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RADIO TEST REPORT

Report ID:
REP016362

Project number:
PRJ0041020

Type of assessment:
Class II Permissive Change

Type of radio equipment:
Spread Spectrum/Digital Device (902–928 MHz)

Equipment class:
DSS

Applicant:
Cooper Industries (Electrical) Inc.

Product marketing name (PMN):
XPD900

Model/HVIN:
TPCB-3612-01

FCC identifier:
FCC ID: IA9XPD900

ISED certification number:
IC: 1338B-XPD900

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247
- RSS-247, Issue 3, Aug 2023, Section 5

Date of issue: October 5, 2023

Sarveshkumar Patel, EMC/RF Specialist
Tested by


Signature

Fahar A Sukkoor , EMC/RF Specialist
Reviewed by


Signature

Lab locations

Company name	Nemko Canada Inc.		
Facilities	*Ottawa site:* 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	*Montréal site:* 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	*Cambridge site:* 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2 Tel: +1 519 650 4811

Test site identifier	**Organization**	**Ottawa**	**Montreal**	**Cambridge**
	FCC:	CA2040	CA2041	CA0101
	ISED:	2040A-4	2040G-5	24676
Website	www.nemko.com			

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
RSS-247, Issue 3, Aug 2023, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.2 Test methods

558074 D01 15.247 Meas Guidance v05r02 (April 2, 2019)	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.
DA 00-705, Released March 30, 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
RSS-Gen, Issue 5, April 2018	General Requirements for Compliance of Radio Apparatus
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.3 Exclusions

Partial testing was performed on the product with the transmitter operating to confirm that after the change in the product it still meets the FCC and ISED requirements. This investigation of the final product was done by spot checking emissions, output power and spectral density from the device while operating the host as a composite system.

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.
Determining compliance is based on the results of the compliance measurement, not taking into account measurement uncertainty, in accordance with section 1.3 of ANSI C63.10 v2013.

See "Summary of test results" for full details.

1.5 Test report revision history

Table 1.5-1: Test report revision history

Revision #	Date of issue	Details of changes made to test report
REP016362	October 5, 2023	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

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

2.2 Technical judgment

This test report covers only partial testing of unit for C2PC change in reference to original report "11356-1E" FCC ID: IA9XPD900 and IC: 1338B-XPD900 for the following reasons:

1) To add the two new antennas (6 variants total) listed in section 4.4 to the existing approved antenna.
2) The new module is now using a new firmware which causes change in duty cycle.
3) The same PCB matching circuit components are used on the Antenna R270 Rev.3 [PCB- 3958R03] and R270 Rev.4 [FPCB- 3958R04] and as a result testing is performed on only R270 Rev.4 [FPCB- 3958R04] for both variants.

The following test are performed for the assessment:

- Output power
- Occupied bandwidth
- Duty Cycle
- Time of occupancy
- Radiated Spurious emissions.

All the emissions plots for Antenna R270 Rev 4, R260 Rev 7 and R260 Rev 13 are the test data with the back metal plates attached to it. And for the worst-case antenna (R260 Rev 13), testing was also performed to verify that they are compliant with or without the metal plate attached. Form the results it observed that the antennas are compliant and can be used in both configurations i.e., with the plate or without the plate.

2.3 Model variant declaration

There were no model variants declared by the applicant.

2.4 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 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 4 Information provided by the applicant

4.1 Disclaimer

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

4.2 Applicant / Manufacturer

Applicant name	Cooper Industries (Electrical) Inc.
Applicant address	74-1833 Coast Meridian Rd., Port Coquitlam, BC, V3C 6G5, Canada
Manufacturer name	Same as applicant
Manufacturer address	Same as applicant

4.3 EUT information

Product name (PMN)	XPD900
Product description	900 MHz Data Transceiver Module
Model / HVIN	TPCB-3612-01
Serial number	1E162921
Power supply requirements	3.3 to 6.5V_{DC}, (typically 5 V_{DC})
Product description and theory of operation	This is a 900 MHz FHSS radio transceiver module. It is used in Eaton host devices (wireless remote-control devices) to provide wireless control or monitoring of industrial equipment. The host devices can be mobile or portable devices.
Software details	363001R48762

4.4 Radio technical information

Category of Wideband Data Transmission equipment	☒ Frequency Hopping Spread Spectrum (FHSS) equipment ☐ Other types of Wideband Data Transmission equipment (e.g. DSSS, OFDM, etc.).
Frequency band	902–928 MHz
Frequency Min	902.2 MHz
Frequency Max	927.7 MHz
Type of modulation	2FSK
Emission classification	24K5F1D
RF power Max (W), Conducted	0.076 (18.82 dBm)
Transmitter spurious, dBµV/m @ 3 m	[TD3100 Rev 4] High Channel, Peak: 60.71 dBµV/m, Calculated Average: 43.64 dBµV/m

Antenna information

Antenna Mfg.	Mfg. Part Number	Antenna Type	Antenna Gain (dBi)	Antenna Connector Type	Host Product	Host PCB
Linx	ANT-916-uSP	1/4 λ monopole	0.3	SMT soldered on PCB	TD1141 Rev.4	FPCB-4053R04
Linx	ANT-916-uSP	1/4 λ monopole	0.3	SMT soldered on PCB	TD3100 Rev.4	FPCB-3875R04
Eaton/Cooper Industries (Electrical) Inc.	ACAB-2683-07	1/4 λ monopole	2.54	Soldered to PTH on PCB	R260 Rev.7	FPCB-3375R07
Eaton/Cooper Industries (Electrical) Inc.	ACAB-2683-07	1/4 λ monopole	2.54	Soldered to PTH on PCB	R260 Rev.13	FPCB-3375R13
Eaton/Cooper Industries (Electrical) Inc.	ACAB-2683-07	1/4 λ monopole	2.54	Soldered to PTH on PCB	R270 Rev.3	FPCB-3958R03
Eaton/Cooper Industries (Electrical) Inc.	ACAB-2683-07	1/4 λ monopole	2.54	Soldered to PTH on PCB	R270 Rev.4	FPCB-3958R04

4.5 EUT setup details

4.5.1 Radio exercise details

Operating conditions	Laptop was connected to EUT using USB to RS-232 dongle. Tera Term was used to set the EUT to transmit in different channels and mode through set of commands.
Transmitter state	Transmitter was set to transmit continuously on a specific channel (with typical FSK modulation).

4.5.2 EUT setup configuration

Table 4.5-1: Support equipment

Description	Brand name	Model, Part number, Serial number, Revision level
Radio Module development board	Eaton	PN: FPCB3498R01
Laptop	Dell	MN: E7470, SN: 1PN6Q72

Table 4.5-2: Inter-connection cables

Cable description	From	To	Length (m)
RS-232 to USB cable	Radio Module development board	Laptop	2
Unshielded twisted power cable	Radio Module development board	Power supply	1.5

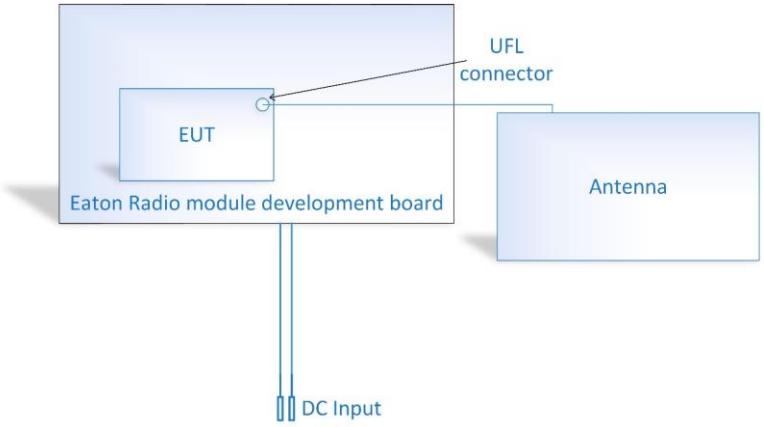


Figure 4.5-1: Radiated testing block diagram

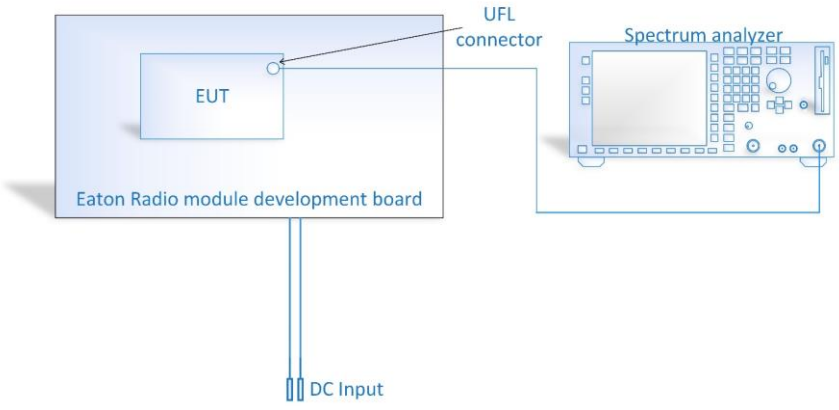


Figure 4.5-2: Antenna port testing block diagram

Section 5 Summary of test results

5.1 location

Test location (s)	Ottawa

5.2 Testing period

Test start date	August 24, 2023	Test end date	September 1, 2023

5.3 Sample information

Receipt date	August 18, 2023	Nemko sample ID number(s)	PRJ0041020001

5.4 FCC test results

Table 5.4-1: FCC requirements results

Part	Test description	Verdict
Generic requirements		
§15.247(d)	Spurious emissions	Pass
FHSS specific requirements		
§15.247(a)(1)(i),	Requirements for operation in the 902–928 MHz band	Pass
§15.247(b)(2)(4),	Maximum peak output power in the 902–928 MHz band	Pass

Notes: As per the requirements of C2PC, only the required tests are performed

Table 5.4-2: ISED requirements results

Part	Test description	Verdict
Generic requirements		
RSS-247, 5.5	Unwanted emissions	Pass
FHSS specific requirements		
RSS-247, 5.1 (c)	Number of hopping channels, dwell time and occupied channel bandwidth in the 902–928 MHz band	Pass
RSS-247, 5.4 (a)	Transmitter output power requirements in the 902–928 MHz band	Pass

Notes: As per the requirements of C2PC, only the required tests are performed

Section 6 Test equipment

6.1 Test equipment list

Table 6.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	January 19, 2024
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
61505 source	Chroma	61509	FA003036	—	VOU
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	March 2, 2024
Horn (1–18 GHz)	ETS Lindgren	3117	FA002840	1 year	March 7, 2024
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	November 18, 2023
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	March 7, 2024
50 Ω coax cable	Carlisle	WHU18-1818-072	FA002391	1 year	October 17, 2023
Spectrum analyzer	Rohde & Schwarz	FSV 40	FA002731	1 year	March 2, 2024

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

Table 6.1-2: *Automation software details*

Test description	Manufacturer of Software	Details
Radiated spurious emissions	Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 11.20.00

Table 6.1-3: Measurement uncertainty calculations based on equipment list

Measurement	U_{cispr} dB	U_{lab} dB
Radiated spurious emissions (30 MHz to 1 GHz)	6.3	5.8
Radiated spurious emissions (1 GHz to 6 GHz)	5.2	4.7
Radiated spurious emissions (6 GHz to 10 GHz)	5.5	5.0
Other antenna port measurements	-	0.55

Notes: UKAS Lab 34, TIA-603 and ETSI TR 100 028-1&2 have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Section 7 Testing data

7.1 Transmitter output power requirements for FHSS 900 MHz

7.1.1 References, definitions and limits

FCC §15.247:

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

(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(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.

7.1.2 Test summary

Verdict	Pass		
Test date	September 1, 2023	Temperature	22 °C
Tested by	Sarveshkumar Patel	Air pressure	1035 mbar
Test location	Ottawa	Relative humidity	66 %

7.1.3 Observations, settings and special notes

- Conducted output power was tested per ANSI C63.10 subclause 7.8.5. The hopping shall be disabled for this test.
- Output power measurements were performed to see that it is similar to previous assessment and eligible for C2PC testing.
- Spectrum analyser settings:

Resolution bandwidth	> 20 dB bandwidth of the emission being measured
Video bandwidth	≥ RBW
Frequency span	approximately 5 times the 20 dB bandwidth, centered on a hopping channel
Detector mode	Peak
Trace mode	Max Hold

7.1.4 Test data

Table 7.1-1: Output power results

Frequency, MHz	Output power, dBm	Output power limit, dBm	Margin, dB
902.2	18.82	30.00	11.18
915.0	18.60	30.00	11.40
927.7	18.41	30.00	11.59

Notes: None

Test data, continued

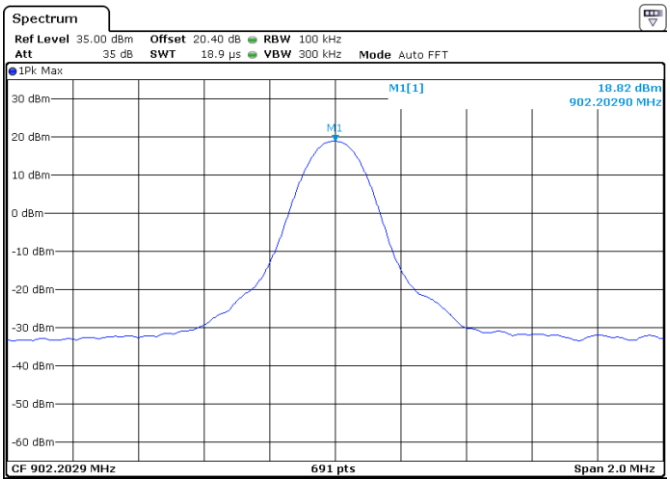


Figure 7.1-1: Output power on low channel

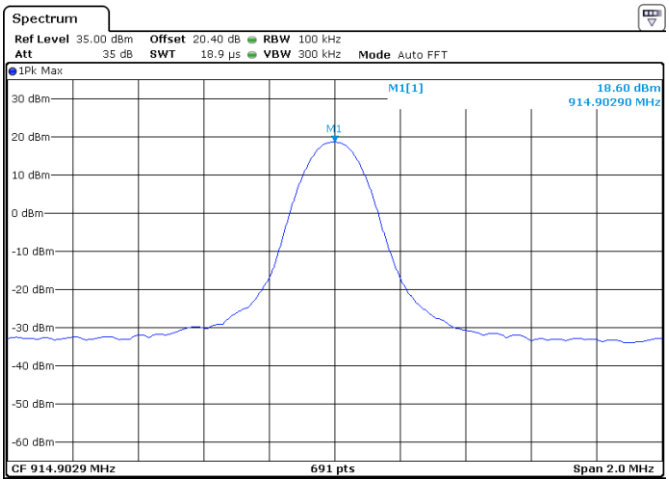


Figure 7.1-2: Output power on mid channel

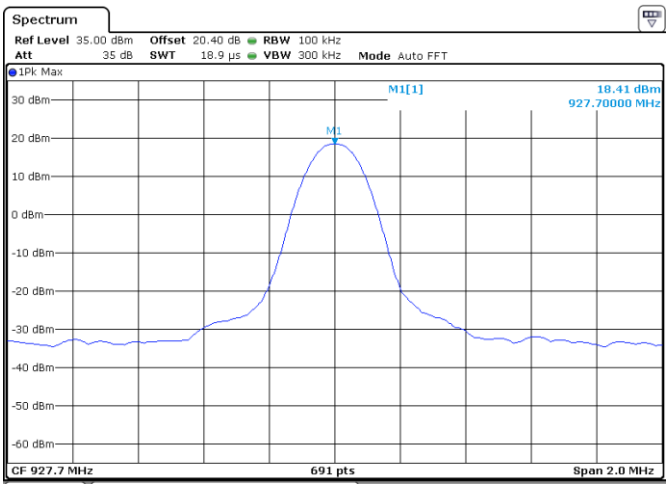


Figure 7.1-3: Output power on high channel

7.2 Frequency Hopping Systems requirements, 900 MHz operation

7.2.1 References, definitions and limits

FCC §15.247:

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Table 7.2-1: Summary of the basic requirements

$P_{max\text{-}pk} \leq 1$ W
$N_{ch} \geq 50$
$\Delta f \geq$ MAX { 25 kHz, $BW_{20\ dB}$ }
max. $BW_{20\ dB} < 250$ kHz
$t_{ch} \leq 0.4$ s for 20 seconds

Note: t_{ch} = average time of occupancy; T = period; N_{ch} = # hopping frequencies; BW = bandwidth; Δf = hopping channel carrier frequency separation

RSS-247, Clause 5.1:

a. The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system's radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

b. FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

c. For FHSs in the band 902–928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10‑second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

RSS-247, Clause 5.4:

a. For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

7.2.2 Test summary

Verdict	Pass		
Test date	September 1 & 18, 2023	Temperature	22 & 21°C
Tested by	Sarveshkumar Patel	Air pressure	1035 & 1025 mbar
Test location	Ottawa	Relative humidity	65 & 58 %

7.2.3 Observations, settings and special notes

Number of hopping frequencies was tested per ANSI C63.10 subclause 7.8.3. Spectrum analyser settings:

Resolution bandwidth	To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
Video bandwidth	≥ RBW
Frequency span	The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
Detector mode	Peak
Trace mode	Max Hold

Time of occupancy (dwell time) was tested per ANSI C63.10 subclause 7.8.4. Spectrum analyser settings:

Resolution bandwidth	1 MHz
Video bandwidth	≥ RBW
Frequency span	Zero span, centered on a hopping channel.
Detector mode	Peak
Trace mode	Max Hold

20 dB bandwidth was tested per ANSI C63.10 subclause 6.9.2. Spectrum analyser settings:

Resolution bandwidth	≥ 1–5% of the 20 dB bandwidth
Video bandwidth	≥ RBW
Frequency span	approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel
Detector mode	Peak
Trace mode	Max Hold

7.2.4 Test data

Table 7.2-2: *Number of hopping frequencies results*

Number of hopping frequencies	Minimum limit
63	50

Table 7.2-3: Average time of occupancy results

Dwell time of each pulse, ms	Number of pulses within period	Total dwell time within period, ms	Limit, ms	Margin, ms
14.05	12	168.6	400	231.4

Notes: Measurement Period is 20 s

Table 7.2-4: 20 dB bandwidth results

Frequency, MHz	20 dB bandwidth, kHz
902.2	23.37

Table 7.2-5: 99% occupied bandwidth results

Frequency, MHz	99% occupied bandwidth, kHz
902.2	22.7

Notes: There is no 99% occupied bandwidth limit in the standard's requirements the measurement results provided for information purposes only.

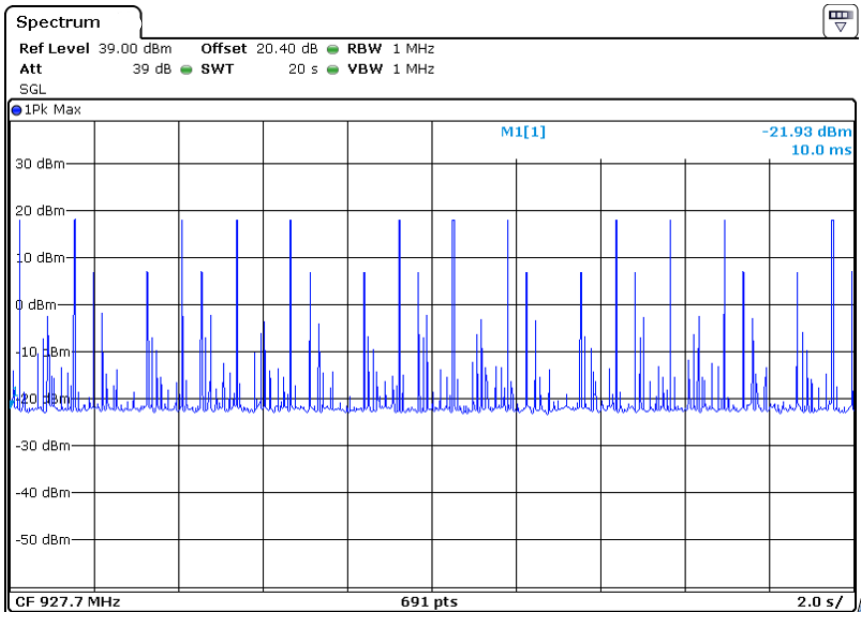


Figure 7.2-1: Dwell time (Number of hops within 20 s period)

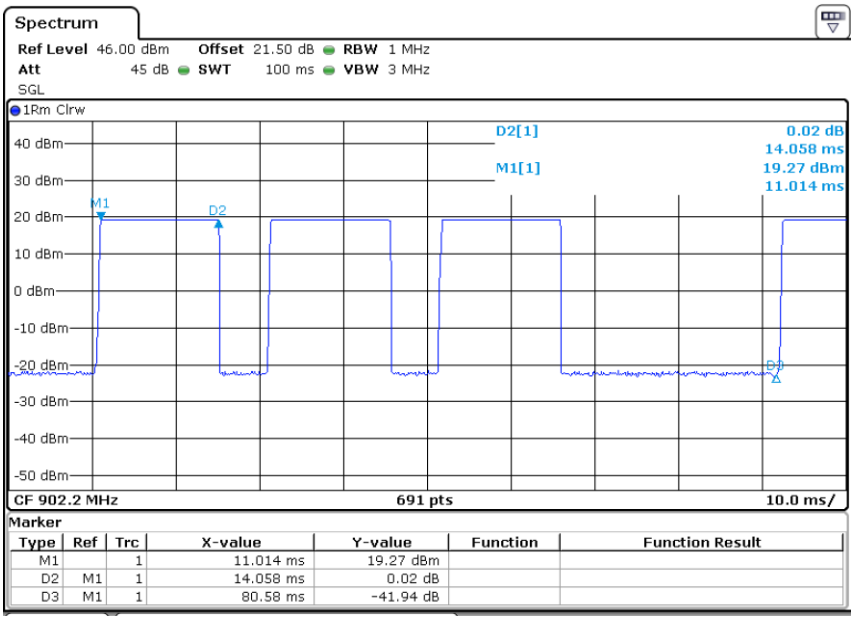


Figure 7.2-2: Single pulse width

Note: With Hopping on a single low channel (to see worst case duty cycle)
Single Pulse width in this mode is same as Typical or worst-case operational hopping mode.
Duty cycle calculation: [(3x14.058)/80.58]x100 = 52.34%

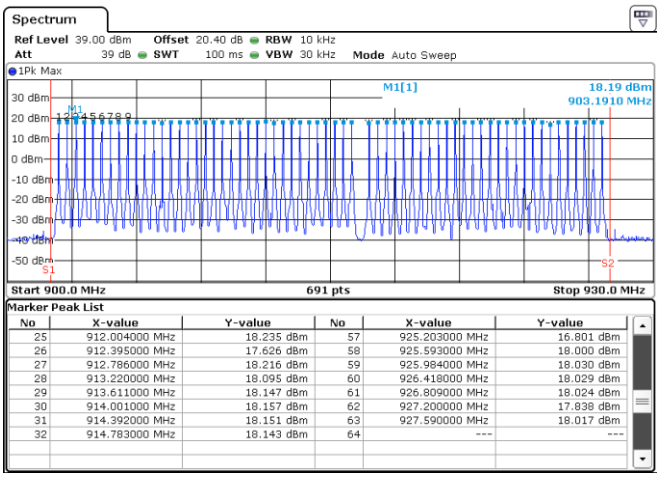


Figure 7.2-3: Number of hopping channels [63 channels]

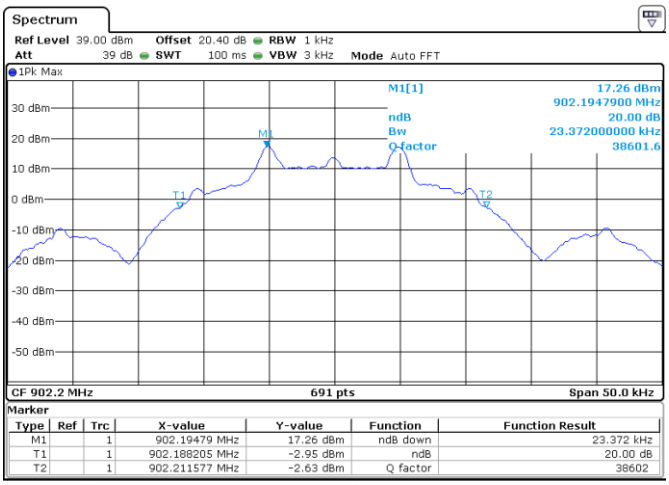


Figure 7.2-4: 20 dB bandwidth on low channel

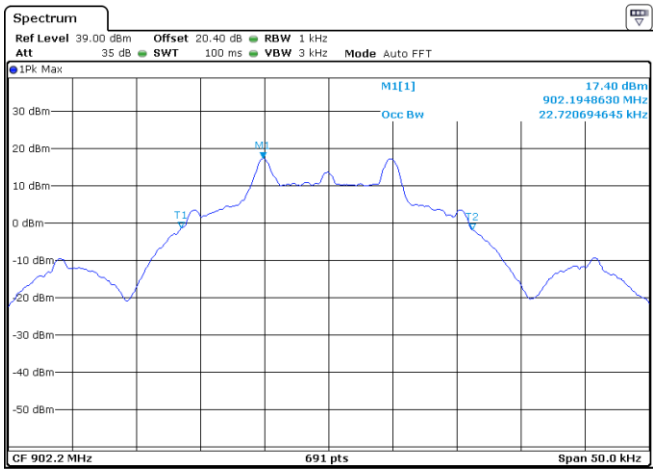


Figure 7.2-5: 99% Occupied bandwidth on low channel

7.3 Spurious (out-of-band) unwanted emissions

7.3.1 References, definitions and limits

FCC §15.247:

(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, Clause 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.

RSS-Gen:

8.9 Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table below.

8.10 Restricted frequency bands are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. The following conditions related to the restricted frequency bands apply:

a The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands.

b Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table below.

c Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in table below.

Table 7.3-1: FCC §15.209 and RSS-Gen – Radiated emission limits

	Field strength of emissions		
Frequency, MHz	**µV/m**	**dBµV/m**	**Measurement distance, 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.

References, definitions and limits, continued

Table 7.3-2: ISED restricted frequency bands

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

Note: Certain frequency bands listed in Table 7.3-2 and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

Table 7.3-3: FCC restricted frequency bands

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

7.3.2 Test summary

Verdict	Pass		
Test date	August 24 & 28, 2023	Temperature	22 & 23 °C
Tested by	Sarveshkumar Patel	Air pressure	1015 & 1035 mbar
Test location	Ottawa	Relative humidity	60 & 65 %

7.3.3 Observations, settings and special notes

- As part of the current assessment, the test range of 9 kHz to 10 GHz has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the GHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.
- EUT was set to transmit in to transmit continuously on a specific channel (with typical FSK modulation).
- Radiated measurements were performed at a distance of 3 m.
- Average was calculated from peak results using duty cycle correction factor (DCCF).
- Pulse width = 14 ms, Pulse repetition = 1 every 100 ms DCCF = $20 \times \text{Log}_{10}((14 \times 1) / 100) = -17.07$ dB
- All the emissions plots for Antenna R270 Rev 4, R260 Rev 7 and R260 Rev 13 are the test data with the back metal plates attached to it. And for the worst-case antenna (R260 Rev 13), testing was also performed to verify that they are compliant with or without the metal plate attached. Plots for the same are also attached with appropriate label.

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

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

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

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

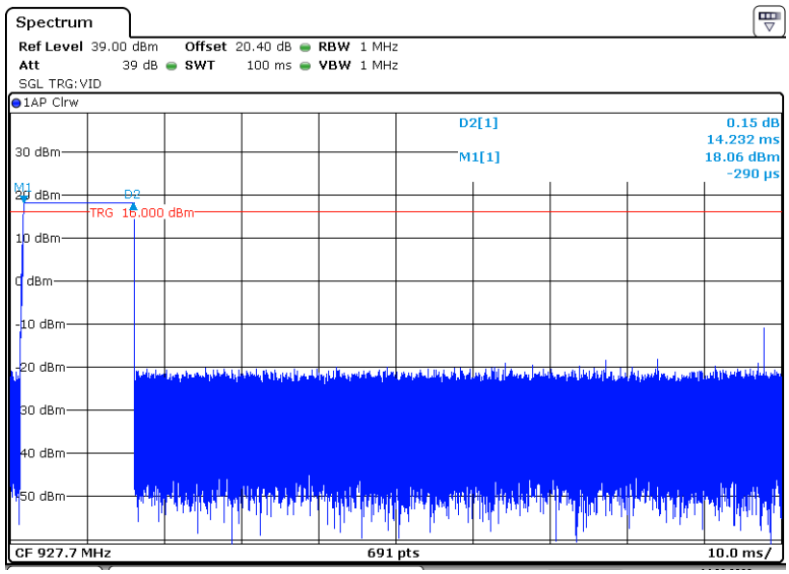


Figure 7.3-1: Pulse width measurements plot within 100 ms in Typical operational hopping mode

Note

7.3.4 Test data

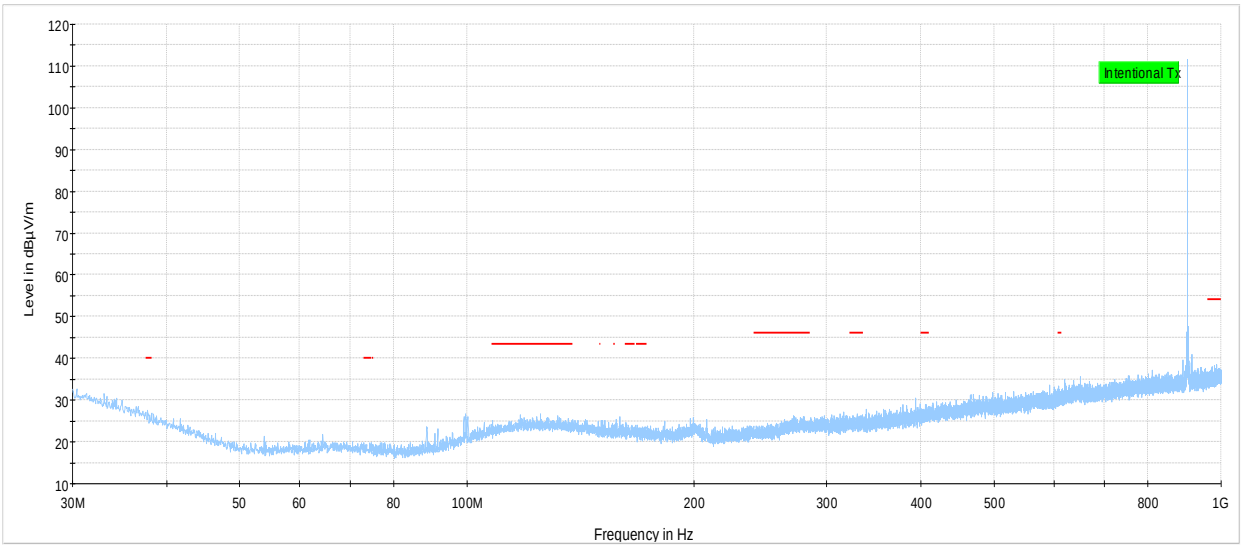


Figure 7.3-2: Radiated spurious emissions 30-1000 MHz Low channel [R260 Rev 7 - with Metal plate]

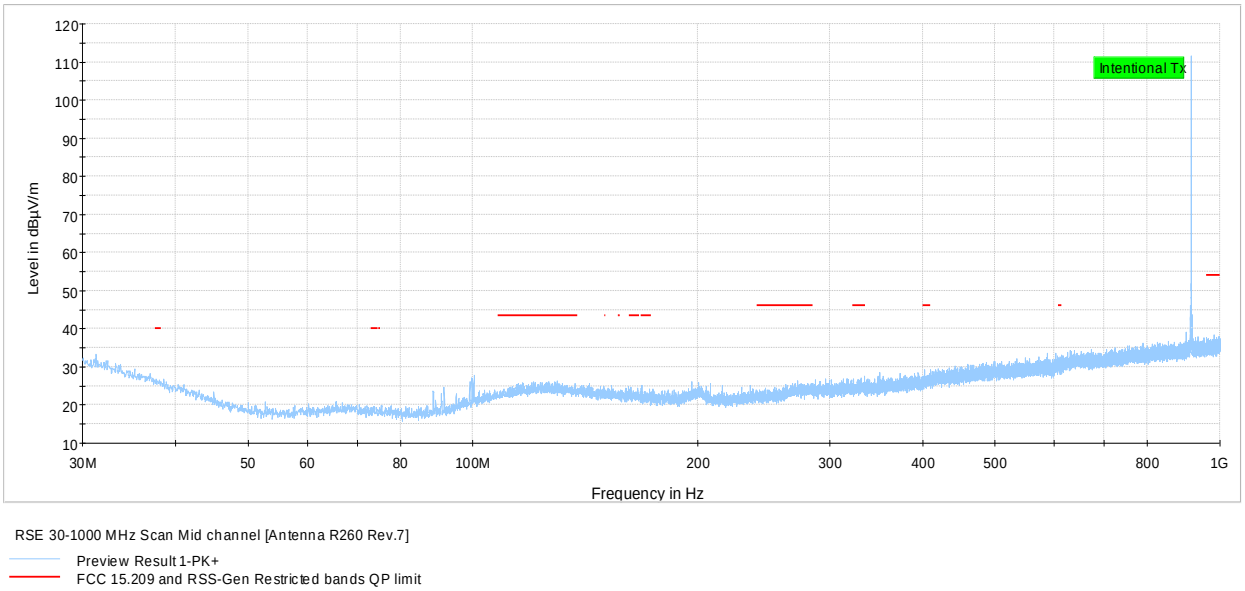


Figure 7.3-3: Radiated spurious emissions 30-1000 MHz Mid channel [R260 Rev 7 - with Metal plate]

Test data, continued

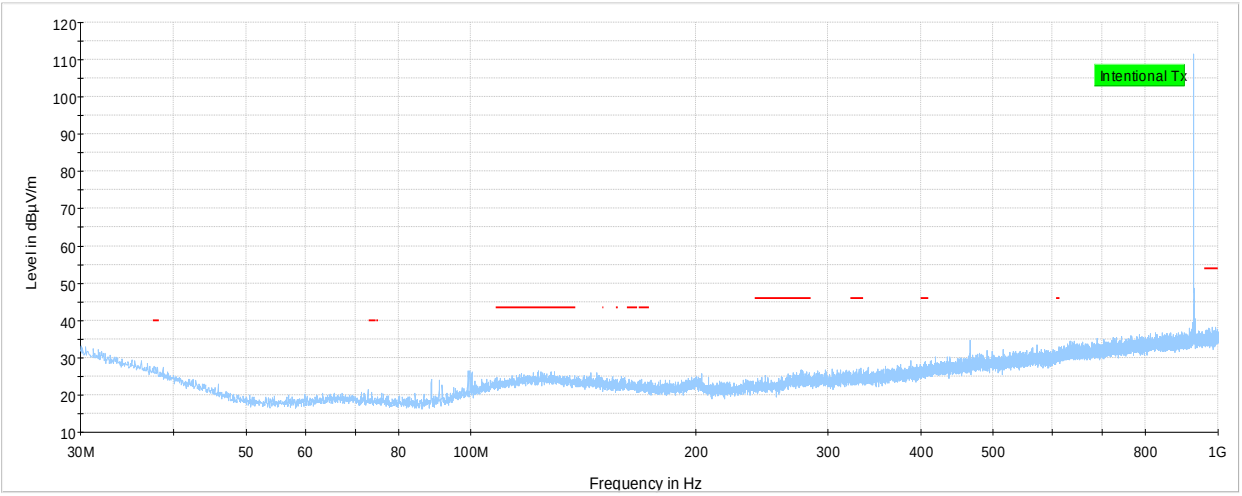


Figure 7.3-4: Radiated spurious emissions 30-1000 MHz High channel [R260 Rev 7 - with Metal plate]

Test data, continued

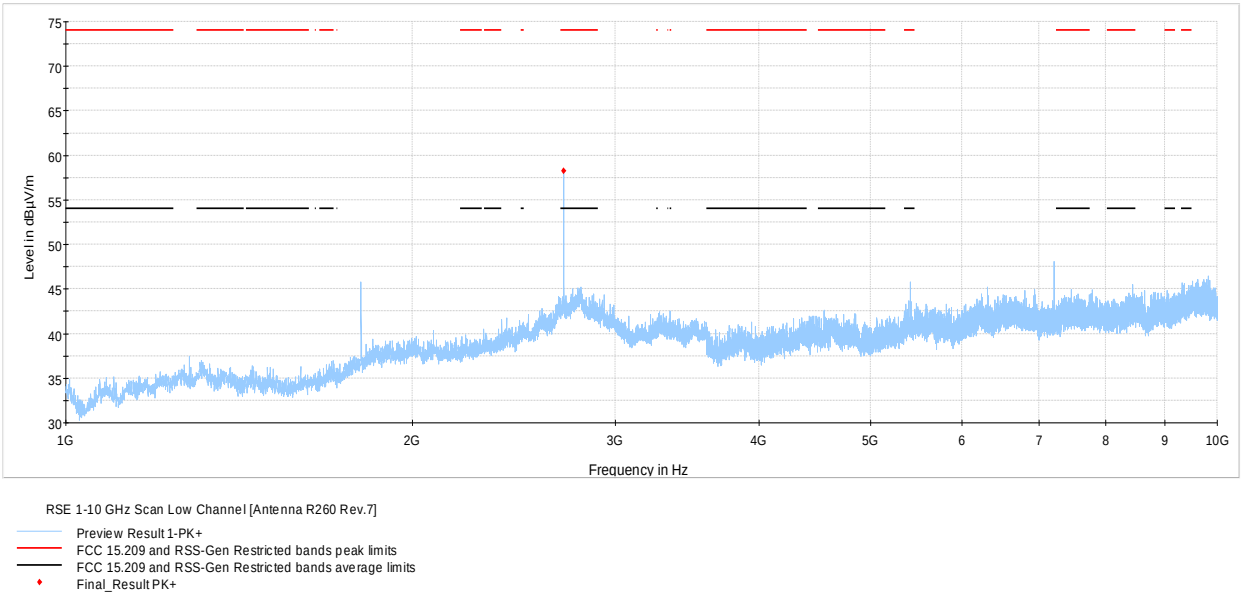


Figure 7.3-5: Radiated spurious emissions 1-10 GHz low channel [R260 Rev 7 - with Metal plate]

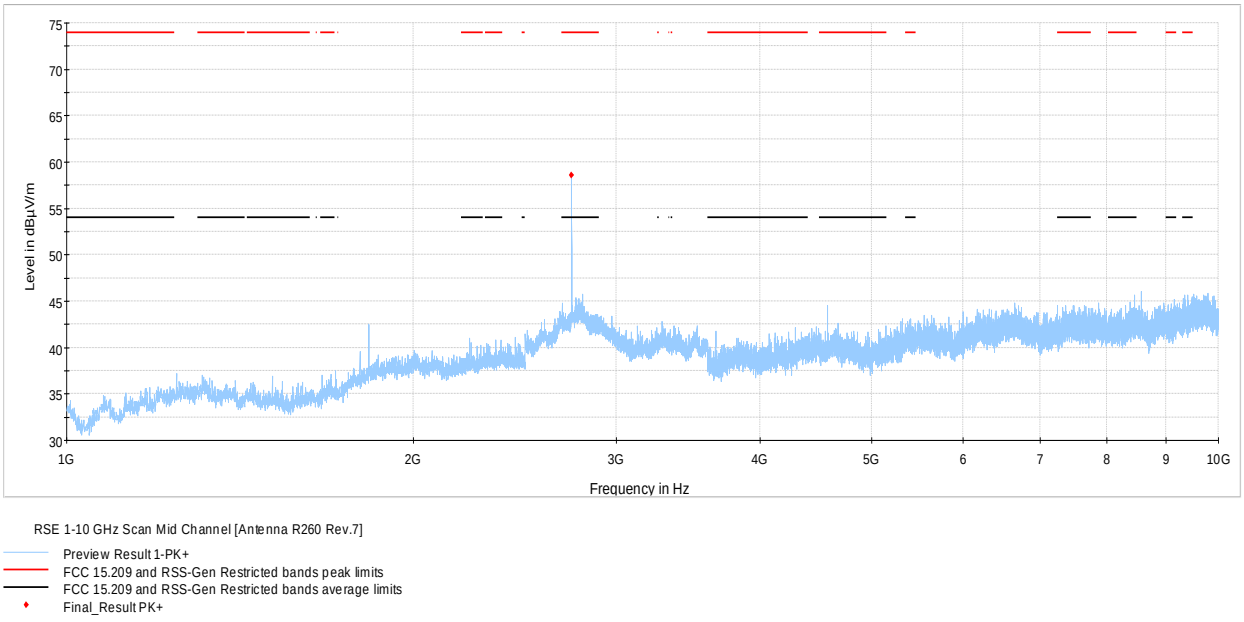


Figure 7.3-6: Radiated spurious emissions 1-10 GHz Mid channel [R260 Rev 7 - with Metal plate]

Test data, continued

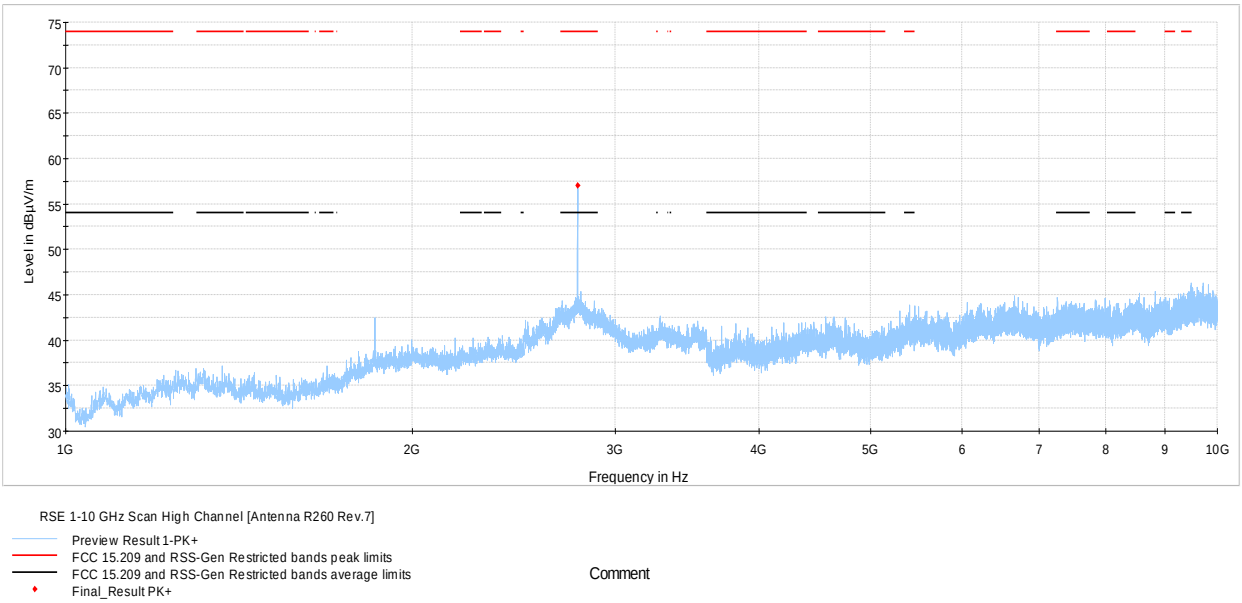


Figure 7.3-7: Radiated spurious emissions 1-10 GHz High channel [R260 Rev 7 - with Metal plate]

Table 7.3-4: Radiated spurious emissions field strength measurement results [R260 Rev 7 - with Metal plate]

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Calculated	Limit	
Low	2706.5714	58.21	74.00	15.79	41.14	54.00	12.86
Mid	2744.6785	58.53	74.00	15.47	41.46	54.00	12.54
High	2783.1000	57.06	74.00	16.94	39.99	54.00	14.01

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Average field strength was calculated: Peak field strength – DCCF (-17.07 dB)

Test data, continued

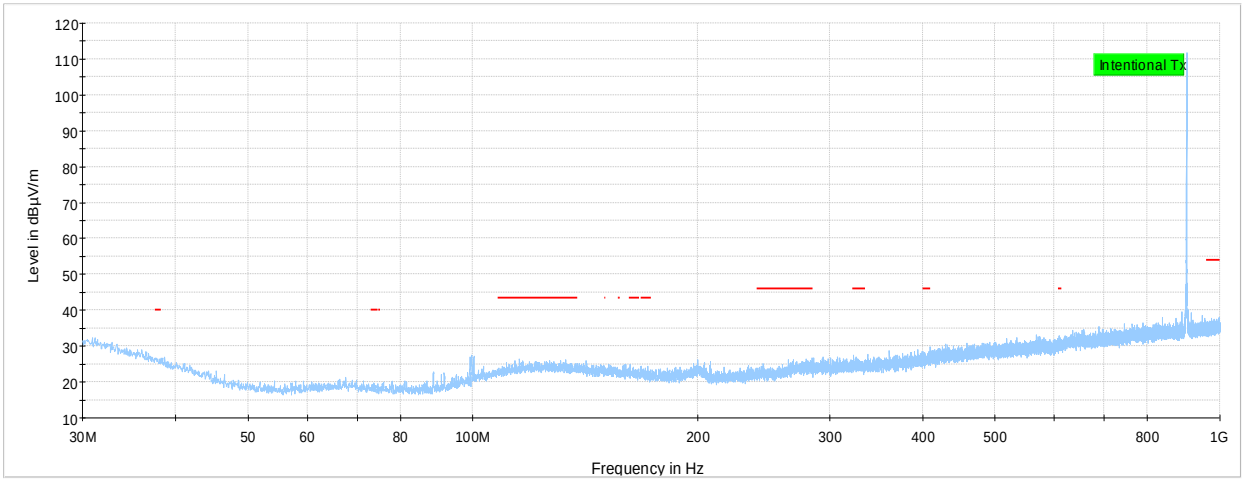


Figure 7.3-8: Radiated spurious emissions 30-1000 MHz Low channel [R260 Rev 13 - with Metal plate]

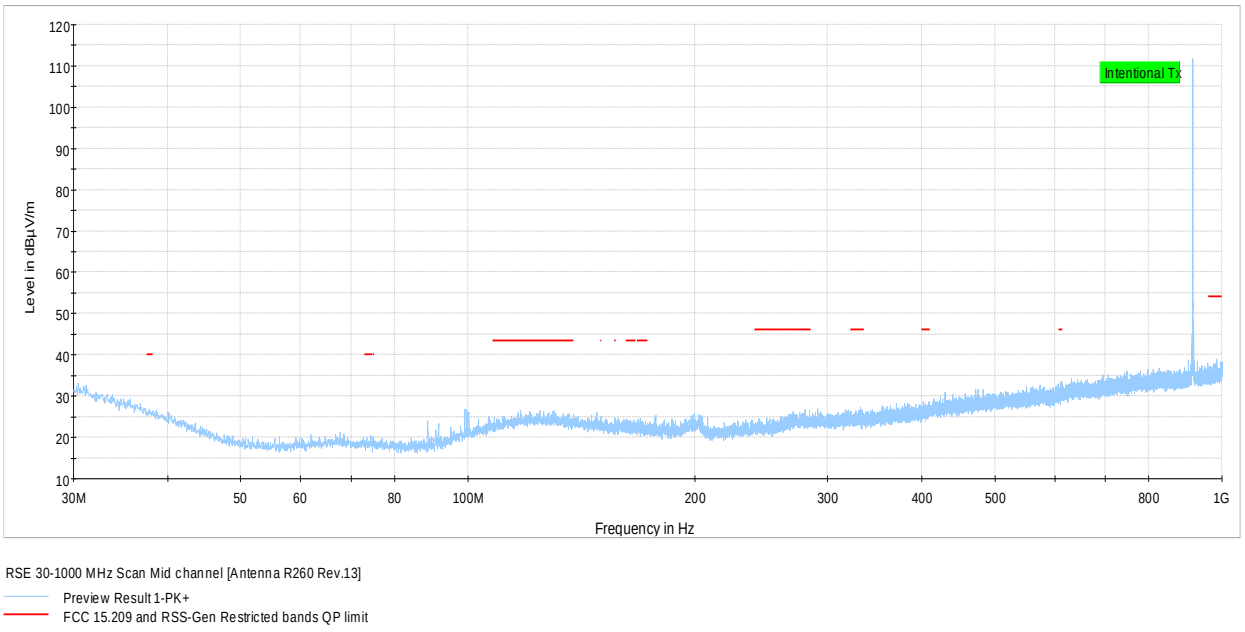
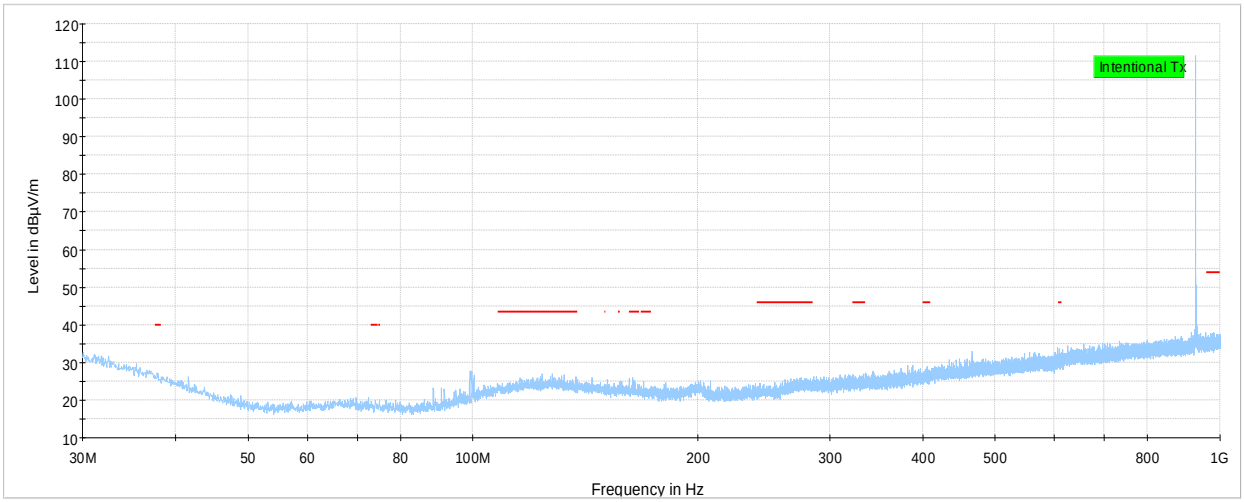


Figure 7.3-9: Radiated spurious emissions 30-1000 MHz Mid channel [R260 Rev 13 - with Metal plate]

Test data, continued



RSE 30-1000 MHz Scan High channel [Antenna R260 Rev.13]
Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands QP limit

Figure 7.3-10: Radiated spurious emissions 30-1000 MHz High channel [R260 Rev 13 - with Metal plate]

Test data, continued

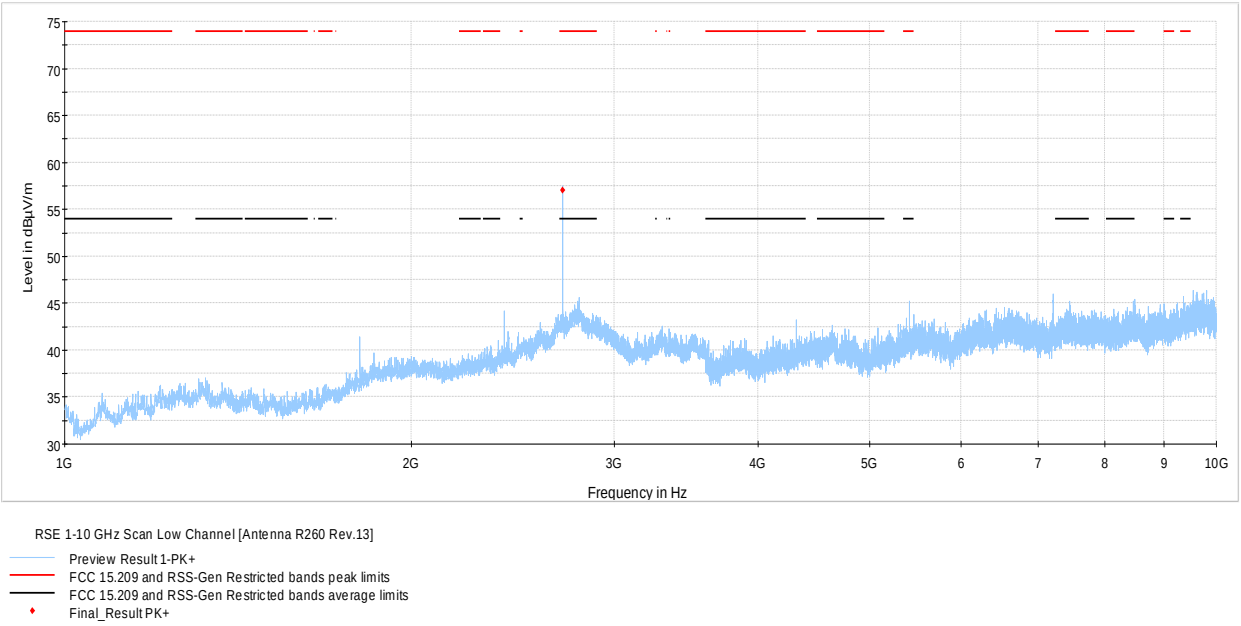


Figure 7.3-11: Radiated spurious emissions 1-10 GHz low channel [R260 Rev 13 - with Metal plate]

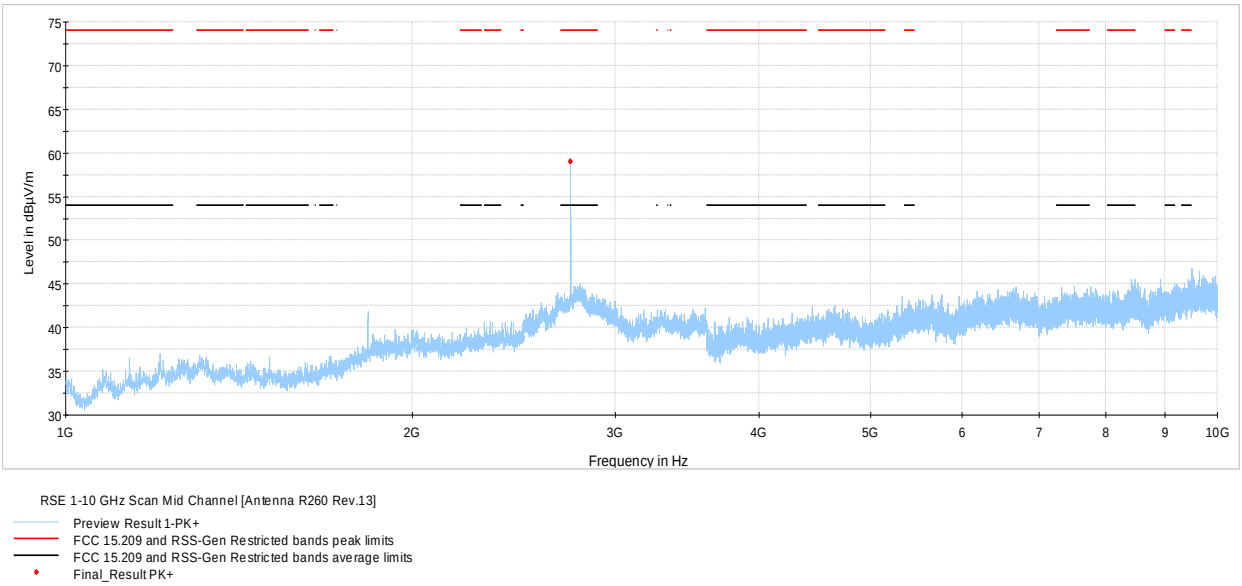


Figure 7.3-12: Radiated spurious emissions 1-10 GHz Mid channel [R260 Rev 13 - with Metal plate]

Test data, continued

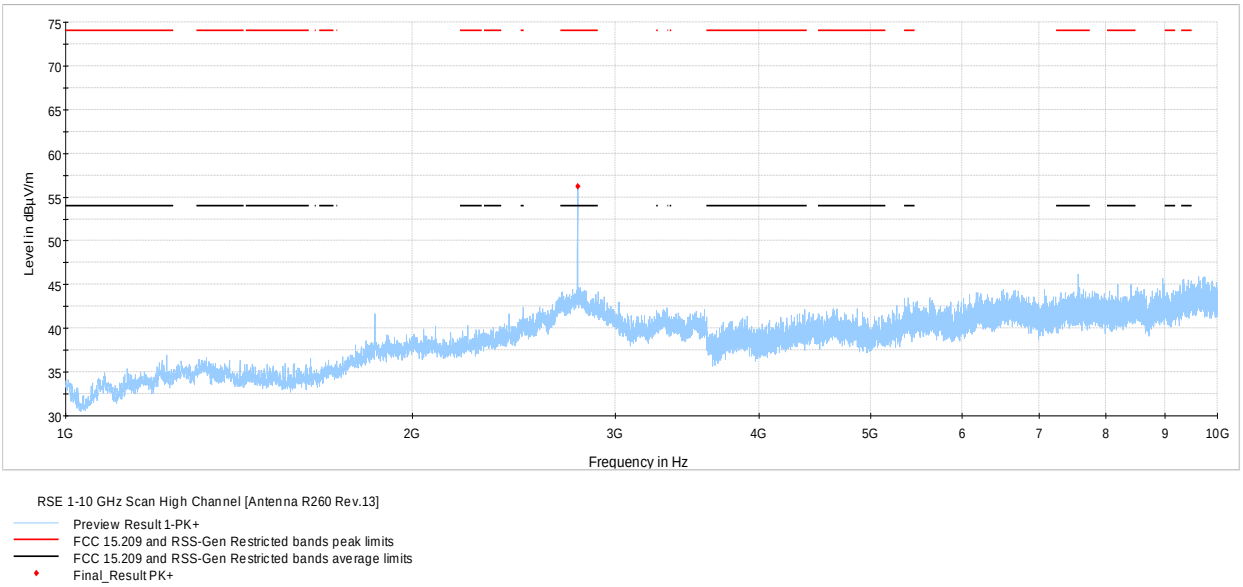


Figure 7.3-13: Radiated spurious emissions 1-10 GHz High channel [R260 Rev 13 - with Metal plate]

Table 7.3-5: Radiated spurious emissions field strength measurement results [R260 Rev 13 - with Metal plate]

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Calculated	Limit	
Low	2706.5964	57.05	74.00	16.95	39.98	54.00	14.02
Mid	2744.6964	59.04	74.00	14.96	41.97	54.00	12.03
High	2783.0857	56.17	74.00	17.83	39.10	54.00	14.90

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Average field strength was calculated: Peak field strength – DCCF (-17.07 dB)

Test data, continued

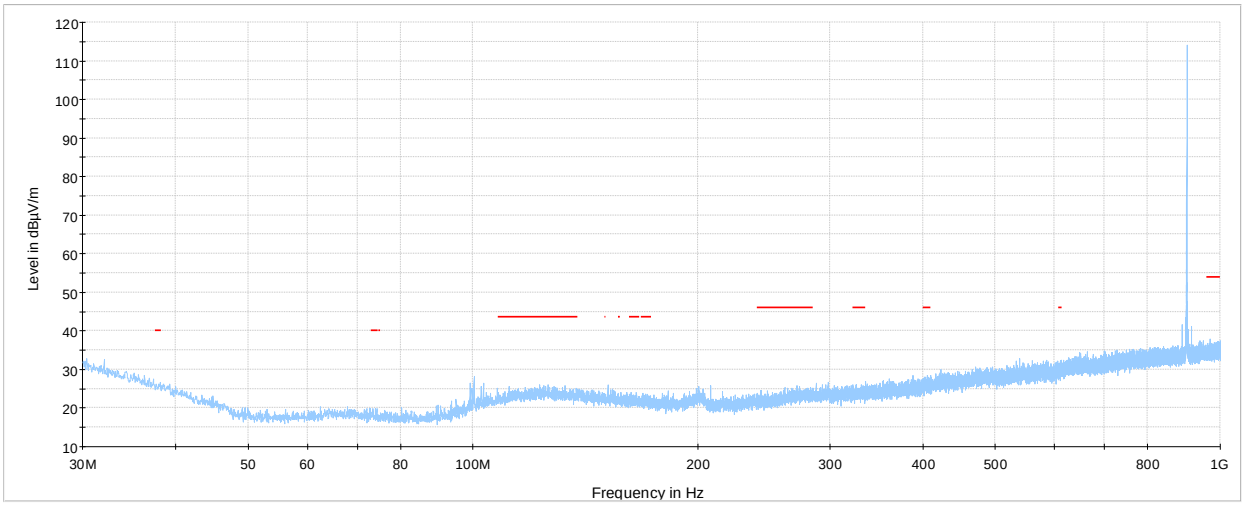


Figure 7.3-14: Radiated spurious emissions 30-1000 MHz Low channel [R260 Rev 13 - without Metal plate]

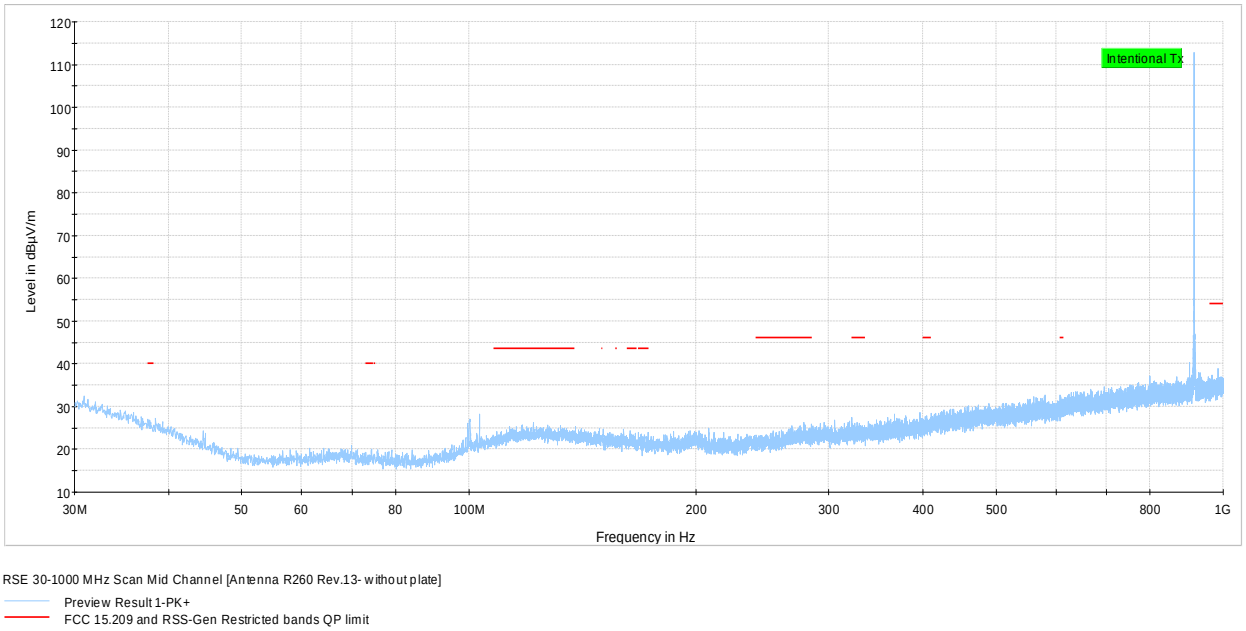
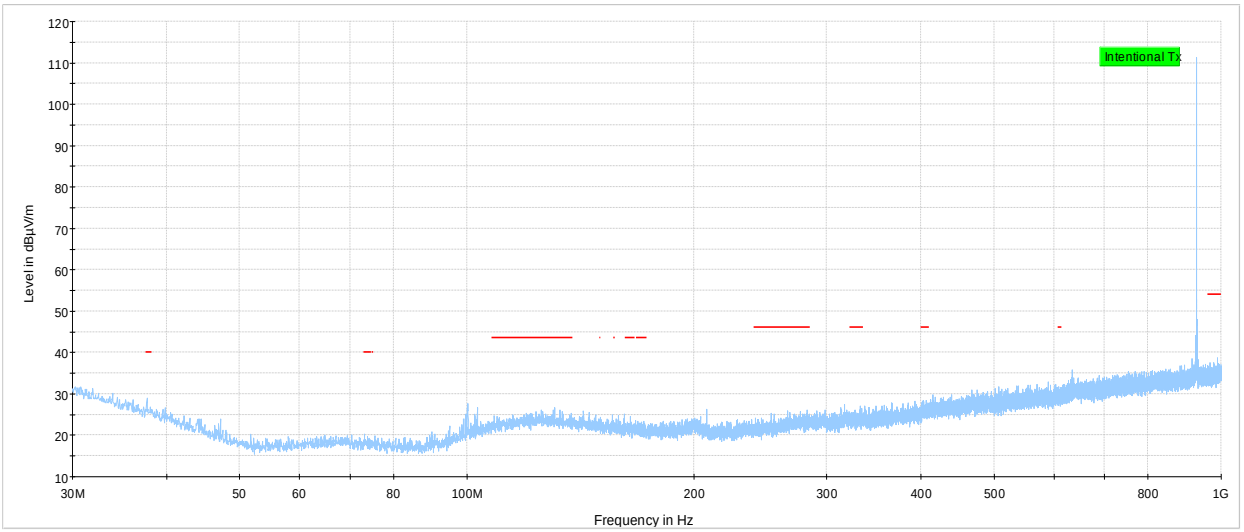


Figure 7.3-15: Radiated spurious emissions 30-1000 MHz Mid channel [R260 Rev 13 - without Metal plate]

Test data, continued



RSE 30-1000 MHz Scan High Channel [Antenna R260 Rev.13- without plate]
Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands QP limit

Figure 7.3-16: Radiated spurious emissions 30-1000 MHz High channel [R260 Rev 13 - without Metal plate]

Test data, continued

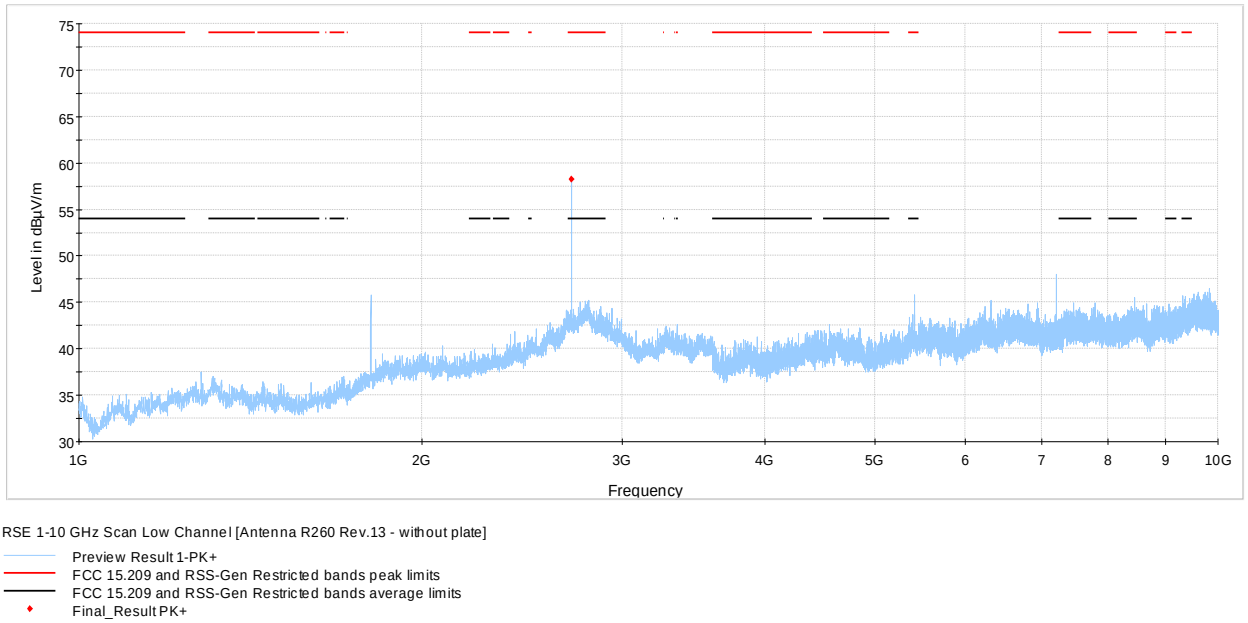


Figure 7.3-17: Radiated spurious emissions 1-10 GHz low channel [R260 Rev 13 - without Metal plate]

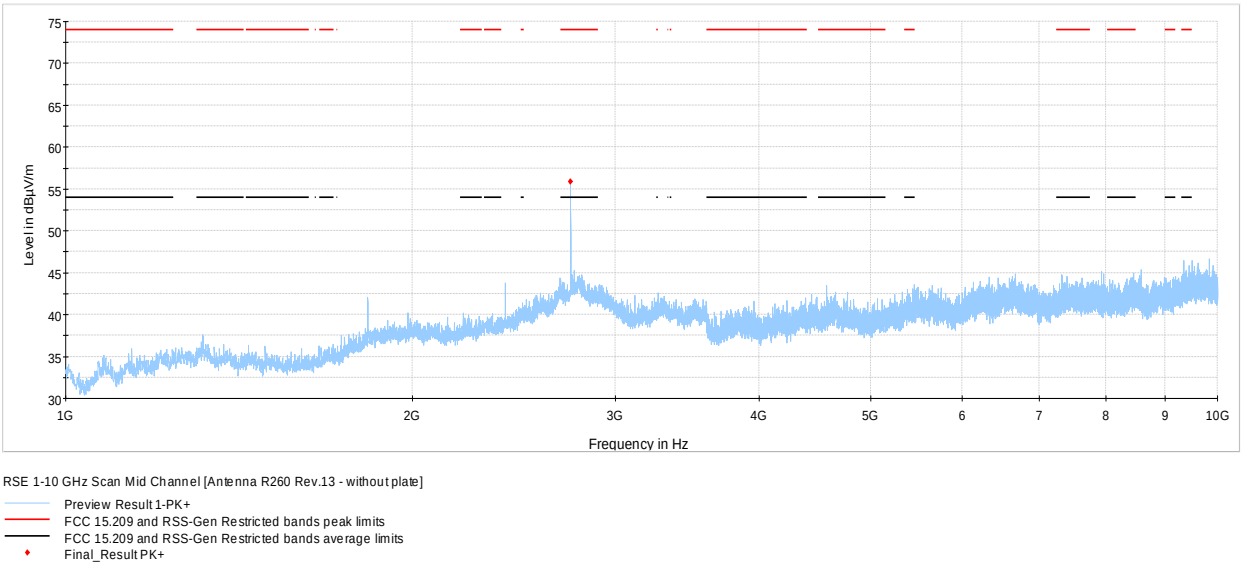


Figure 7.3-18: Radiated spurious emissions 1-10 GHz Mid channel [R260 Rev 13 - without Metal plate]

Test data, continued

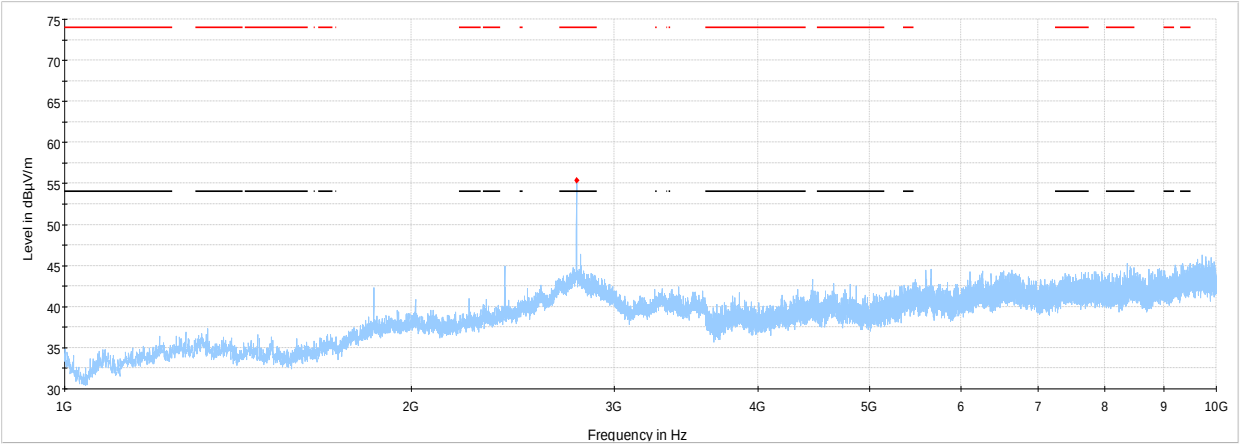


Figure 7.3-19: Radiated spurious emissions 1-10 GHz High channel [R260 Rev 13 - without Metal plate]

Table 7.3-6: Radiated spurious emissions field strength measurement results [R260 Rev 13 - without Metal plate]

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Calculated	Limit	
Low	2706.5714	58.21	74.00	15.79	41.14	54.00	12.86
Mid	2744.6928	55.89	74.00	18.11	38.82	54.00	15.18
High	2783.0857	55.40	74.00	18.60	37.33	54.00	16.67

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Average field strength was calculated: Peak field strength – DCCF (-17.07 dB)

Test data, continued

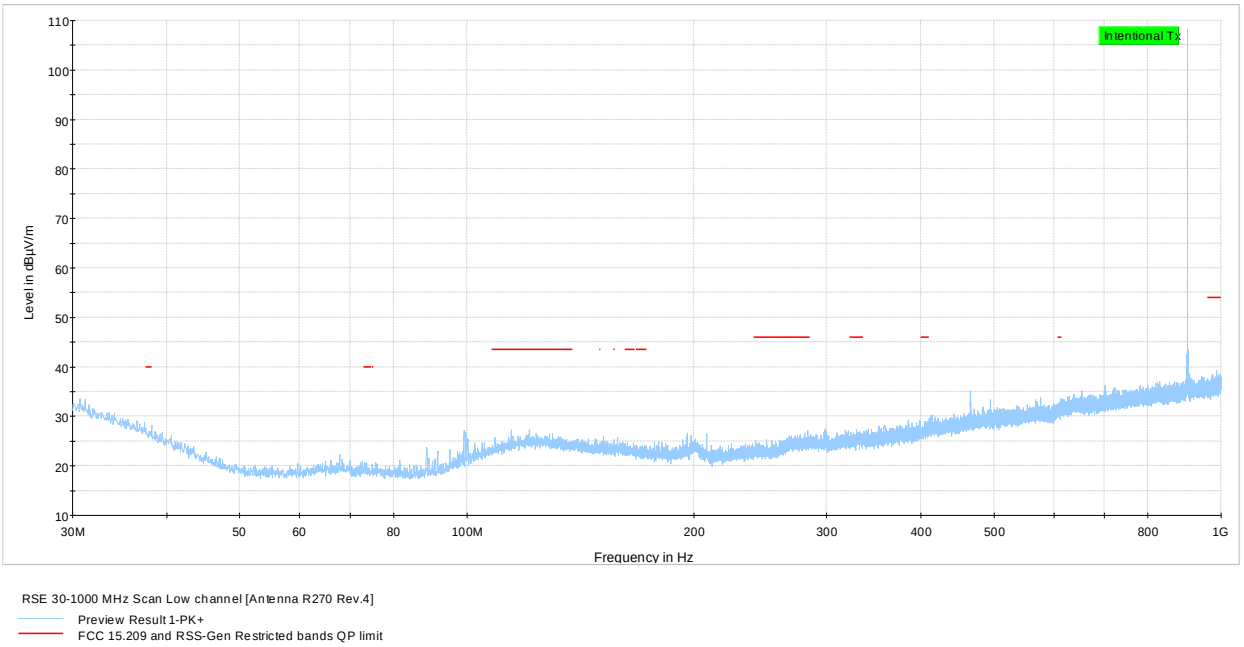


Figure 7.3-20: Radiated spurious emissions 30-1000 MHz Low channel [R270 Rev 4 - with Metal plate]

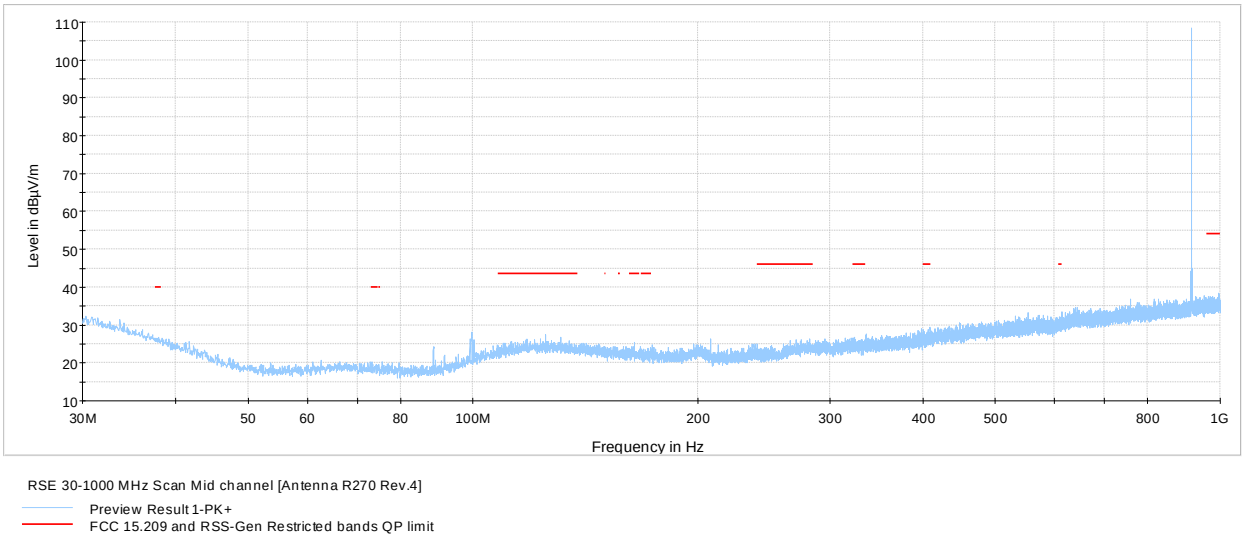


Figure 7.3-21: Radiated spurious emissions 30-1000 MHz Mid channel [R270 Rev 4 - with Metal plate]

Test data, continued

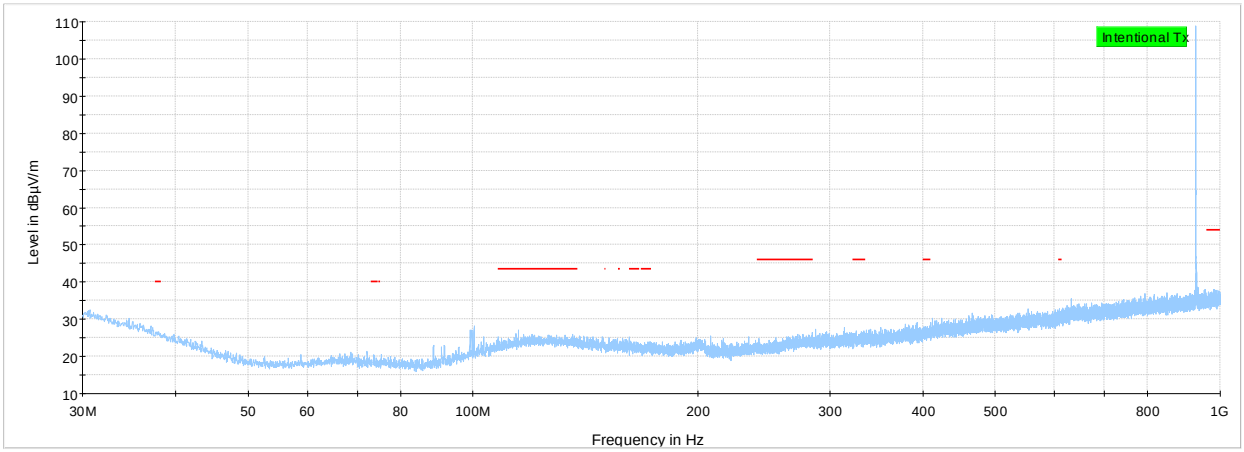


Figure 7.3-22: Radiated spurious emissions 30-1000 MHz High channel [R270 Rev 4 - with Metal plate]

Test data, continued

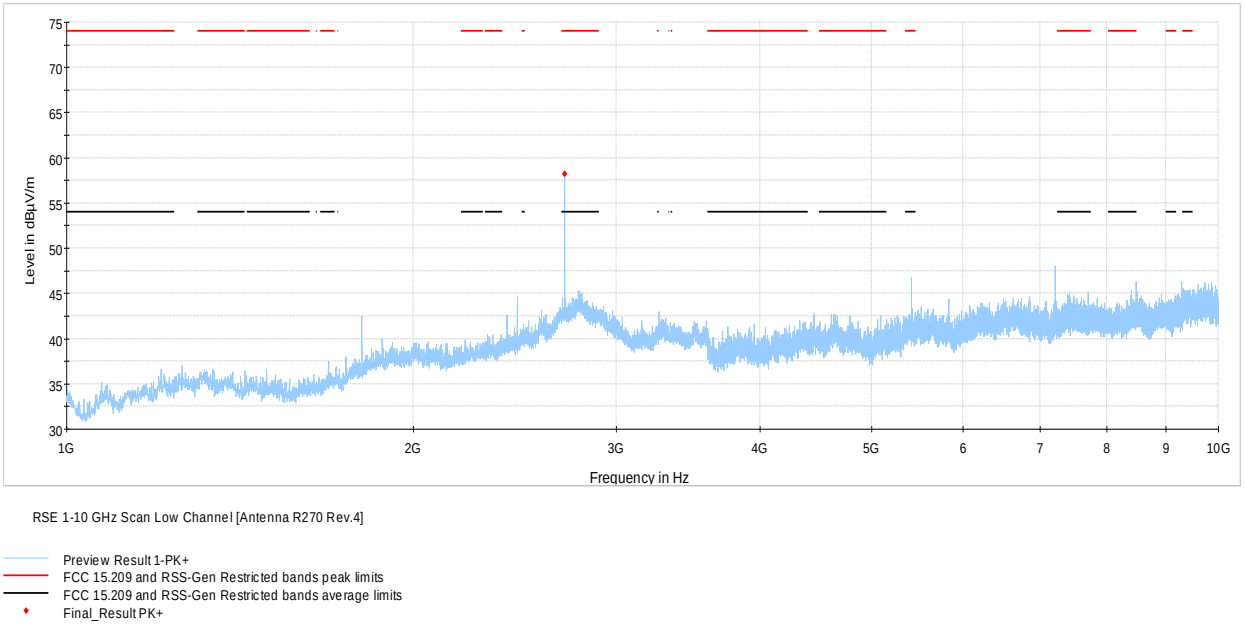


Figure 7.3-23: Radiated spurious emissions 1-10 GHz low channel [R270 Rev 4 - with Metal plate]

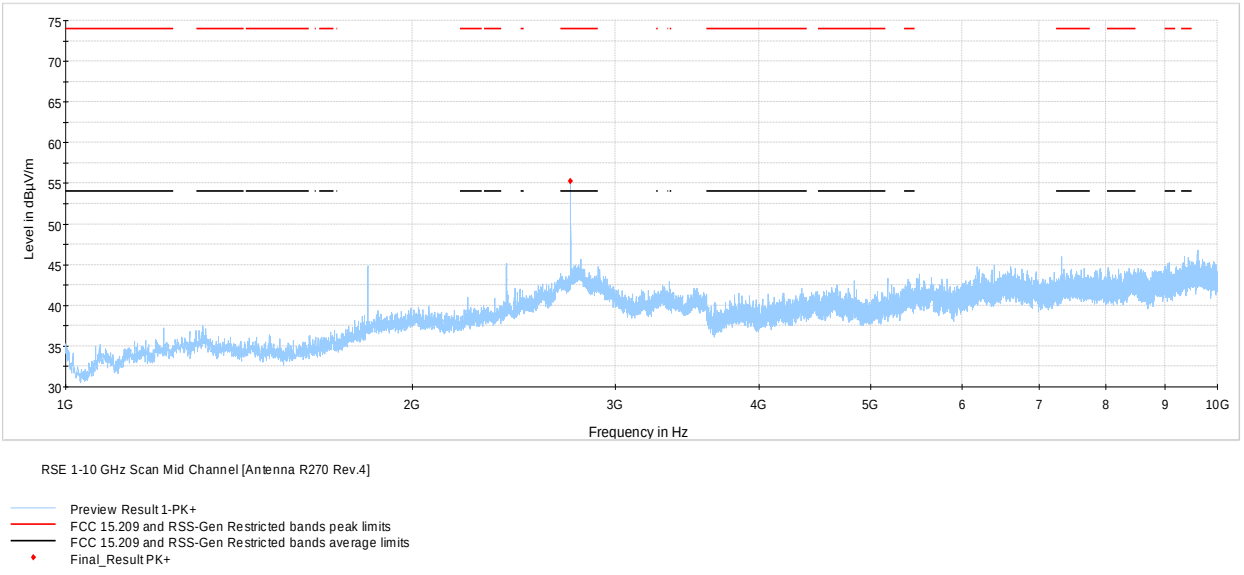


Figure 7.3-24: Radiated spurious emissions 1-10 GHz Mid channel [R270 Rev 4 - with Metal plate]

Test data, continued

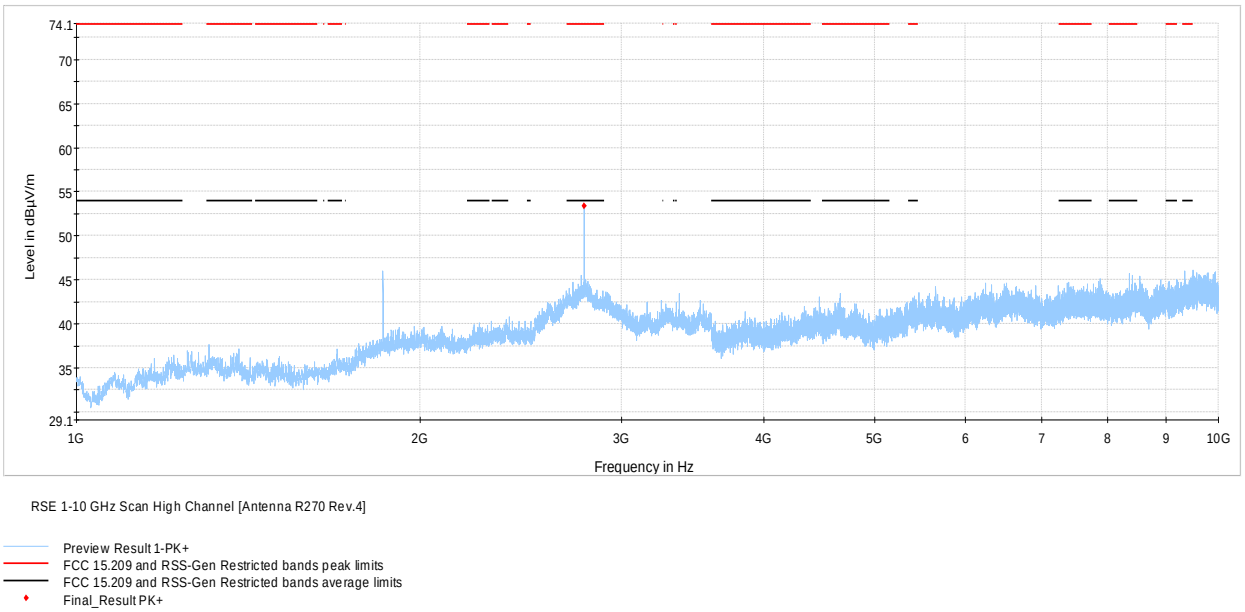


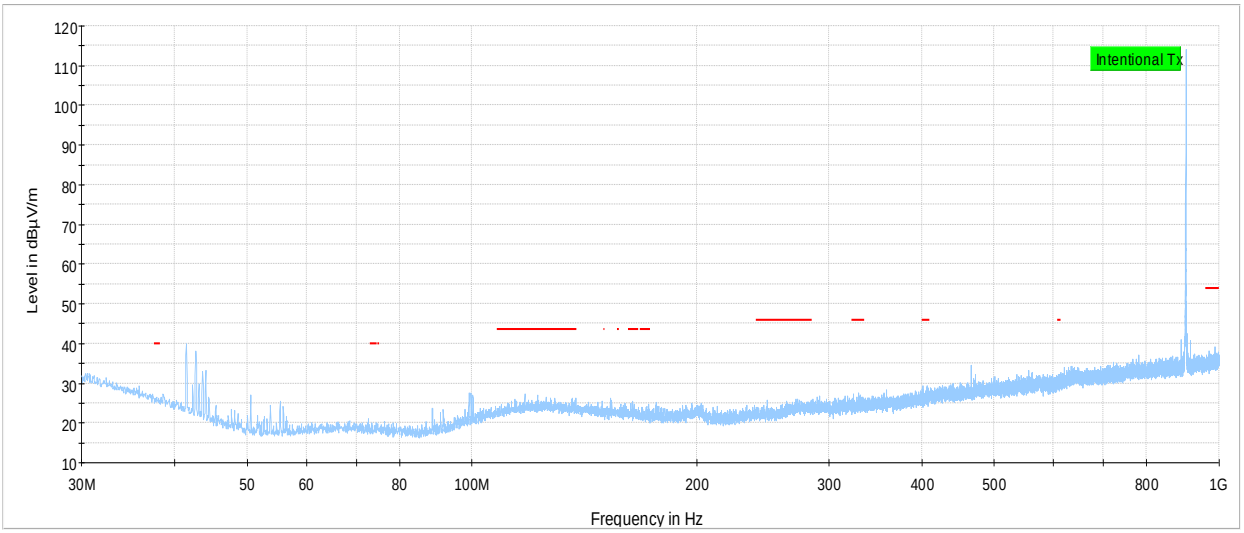
Figure 7.3-25: Radiated spurious emissions 1-10 GHz High channel [R270 Rev 4 - with Metal plate]

Table 7.3-7: Radiated spurious emissions field strength measurement results [R270 Rev 4 - with Metal plate]

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Calculated	Limit	
Low	2706.6107	58.23	74.00	15.77	41.16	54.00	12.84
Mid	2744.7214	55.21	74.00	18.79	38.14	54.00	15.86
High	2783.1357	53.39	74.00	20.61	36.32	54.00	17.68

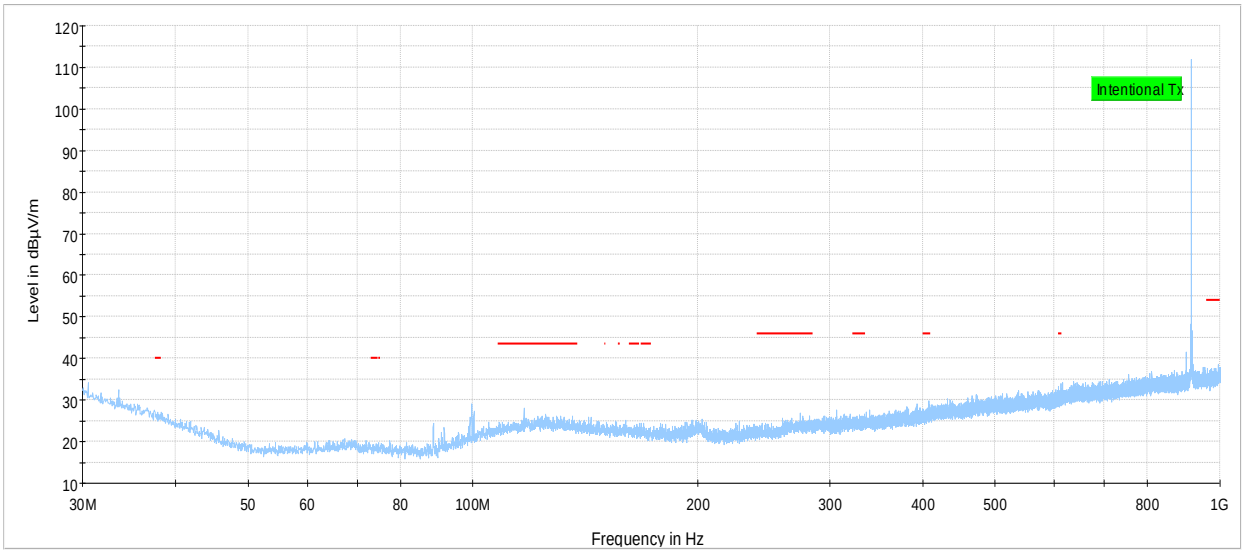
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Average field strength was calculated: Peak field strength – DCCF (-17.07 dB)

Test data, continued



RSE 30-1000 MHz Scan Low Channel [Antenna TD1141 Rev.4]
Preview Result 1-PK+
PK+
FCC 15.209 and RSS-Gen Restricted bands QP limit

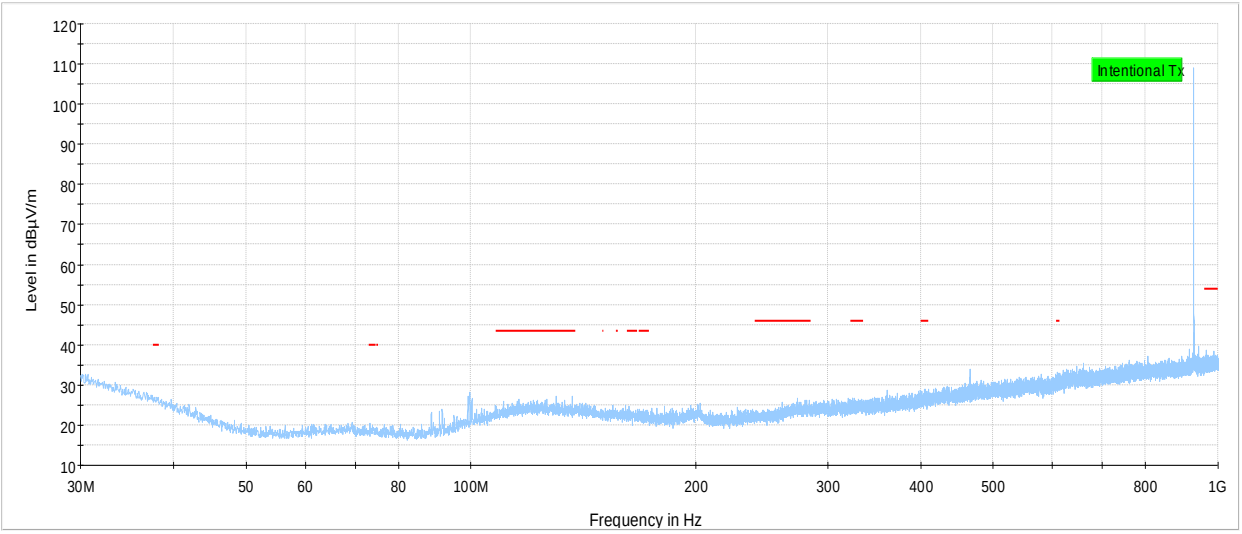
Figure 7.3-26: Radiated spurious emissions 30-1000 MHz Low channel [TD1141 Rev 4]



RSE 30-1000 MHz Scan Mid Channel [Antenna TD1141 Rev.4]
Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands QP limit

Figure 7.3-27: Radiated spurious emissions 30-1000 MHz Mid channel [TD1141 Rev 4]

Test data, continued



RSE 30-1000 MHz Scan High channel [Antenna TD1141 Rev.4]

Preview Result 1-PK+

FCC 15.209 and RSS-Gen Restricted bands QP limit

Figure 7.3-28: Radiated spurious emissions 30-1000 MHz High channel [TD1141 Rev 4]

Test data, continued

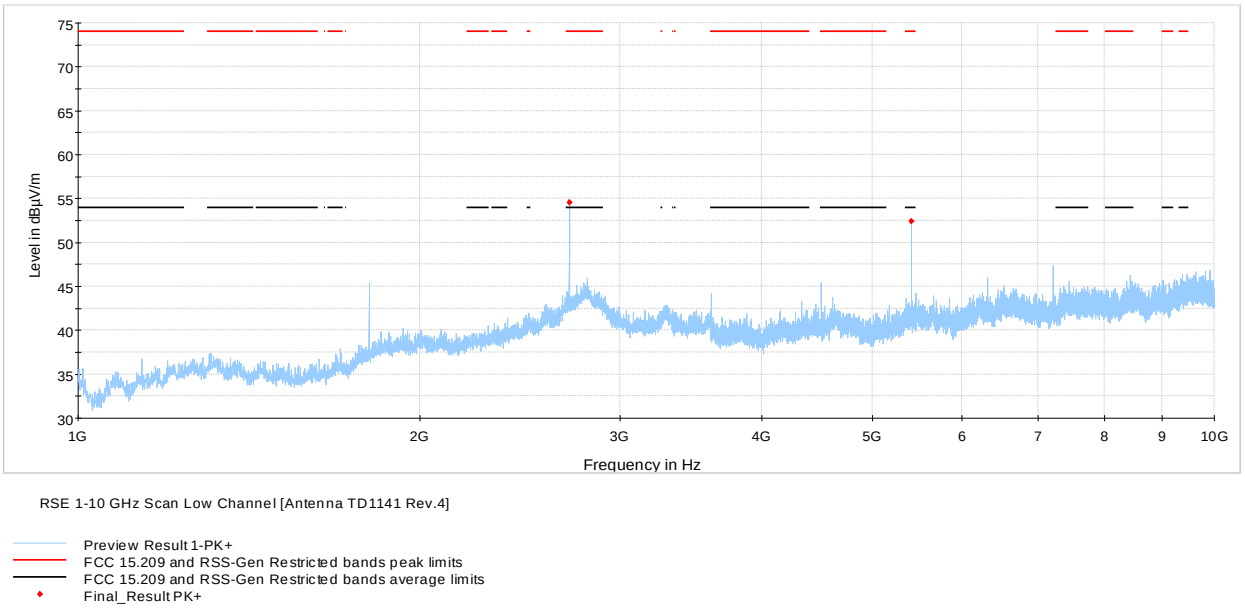


Figure 7.3-29: Radiated spurious emissions 1-10 GHz low channel [TD1141 Rev 4]

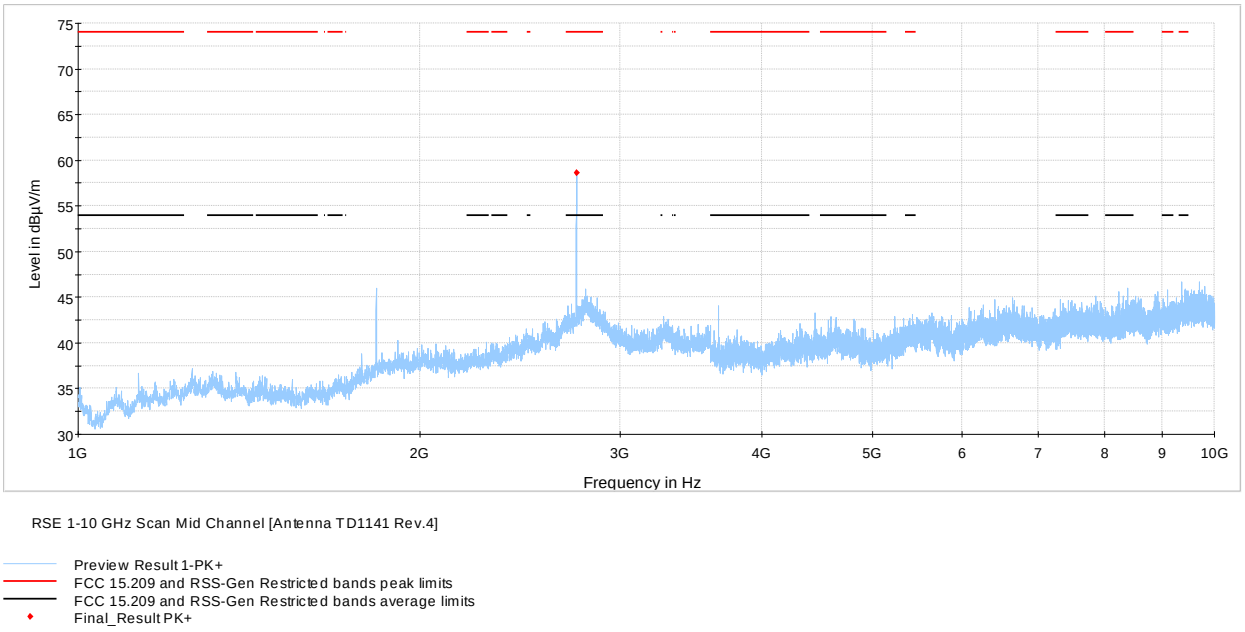


Figure 7.3-30: Radiated spurious emissions 1-10 GHz Mid channel [TD1141 Rev 4]

Test data, continued

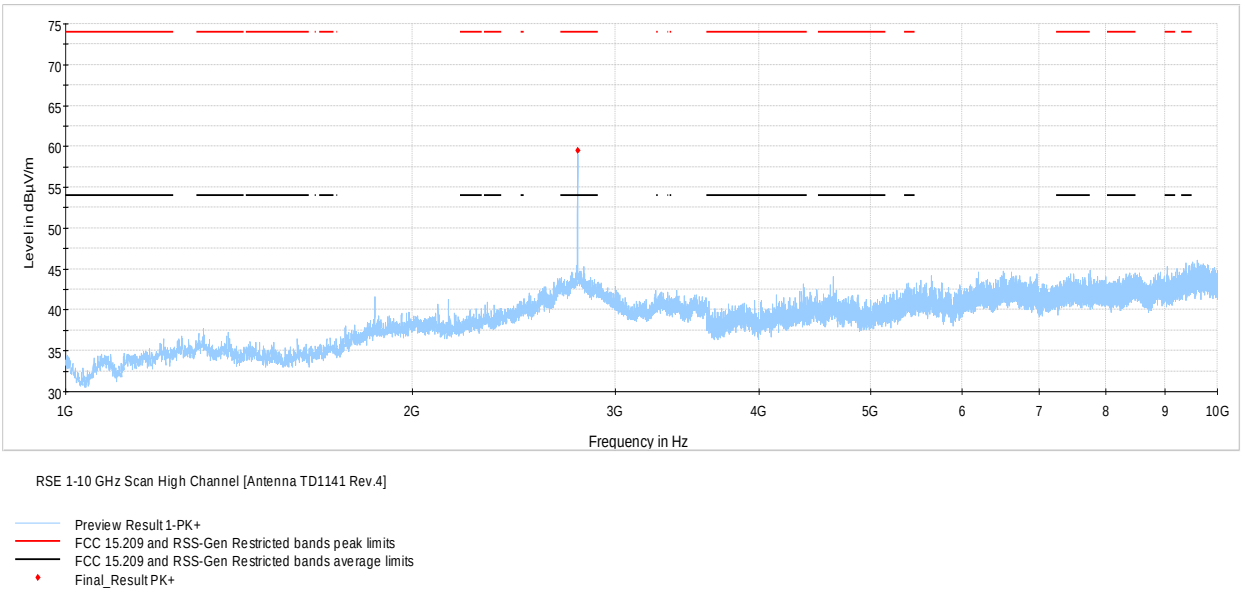


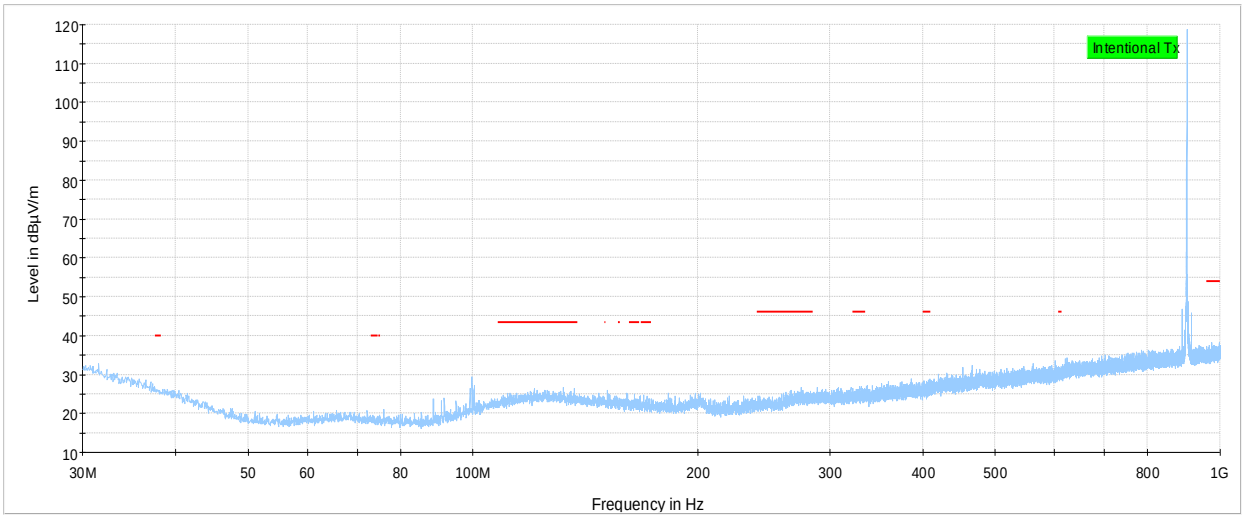
Figure 7.3-31: Radiated spurious emissions 1-10 GHz High channel [TD1141 Rev 4]

Table 7.3-8: Radiated spurious emissions field strength measurement results [TD1141 Rev 4]

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Calculated	Limit	
Low	2706.6214	54.58	74.00	19.42	37.51	54.00	16.49
Low	5413.1678	52.45	74.00	21.55	35.38	54.00	18.62
Mid	2744.7357	58.57	74.00	15.43	41.50	54.00	12.50
High	2783.0892	59.49	74.00	14.51	42.42	54.00	11.58

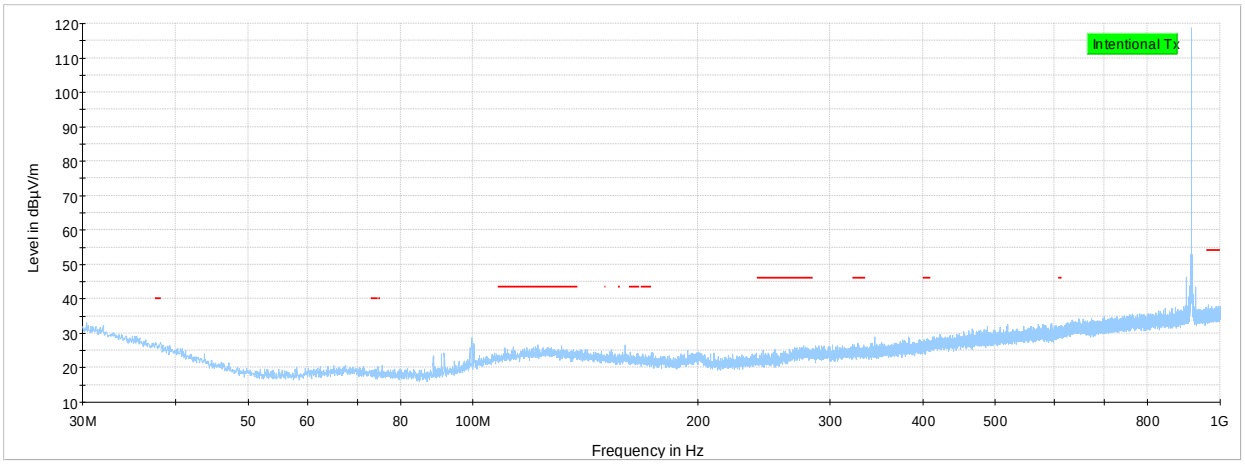
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Average field strength was calculated: Peak field strength – DCCF (-17.07 dB)

Test data, continued



RSE 30-1000 MHz Scan Low Channel [Antenna TD3100 Rev.4]
Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands QP limit

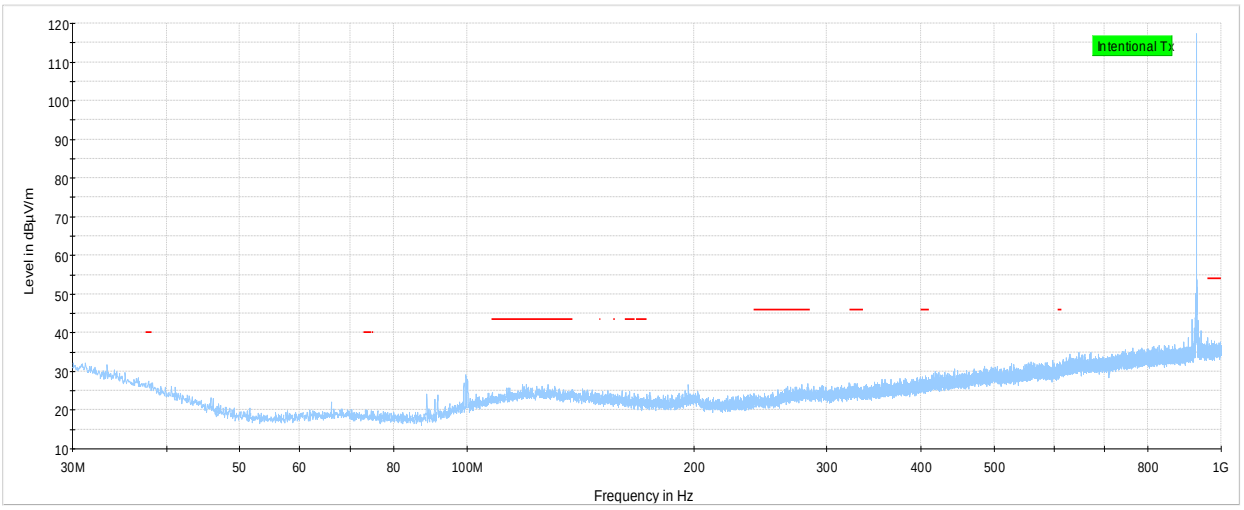
Figure 7.3-32: Radiated spurious emissions 30-1000 MHz Low channel [TD3100 Rev 4]



RSE 30-1000 MHz Scan Mid Channel [Antenna TD3100 Rev.4]
Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands QP limit

Figure 7.3-33: Radiated spurious emissions 30-1000 MHz Mid channel [TD3100 Rev 4]

Test data, continued

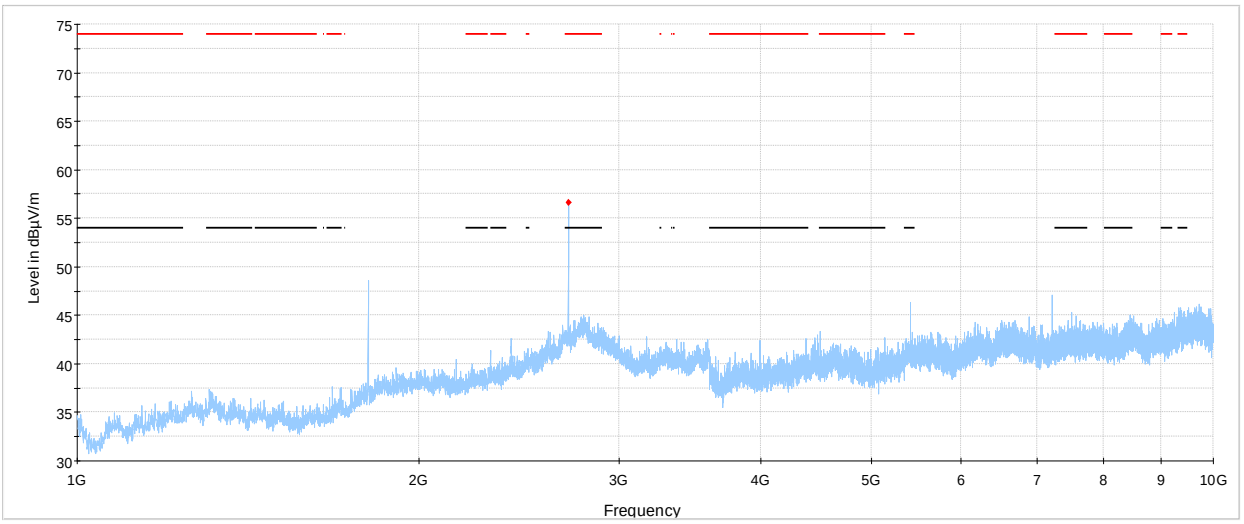


RSE 30-1000 MHz Scan High Channel [Antenna TD3100 Rev.4]

Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands QP limit

Figure 7.3-34: Radiated spurious emissions 30-1000 MHz High channel [TD3100 Rev 4]

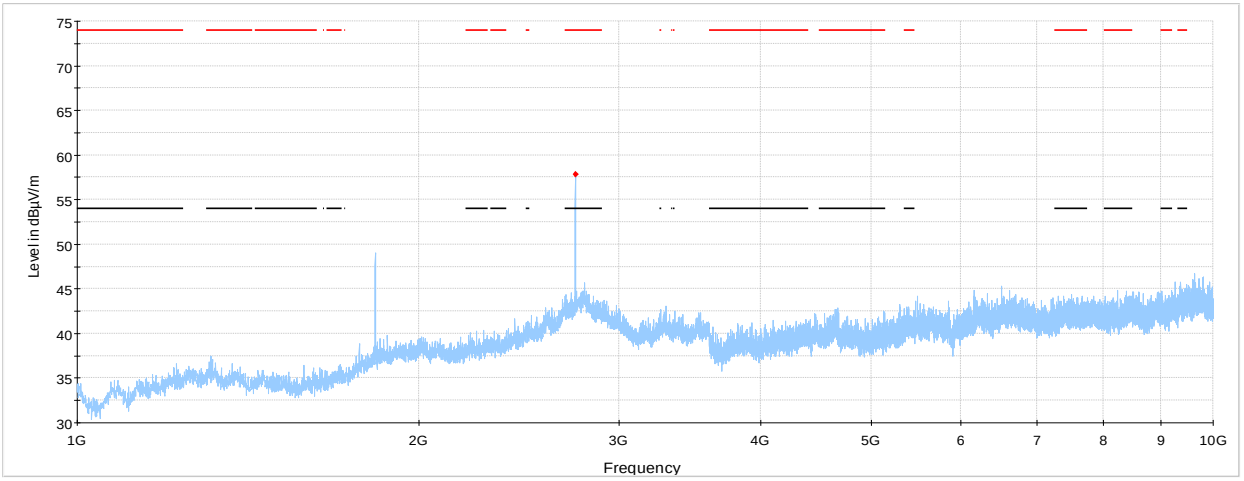
Test data, continued



RSE 1-10 GHz Scan Low Channel [Antenna TD3100 Rev.4]

Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands peak limits
FCC 15.209 and RSS-Gen Restricted bands average limits
Final_Result PK+

Figure 7.3-35: Radiated spurious emissions 1-10 GHz low channel [TD3100 Rev 4]



RSE 1-10 GHz Scan Mid Channel [Antenna TD3100 Rev.4]

Preview Result 1-PK+
FCC 15.209 and RSS-Gen Restricted bands peak limits
FCC 15.209 and RSS-Gen Restricted bands average limits
Final_Result PK+

Figure 7.3-36: Radiated spurious emissions 1-10 GHz Mid channel [TD3100 Rev 4]

Test data, continued

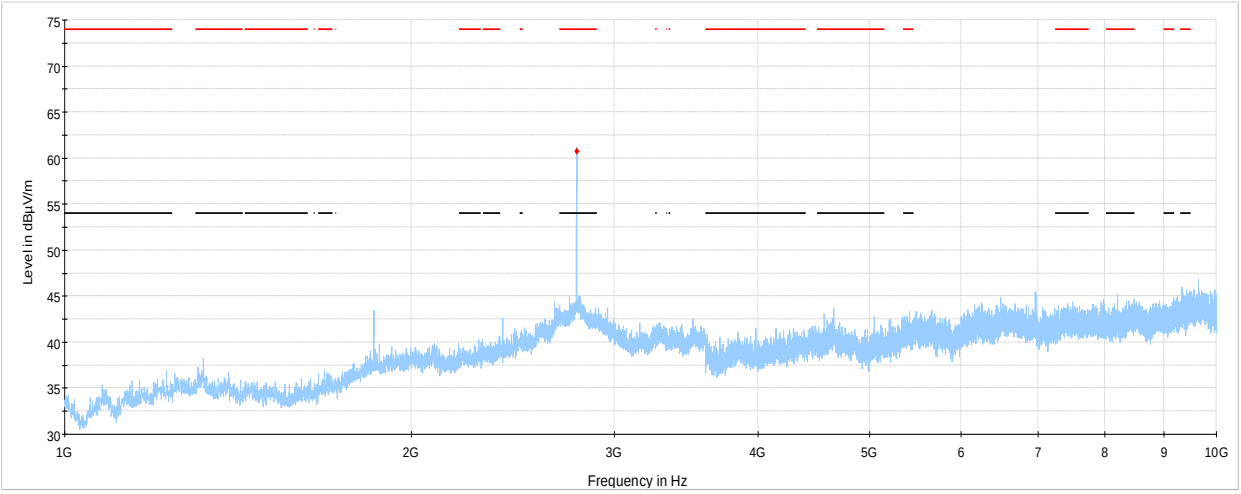


Figure 7.3-37: Radiated spurious emissions 1-10 GHz High channel [TD3100 Rev 4]

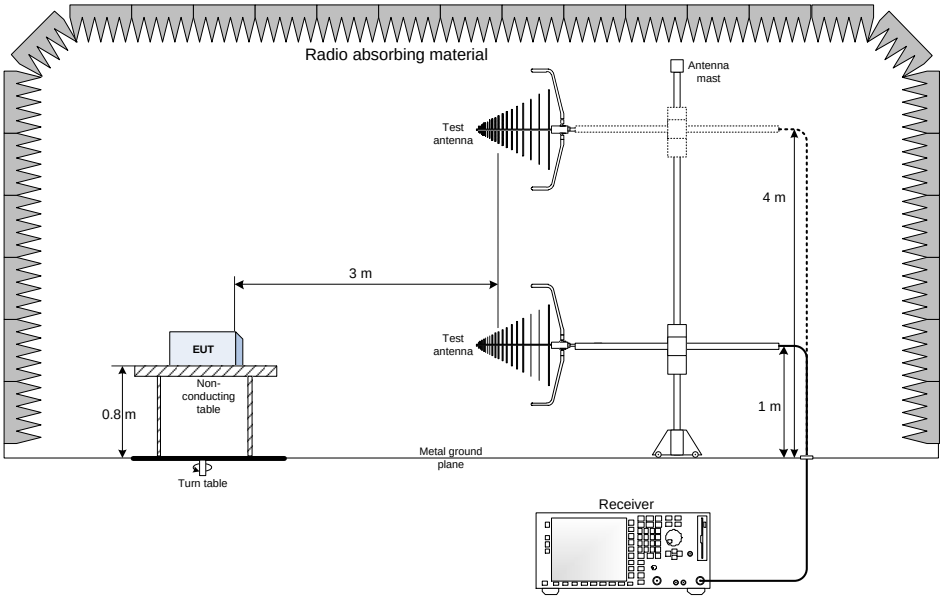
Table 7.3-9: Radiated spurious emissions field strength measurement results [TD3100 Rev 4]

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Calculated	Limit	
Low	2706.5892	56.61	74.00	17.39	39.54	54.00	14.46
Mid	2744.6964	57.83	74.00	16.17	40.76	54.00	13.24
High	2783.0928	60.71	74.00	13.29	43.64	54.00	10.36

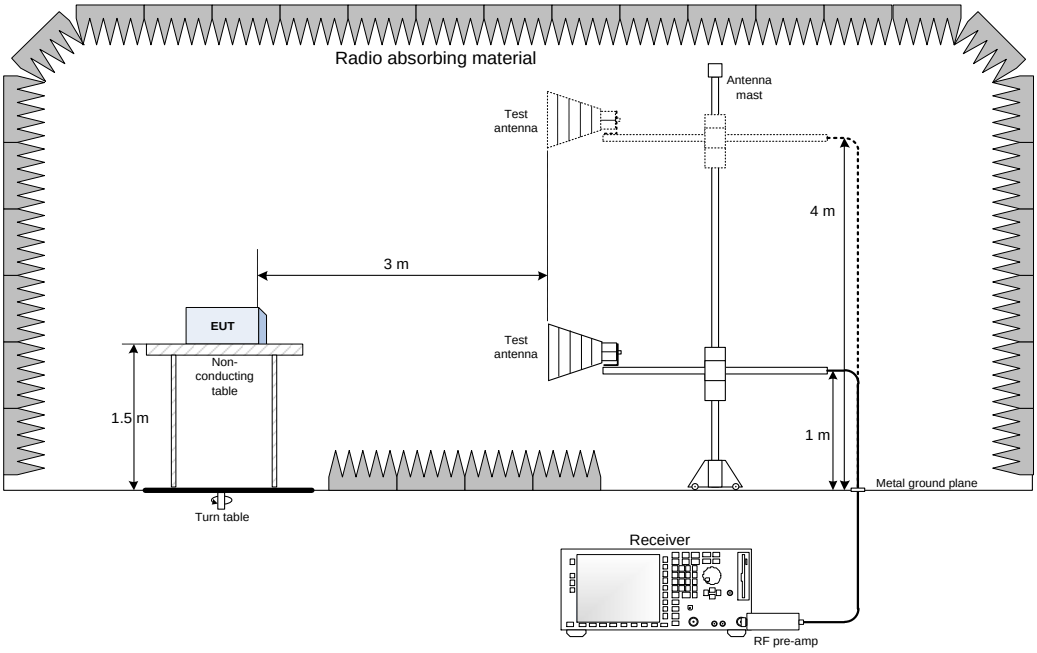
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Average field strength was calculated: Peak field strength – DCCF (-17.07 dB)

Section 8 Test setup diagrams

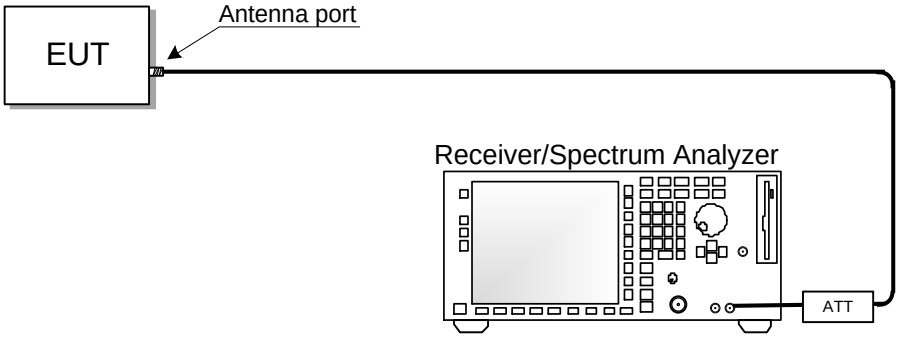
8.1 Radiated emissions set-up for frequencies below 1 GHz



8.2 Radiated emissions set-up for frequencies above 1 GHz



8.3 Antenna port set-up



End of the test report