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Test report

349421-2TRFWL

Date of issue: March 21, 2018

Applicant:

Tait Limited

Product:

Handheld UHF Transceiver

Model:

TPDB1C

FCC ID: CASTPDB1C

ISED Registration number: 737A-TPDB1C

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247 - **partial**
  Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
- RSS-247, Issue 2, February 2017, Section 5 - **partial**
  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: CA2040; IC: 2040A-4 (3 m SAC)

Tested by	Kevin Rose, Wireless/EMC Specialist
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Review date	March 21, 2018
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 Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Tait Limited
Address	558 Wairakei Road
City	Christchurch
Province/State	–
Postal/Zip code	8140
Country	New Zealand

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz
RSS-247, Issue 2, February 2017, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.3 Test methods

ANSI C63.10 - 2013	American National Standard with procedures for compliance testing of unlicensed wireless devices
DA 00-705 (March 30, 2000)	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

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 1.5 below. 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 Exclusions

Limited testing was performed as per quote #Q102128100r4

1.6 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not tested[3]
§15.31(e)	Variation of power source	Pass[1]
§15.203	Antenna requirement	Pass[2]

Notes: [1] The testing was performed with fully charged battery

[2] The Antennas are located within the enclosure of EUT and not user accessible.

[3] Limited testing were performed as per quote #Q102128100r4

2.2 FCC Part 15 Subpart C, intentional radiators test results

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 tested[1]
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not applicable
§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	Pass
§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	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 applicable
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

Notes: [1] Limited testing were performed as per quote #Q102128100r4

2.3 IC RSS-GEN, Issue 4, test results

Part	Test description	Verdict
7.1.2	Receiver radiated emission limits	Not applicable
7.1.3	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Not tested[2]

Notes: [1] According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

[2] Limited testing were performed as per quote #Q102128100r4

2.4 IC RSS-247, Issue 2, test results

Part	Test description	Verdict
5.1	Frequency hopping systems	
5.1 (1)	Bandwidth of a frequency hopping channel	Not tested[1]
5.1 (2)	Minimum channel spacing for frequency hopping systems	Not tested[1]
5.1 (3)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.1 (4)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not tested[1]
5.1 (5)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
5.2	Digital modulation systems	
5.2 (1)	Minimum 6 dB bandwidth	Not applicable
5.2 (2)	Maximum power spectral density	Not applicable
5.3	Hybrid systems	
5.3 (1)	Digital modulation turned off	Not applicable
5.3 (2)	Frequency hopping turned off	Not applicable
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (1)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.4 (2)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Pass
5.4 (3)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
5.4 (4)	Systems employing digital modulation techniques	Not applicable
5.4 (5)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (6)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Out-of-band emissions	Pass

Notes: [1] Limited testing were performed as per quote #Q102128100r4

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 26, 2018
Nemko sample ID number	1

3.2 EUT information

Product name	TP9300 (DMR) / 9400 (P25) hand-portable
Model	TPDB1C
Model variant	T03-00071-BCAA
Serial number	25994518

3.3 Technical information

Applicant IC company number	737A
IC UPN number	TPDB1C
FCC ID	CASTPDB1C
All used IC test site(s) Reg. number	2040A-4
RSS number and Issue number	RSS-247, Issue 2, February 2017
FCC rule part	FCC 47 CFR Part 15 Subpart C, §15.247
Frequency band	2400–2483.5 MHz
Frequency Min (MHz)	2402
Frequency Max (MHz)	2480
RF power Min (W), Conducted	NA
RF power Max (W), Conducted	0.0157
Field strength, Units @ distance	N/A
Measured BW (kHz) (6 dB)	Not tested
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	GFSK, QPSK, 8PSK
Emission classification (F1D, G1D, D1D)	F1E
Transmitter spurious, Units @ distance	56.05 dBµV/m (peak) at 2.388 MHz @ 3 m
Power requirements	7.4 V from Li-Ion Battery
Antenna information	Surface Mount Ceramic Isolated Magnetic Dipole, Gain: 1.39 dBi The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

EUT is a Bluetooth radio module incorporated within hand-held radio transceiver unit.

3.5 EUT exercise details

EUT was controlled from computer via programming cable.

3.6 EUT setup diagram

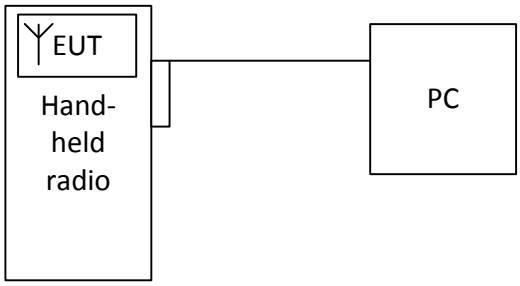

Figure 3.6-1: *Setup diagram*

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	860–1060 mbar

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

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. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Dec. 09/18
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Horn with Preamp (1–18 GHz)	ETS-Lindgren	3117	FA002840	1 year	Dec. 07/18
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	June 27/18
Horn antenna (18–26.5 GHz)	Electro-metrics	SH-50/60-1	FA000479	—	VOU
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	1 year	June 27/18
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	1 year	Aug. 08/18
50 Ω coax cable	Huber + Suhner	None	FA002074	1 year	May 12/18
50 Ω coax cable	Huber + Suhner	None	FA002830	1 year	May 12/18

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

Section 8. Testing data

8.1 FCC 15.247(b) and RSS-247 5.4 (e) Transmitter output power and e.i.r.p. requirements

8.1.1 Definitions and limits

FCC:

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

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt (30 dBm). For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts (21 dBm).

(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.

ISED:

For FHSs operating in the band 2400–2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W (30 dBm) if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W (21 dBm) if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W (36 dBm), except as provided in section 5.4(e).

Section 5.4(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, omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

8.1.2 Test summary

Test date	February 27, 2018	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	35 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	3 MHz
Video bandwidth:	10 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data

Table 8.1-1: *Output power measurements results*

Modulation	Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured	Limit					
GFSK	2402	**11.38**	30	18.62	1.39	12.77	36	23.23
	2440	10.55	30	19.45	1.39	11.94	36	24.06
	2479	10.73	30	19.27	1.39	12.12	36	23.88
QPSK	2402	11.28	30	18.72	1.39	12.67	36	23.33
	2440	10.46	30	19.54	1.39	11.85	36	24.15
	2479	10.73	30	19.27	1.39	12.12	36	23.88
8PSK	2402	11.96	30	18.04	1.39	13.35	36	22.65
	2440	11.25	30	18.75	1.39	12.64	36	23.36
	2479	11.34	30	18.66	1.39	12.73	36	23.27
BLE	2402	**11.38**	30	18.62	1.39	12.77	36	23.23
	2440	10.55	30	19.45	1.39	11.94	36	24.06
	2479	10.73	30	19.27	1.39	12.12	36	23.88

8.2 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) unwanted emissions

8.2.1 Definitions and limits

FCC:
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)).

IC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency 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 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 Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

Table 8.2-1: *FCC §15.209 and RSS-Gen – Radiated emission limits*

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

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

Table 8.2-2: *ISED restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677-5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in Table 8.2-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.2-3: *FCC restricted frequency bands*

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

8.2.2 Test summary

Test date	February 27, 2018	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	35 %

8.2.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
EUT was set to transmit with 100 % duty cycle.

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

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

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

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

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

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

Spectrum analyser settings for conducted spurious emissions measurements:

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

8.2.4 Test data

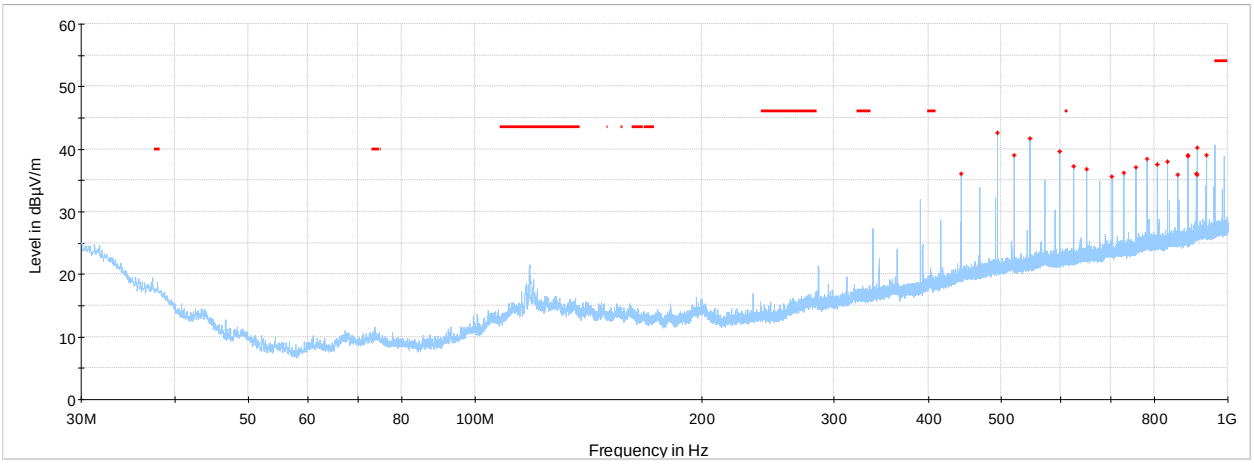

Figure 8.2-1: *Radiated spurious emissions below 1 GHz, sample plot*

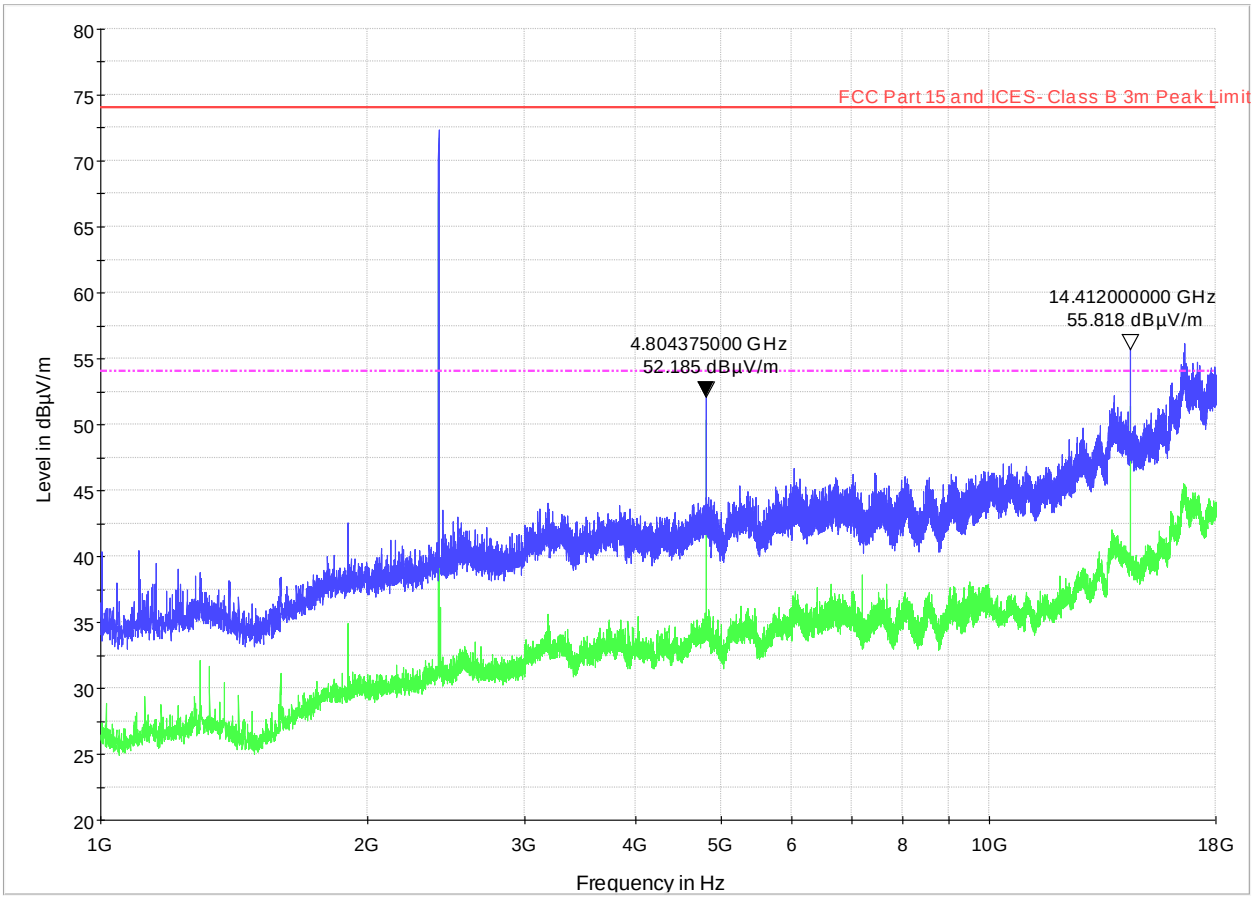

Figure 8.2-2: *Radiated spurious emissions above 1 GHz, sample plot*

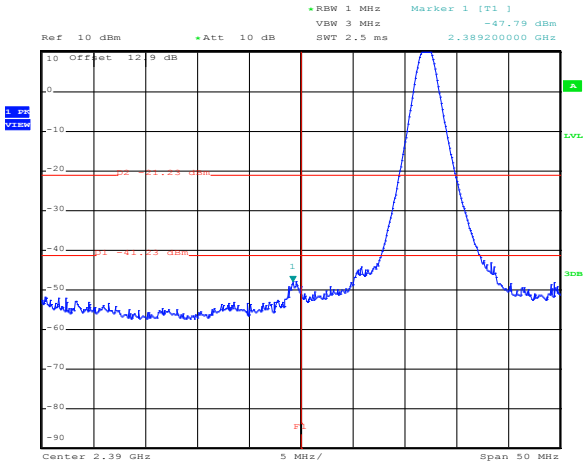

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Figure 8.2-3: *Radiated spurious band edge emission at 2.39 GHz, GFSK modulation, 15.209 limits*

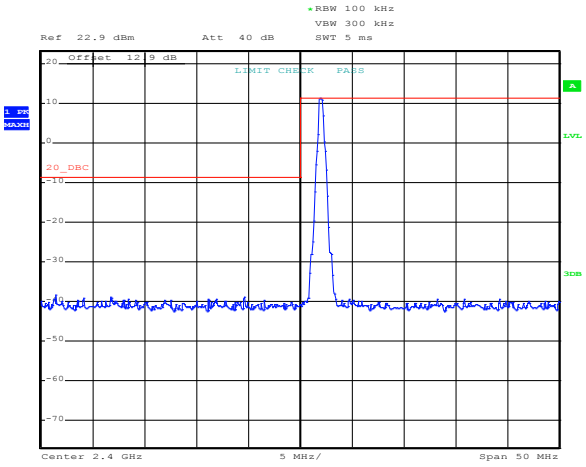

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Figure 8.2-4: *Radiated spurious band edge emission at 2.4 GHz, GFSK modulation, 20 dBc limit*

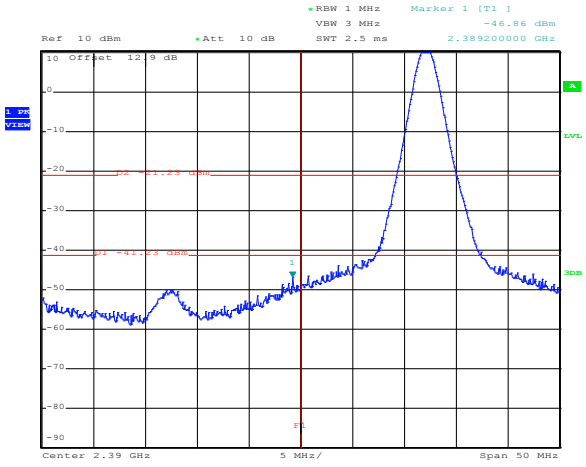

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Figure 8.2-5: *Radiated spurious band edge emission at 2.39 GHz, QPSK modulation, 15.209 limits*

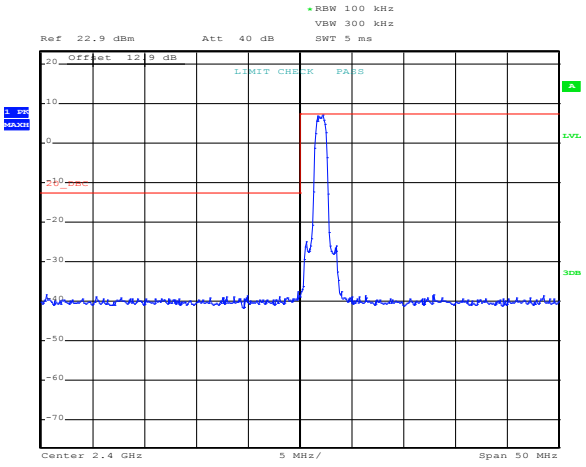

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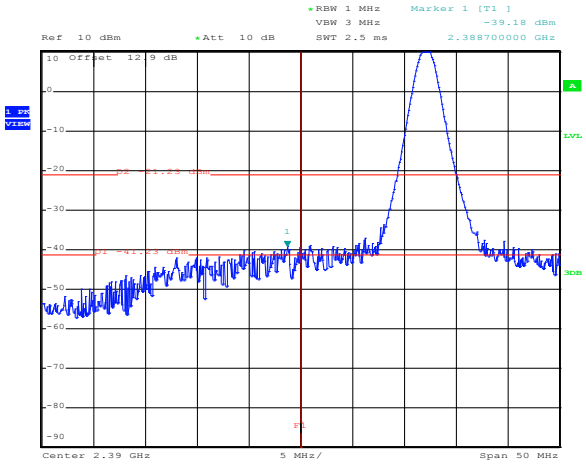
Figure 8.2-6: *Radiated spurious band edge emission at 2.4 GHz, QPSK modulation, 20 dBc limit*

Note: emissions levels measured with peak detector were below the average limits, therefore retesting with average detector was deemed unnecessary.



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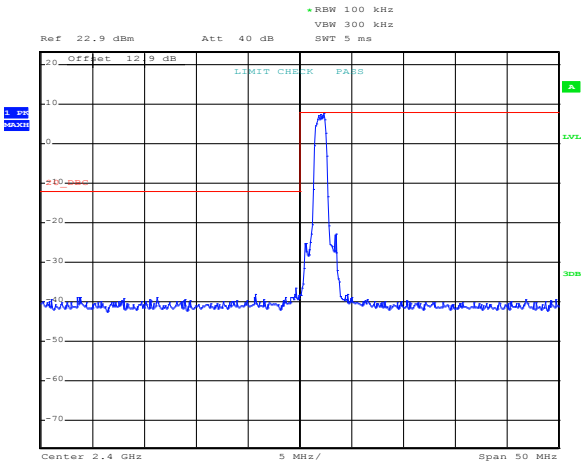

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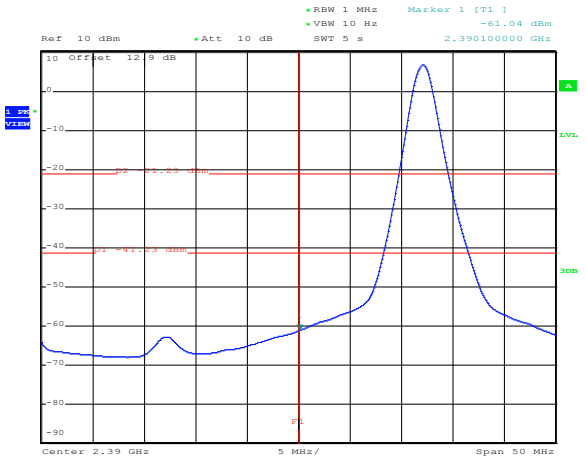

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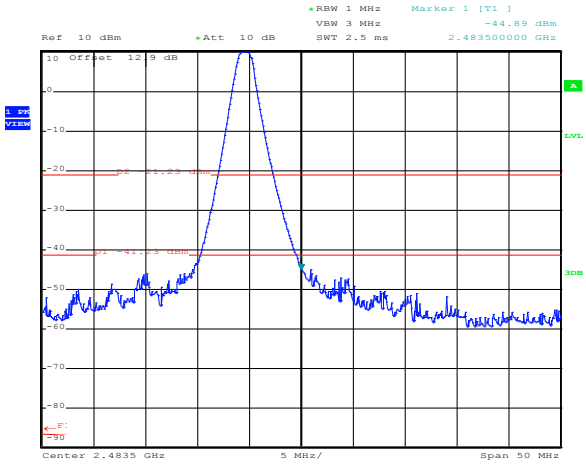
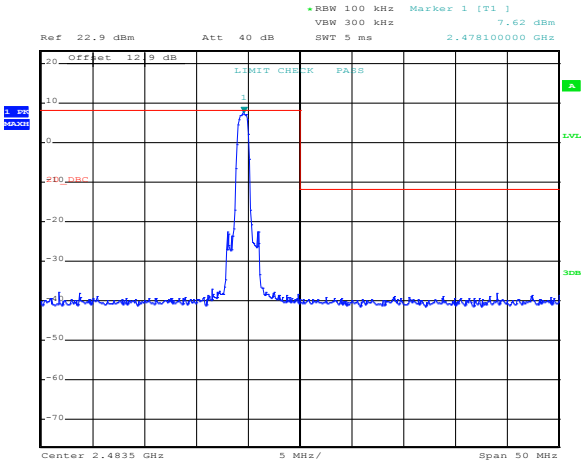
Figure 8.2-7: *Radiated spurious band edge emission at 2.39 GHz, 8DPSK modulation, 15.209 limits*

Figure 8.2-8: *Radiated spurious band edge emission at 2.4 GHz, 8DPSK modulation, 20 dBc limit*



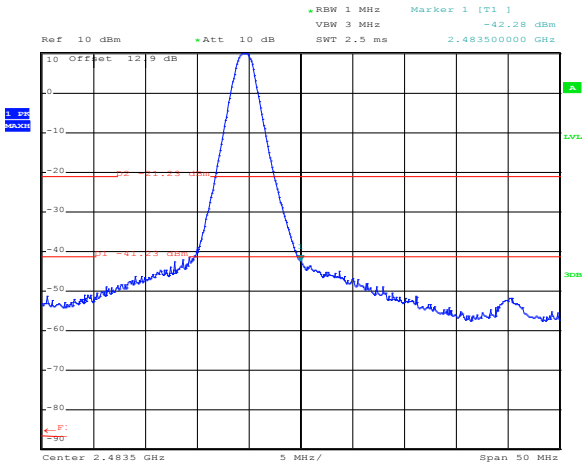
Date: 27.FEB.2018 21:31:25

Figure 8.2-9: *Radiated spurious band edge emission at 2.4835 GHz, QPSK modulation, 15.209 limits*



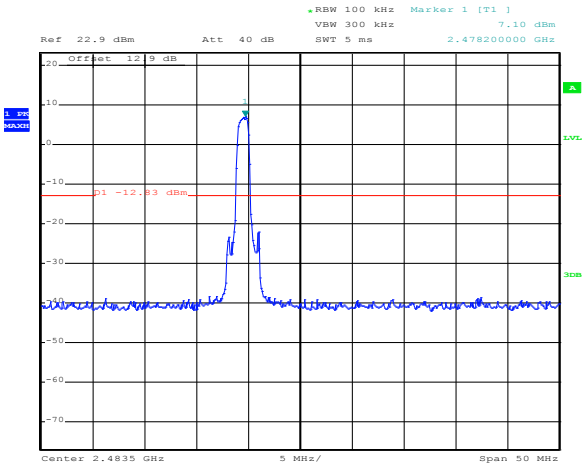
Date: 27.FEB.2018 19:55:34

Figure 8.2-10: *Radiated spurious band edge emission at 2.4835 GHz, QPSK modulation, 20 dBc limit*



Date: 27.FEB.2018 21:33:09

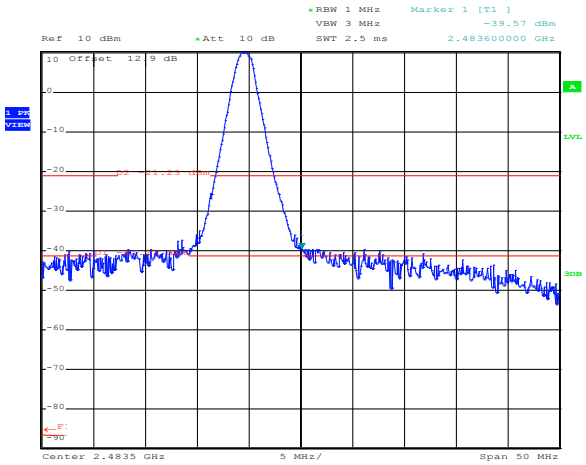
Figure 8.2-11: *Radiated spurious band edge emission at 2.4835 GHz, 8DPSK modulation, 15.209 limits*



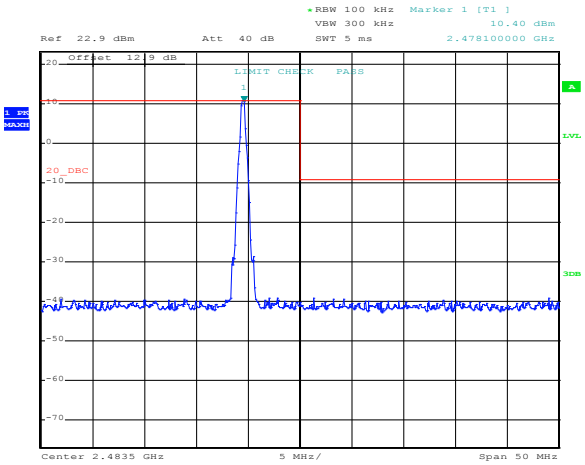
Date: 27.FEB.2018 19:53:56

Figure 8.2-12: *Radiated spurious band edge emission at 2.4835 GHz, 8DPSK modulation, 20 dBc limit*

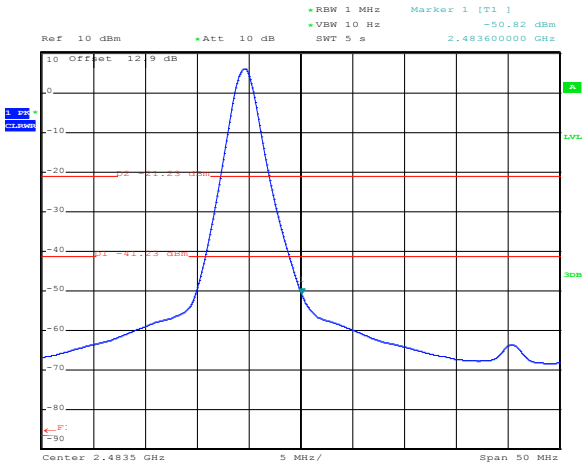
Note: emissions levels measured with peak detector were below the average limits, therefore retesting with average detector was deemed unnecessary.



Date: 27.FEB.2018 21:34:31



Date: 27.FEB.2018 19:57:12



Date: 27.FEB.2018 21:36:35

Figure 8.2-13: *Radiated spurious band edge emission at 2.4835 GHz, GFSK modulation, 15.209 limits*

Figure 8.2-14: *Radiated spurious band edge emission at 2.4835 GHz, GFSK modulation, 20 dBc limit*

Note: emissions levels measured with peak detector were below the average limits, therefore retesting with average detector was deemed unnecessary.

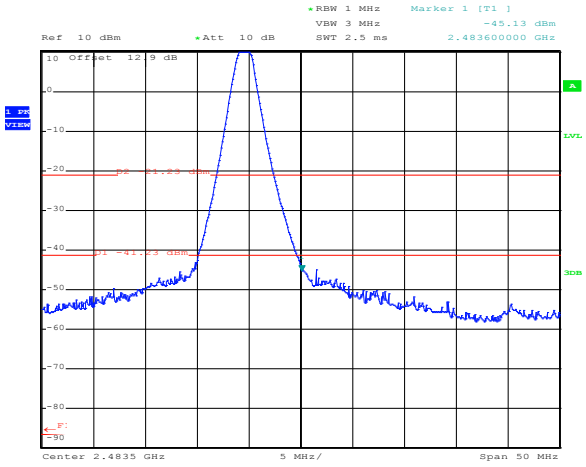


Figure 8.2-15: *Radiated spurious band edge emission at 2.4835 GHz, BLE modulation, 15.209 limits*

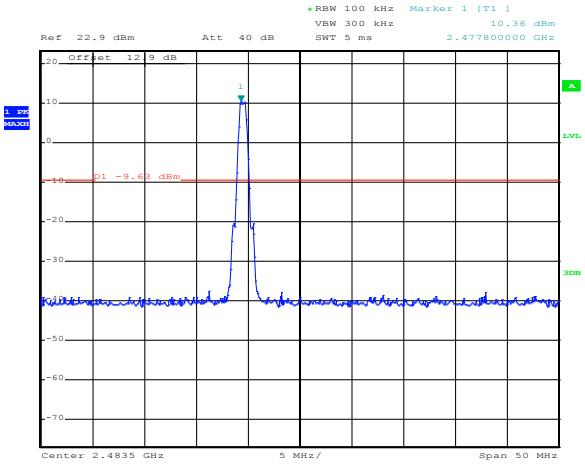
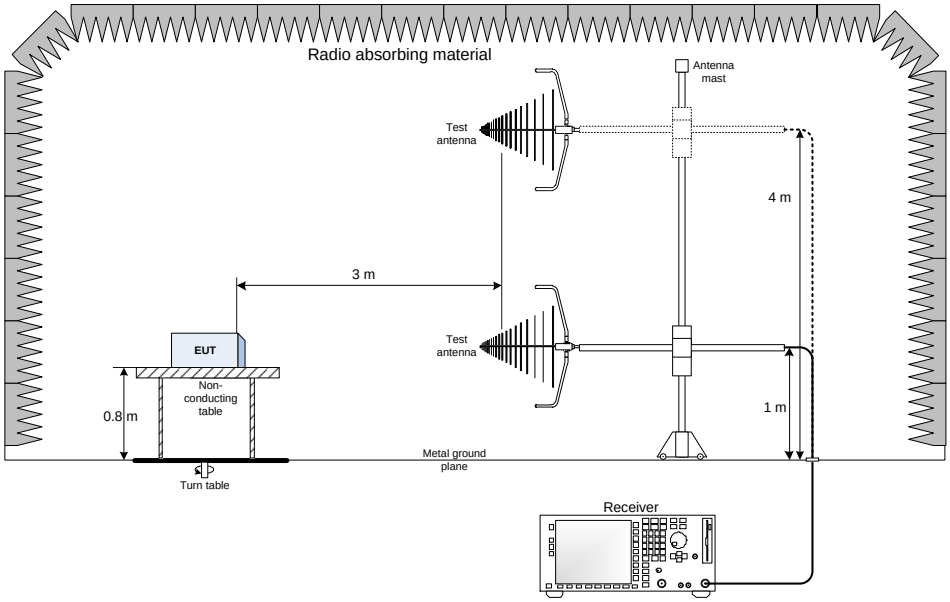


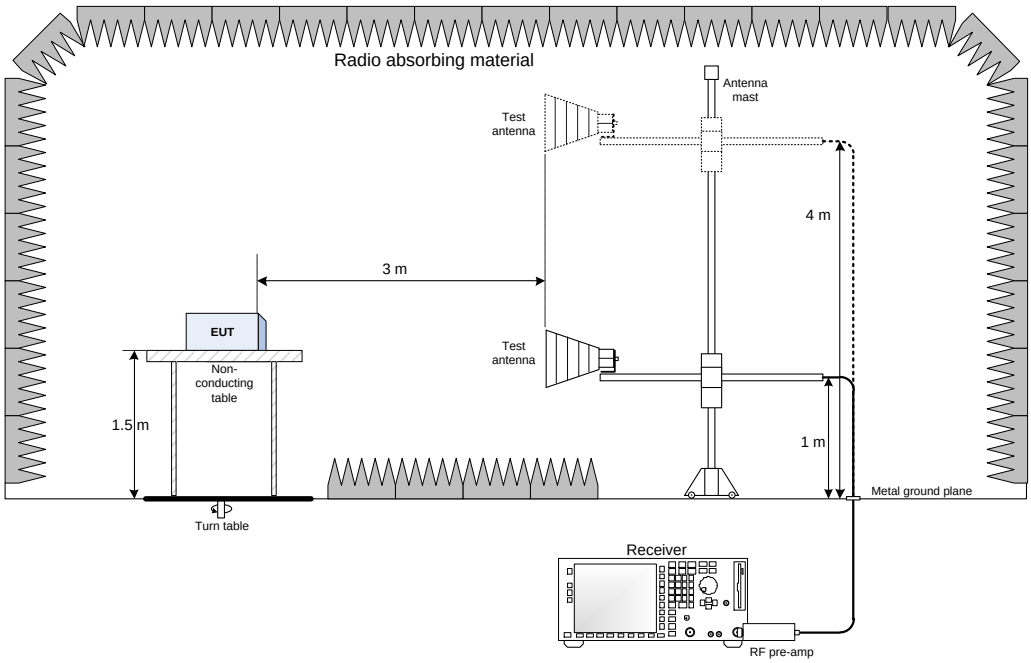
Figure 8.2-16: *Radiated spurious band edge emission at 2.4835 GHz, BLE modulation, 20 dBc limit*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Antenna port set-up