC mains results (Quasi-Peak and Average)*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.156500	---	29.97	55.65	25.68	5000.0	9.000	L1	ON	19.5
0.156500	41.44	---	65.65	24.20	5000.0	9.000	L1	ON	19.5
0.504500	---	36.66	46.00	9.34	5000.0	9.000	L1	ON	19.5
0.504500	38.22	---	56.00	17.78	5000.0	9.000	L1	ON	19.5
1.512500	---	28.74	46.00	17.26	5000.0	9.000	L1	ON	19.5
1.512500	31.90	---	56.00	24.10	5000.0	9.000	L1	ON	19.5
3.524500	---	26.85	46.00	19.15	5000.0	9.000	L1	ON	19.5
3.524500	30.98	---	56.00	25.02	5000.0	9.000	L1	ON	19.5
8.056500	---	24.62	50.00	25.38	5000.0	9.000	L1	ON	19.6
8.056500	30.22	---	60.00	29.78	5000.0	9.000	L1	ON	19.6
21.632500	---	19.49	50.00	30.51	5000.0	9.000	L1	ON	19.9
21.632500	24.94	---	60.00	35.06	5000.0	9.000	L1	ON	19.9

Notes:

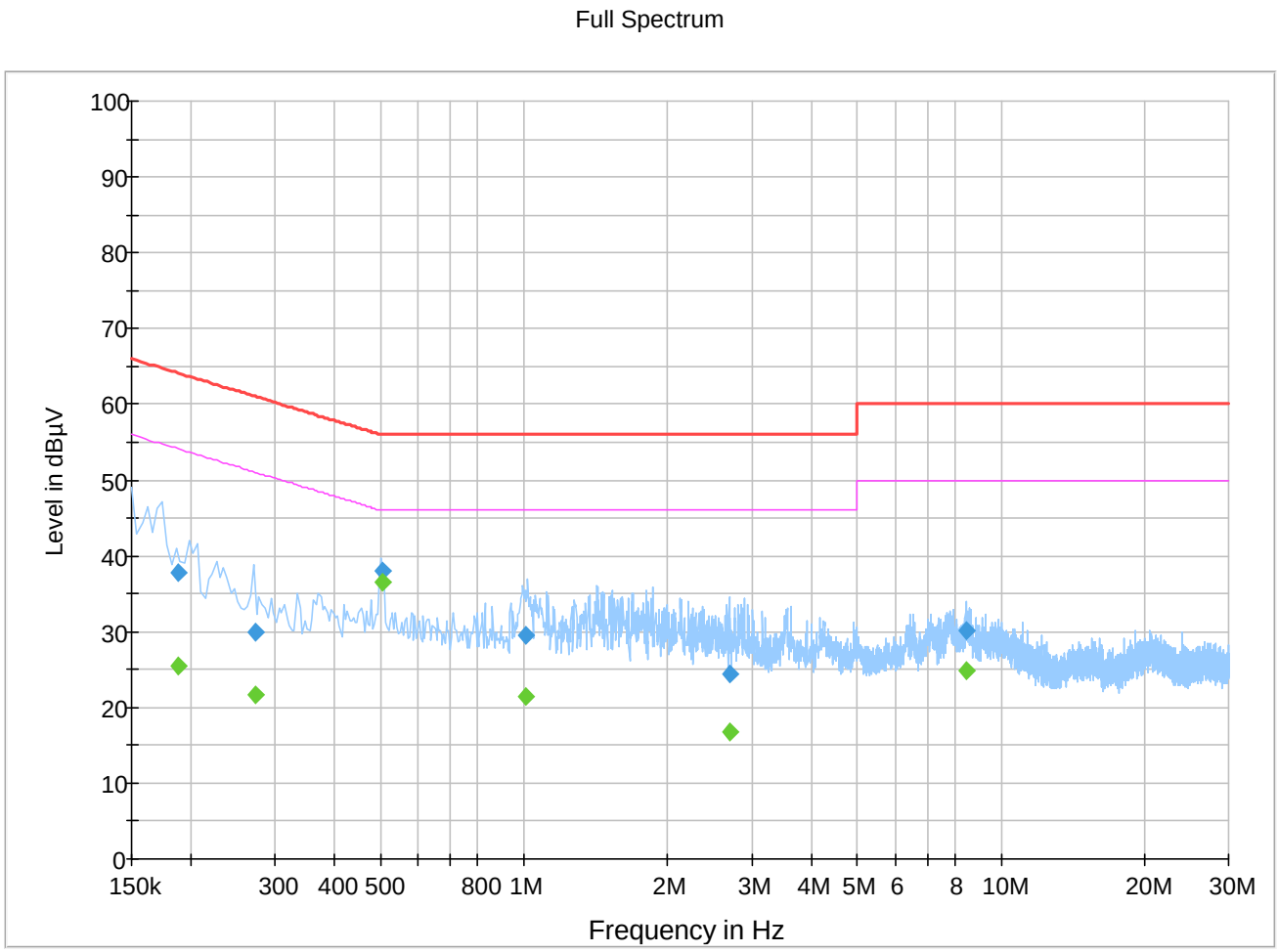
[1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

[3] The maximum measured value observed over a period of 15 seconds was recorded.

[4] As per KDB 174176 D01, EUT was tested with a dummy load in lieu of the antenna to determine compliance within the transmitter's fundamental emission band.

Sample calculation: 63.5 dBµV (result) = 44 dBµV (receiver reading) + 19.5 dB (Correction factor)



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.2.2: *Conducted spurious emissions, from 0.150 – 30 MHz. Signals activates: LTE (Band 2) and Wifi 5.2 GHz. Line N plot (N)*

Table 8.2-3: *Conducted disturbance at DC mains results (Quasi-Peak and Average)*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.187500	---	25.38	54.15	28.77	5000.0	9.000	N	ON	19.5
0.187500	37.85	---	64.15	26.29	5000.0	9.000	N	ON	19.5
0.272500	---	21.57	51.04	29.47	5000.0	9.000	N	ON	19.5
0.272500	29.98	---	61.04	31.07	5000.0	9.000	N	ON	19.5
0.504500	---	36.52	46.00	9.48	5000.0	9.000	N	ON	19.5
0.504500	38.06	---	56.00	17.94	5000.0	9.000	N	ON	19.5
1.004500	---	21.39	46.00	24.61	5000.0	9.000	N	ON	19.5
1.004500	29.56	---	56.00	26.44	5000.0	9.000	N	ON	19.5
2.692500	---	16.84	46.00	29.16	5000.0	9.000	N	ON	19.5
2.692500	24.51	---	56.00	31.49	5000.0	9.000	N	ON	19.5
8.436500	---	24.79	50.00	25.21	5000.0	9.000	N	ON	19.6
8.436500	30.10	---	60.00	29.90	5000.0	9.000	N	ON	19.6

Notes:

[1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

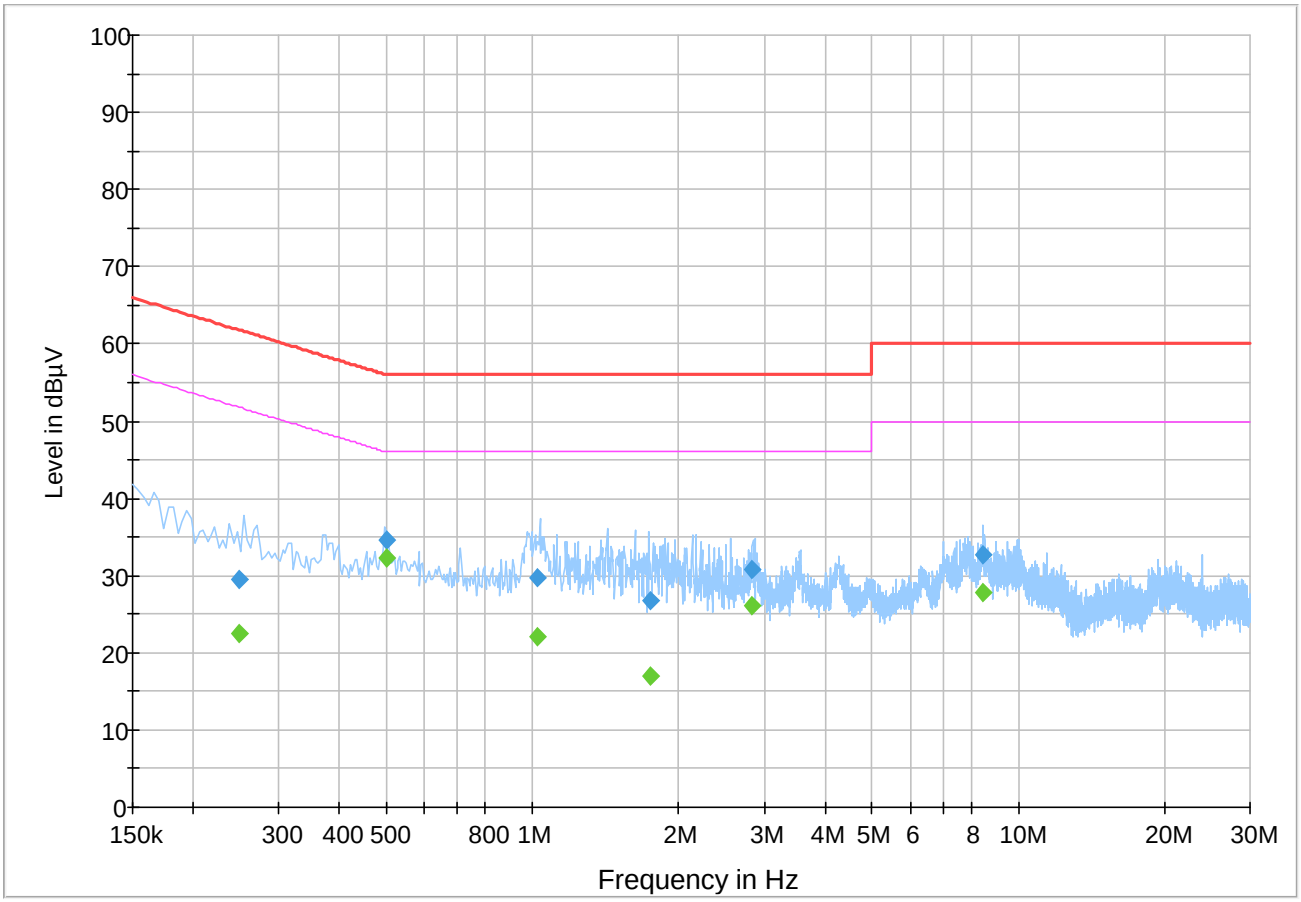
[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

[3] The maximum measured value observed over a period of 15 seconds was recorded.

[4] As per KDB 174176 D01, EUT was tested with a dummy load in lieu of the antenna to determine compliance within the transmitter's fundamental emission band.

Sample calculation: 63.5 dBµV (result) = 44 dBµV (receiver reading) + 19.5 dB (Correction factor)

Full Spectrum



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.2.3: *Conducted spurious emissions, from 0.150 – 30 MHz. Signals activates: W-CDMA (Band 2) and Wifi 2.432 GHz. Line 1 plot (L1)*

Table 8.2-4: *Conducted disturbance at DC mains results (Quasi-Peak and Average)*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.248500	---	22.58	51.81	29.22	5000.0	9.000	L1	ON	19.5
0.248500	29.55	---	61.81	32.26	5000.0	9.000	L1	ON	19.5
0.500500	---	32.26	46.00	13.74	5000.0	9.000	L1	ON	19.5
0.500500	34.66	---	56.00	21.34	5000.0	9.000	L1	ON	19.5
1.024500	---	22.18	46.00	23.82	5000.0	9.000	L1	ON	19.5
1.024500	29.75	---	56.00	26.25	5000.0	9.000	L1	ON	19.5
1.747500	---	16.97	46.00	29.03	5000.0	9.000	L1	ON	19.5
1.747500	26.85	---	56.00	29.15	5000.0	9.000	L1	ON	19.5
2.836500	---	26.09	46.00	19.91	5000.0	9.000	L1	ON	19.5
2.836500	30.72	---	56.00	25.28	5000.0	9.000	L1	ON	19.5
8.436500	---	27.77	50.00	22.23	5000.0	9.000	L1	ON	19.6
8.436500	32.71	---	60.00	27.29	5000.0	9.000	L1	ON	19.6

Notes:

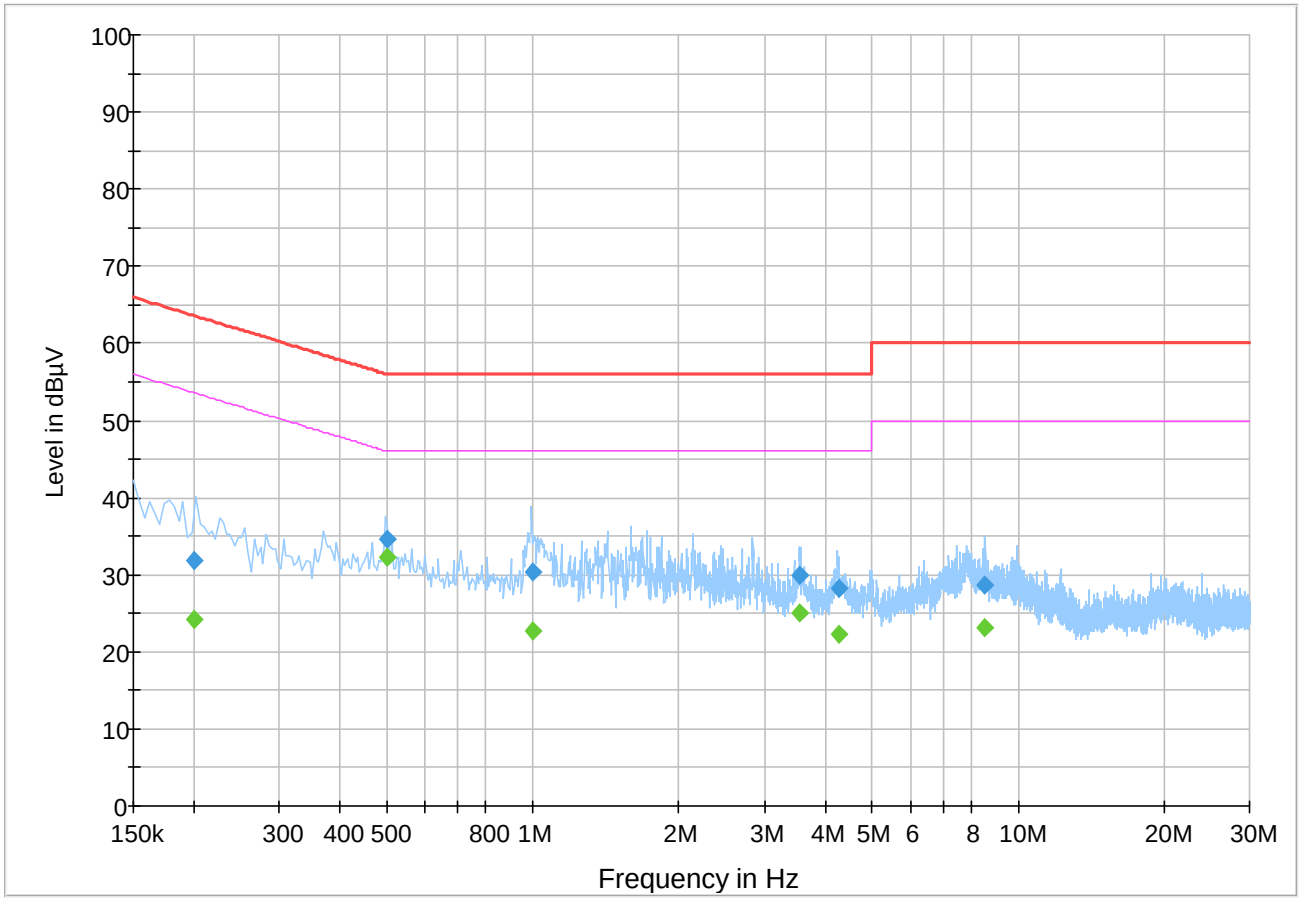
[1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

[3] The maximum measured value observed over a period of 15 seconds was recorded.

[4] As per KDB 174176 D01, EUT was tested with a dummy load in lieu of the antenna to determine compliance within the transmitter's fundamental emission band.

Sample calculation: 63.5 dBµV (result) = 44 dBµV (receiver reading) + 19.5 dB (Correction factor)



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.2.4: *Conducted spurious emissions, from 0.150 – 30 MHz. Signals activates: W-CDMA (Band 2) and Wifi 2.432 GHz. Line N plot (N)*

Table 8.2-5: *Conducted disturbance at DC mains results (Quasi-Peak and Average)*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.200500	---	24.19	53.59	29.40	5000.0	9.000	N	ON	19.5
0.200500	31.89	---	63.59	31.70	5000.0	9.000	N	ON	19.5
0.500500	---	32.19	46.00	13.81	5000.0	9.000	N	ON	19.5
0.500500	34.64	---	56.00	21.36	5000.0	9.000	N	ON	19.5
0.996500	---	22.70	46.00	23.30	5000.0	9.000	N	ON	19.5
0.996500	30.35	---	56.00	25.65	5000.0	9.000	N	ON	19.5
3.552500	---	25.13	46.00	20.87	5000.0	9.000	N	ON	19.5
3.552500	29.87	---	56.00	26.13	5000.0	9.000	N	ON	19.5
4.252500	---	22.37	46.00	23.63	5000.0	9.000	N	ON	19.5
4.252500	28.15	---	56.00	27.85	5000.0	9.000	N	ON	19.5
8.552500	---	23.09	50.00	26.91	5000.0	9.000	N	ON	19.6
8.552500	28.56	---	60.00	31.44	5000.0	9.000	N	ON	19.6

Notes:

[1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

[3] The maximum measured value observed over a period of 15 seconds was recorded.

[4] As per KDB 174176 D01, EUT was tested with a dummy load in lieu of the antenna to determine compliance within the transmitter's fundamental emission band.

Sample calculation: 63.5 dBµV (result) = 44 dBµV (receiver reading) + 19.5 dB (Correction factor)

8.2.6 Conducted Emissions Setup photos

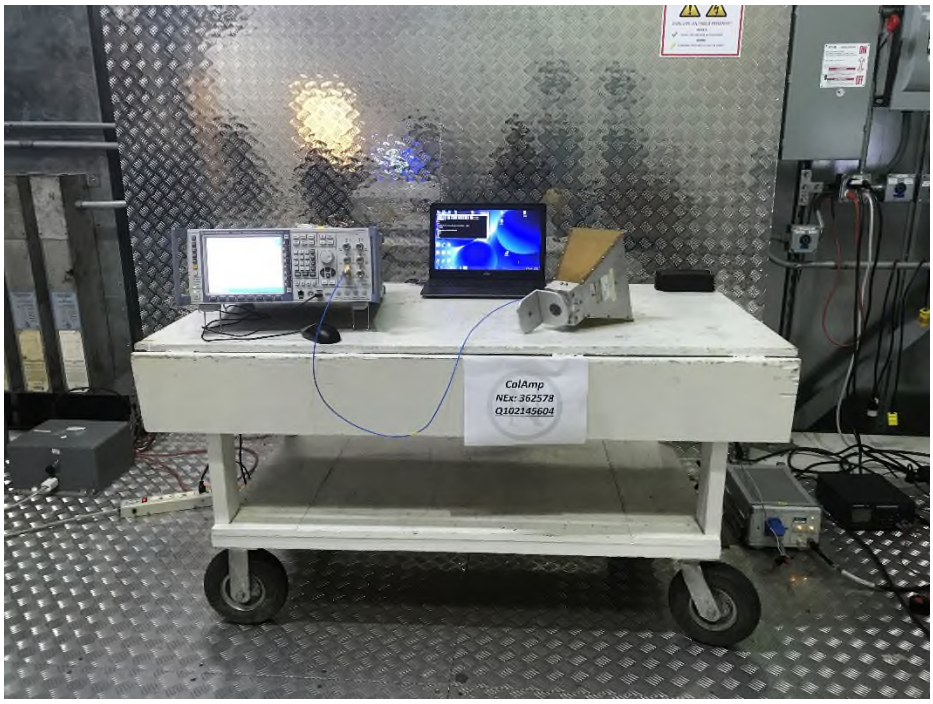


Figure 8.2.5 *Conducted disturbance at DC mains port setup photo*

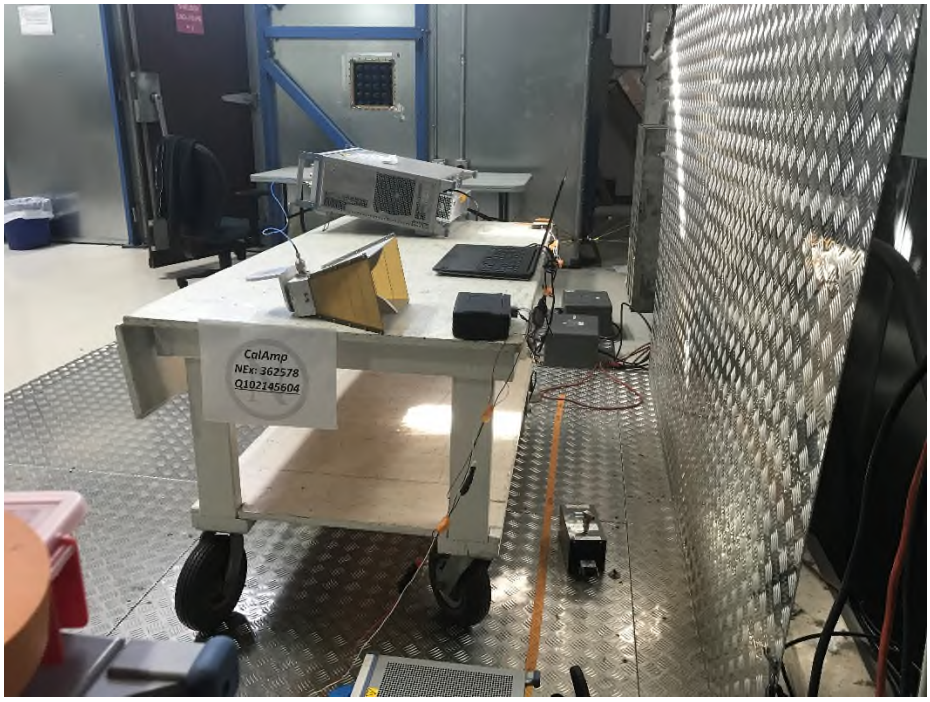
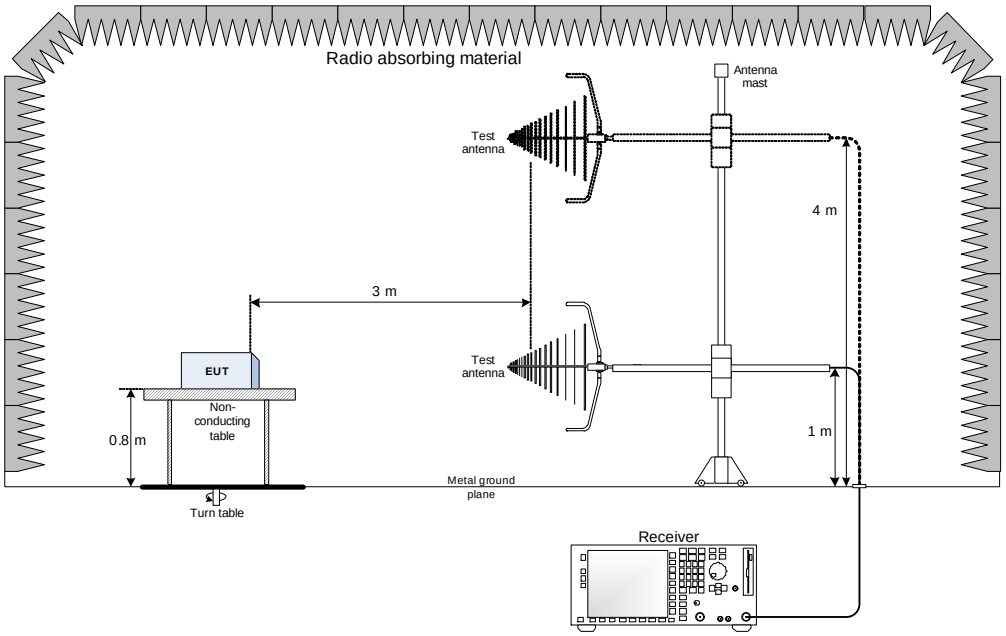


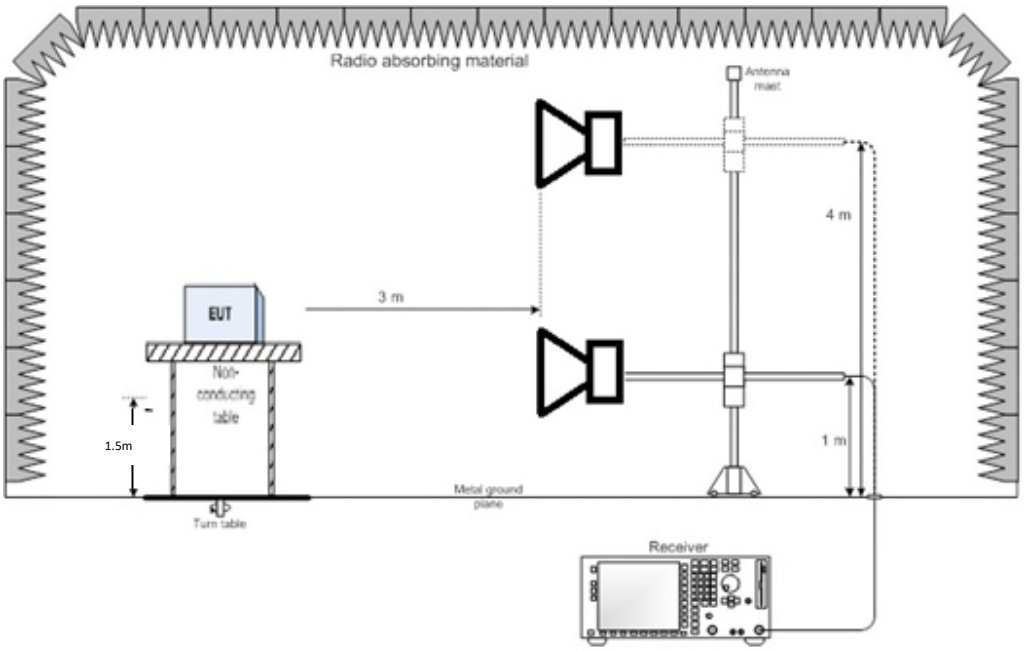
Figure 8.2.6 *Conducted disturbance at DC mains port setup photo*

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up

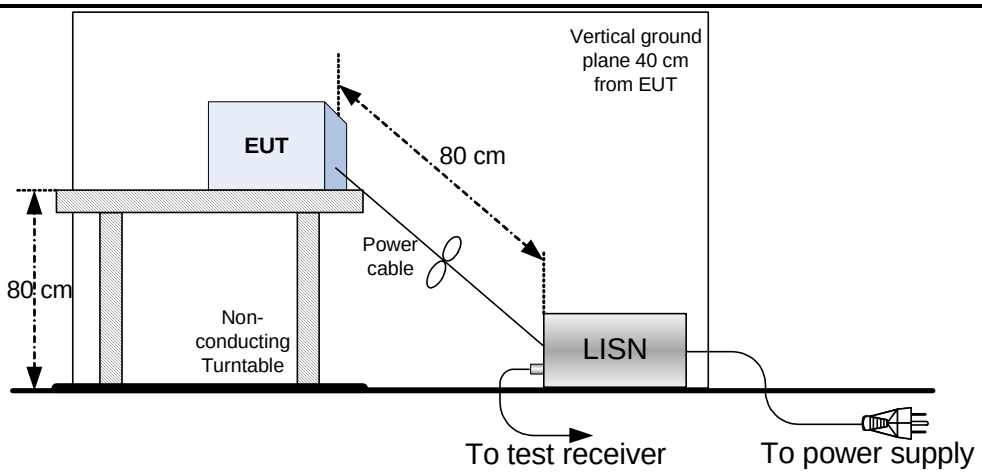


30-1000MHz Setup



Above 1GHz Setup

9.2 Conducted emissions set-up



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