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Nemko Canada Inc., 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Report number: 141816-1TRFWL
Apparatus: P4 UHF 403–477 MHz exciter module
Applicant: Calamp Corporation
5540 Ferrier St, Suite 101
Town of Mont Royal, QC
H4P 1M2, Canada
FCC ID: EOTBDP4-EXCT403

Test specification:

Title 47 – Telecommunication
Chapter I – Federal Communications Commission
Subchapter D – Safety and special radio services
Part 90 – Private land mobile services
Subpart I – General technical standards
– **Radiated and conducted spurious emissions**

Reviewed by: Kevin Ma
Signature
Kevin Ma, Wireless/EMC Specialist

June 3, 2010
Date

Tested by: Andrey Adelberg, Senior Wireless/EMC Specialist

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Report Number: 141816-1TRFWL

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Section 1: Report summary

Report Number: 141816-1TRFWL

Specification: FCC 90

Section 1: Report summary

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc.

Test specification:
FCC Part 90 Private land mobile services
Subpart I – General technical standards

Compliance status:	Complies
Exclusions:	Partial tests were performed as per Nemko quote number 14064R.1.
Non-compliances:	None
Report release history:	Original release
Test location:	Nemko Canada Inc. 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2
Registration number:	176392 (3 m Semi anechoic chamber)

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90. Conducted measurements were performed in accordance with ANSI TIA-603-B-2002. Radiated tests were conducted in accordance with ANSI C63.4-2003.

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

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

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Section 2: Equipment under test

Report Number: 141816-1TRFWL

Specification: FCC 90

Section 2: Equipment under test

2.1 Identification of equipment under test (EUT)

The following information identifies the EUT under test:

Type of equipment:	UHF exciter
Product marketing name:	Patagon4 SDR-T-001-UHF
Model number:	SDR-T-001-403
Serial number:	pre-production sample
Nemko sample number:	1
FCC ID:	EOTBDP4-EXCT403
Date of receipt:	February 18, 2010

2.2 Accessories and support equipment

The following information identifies accessories used to exercise the EUT during testing:

Item # 1	
Type of equipment:	Base station controller/modem module
Brand name:	Paragon4 BSC
Model name or number:	BSC2
Serial number:	pre-production sample
Nemko sample number:	3
Connection port:	Backplane PCB connection
Cable length:	N/A
Item # 2	
Type of equipment:	Low-power digital base station chassis
Brand name:	Paragon 4 chassis
Model name or number:	BDP4-UHF
Model variants:	BDP4-403
Serial number:	pre-production sample
Nemko sample number:	4
Connection port:	Host
Cable length and type:	None

Section 2: Equipment under test, continued

2.3 EUT description

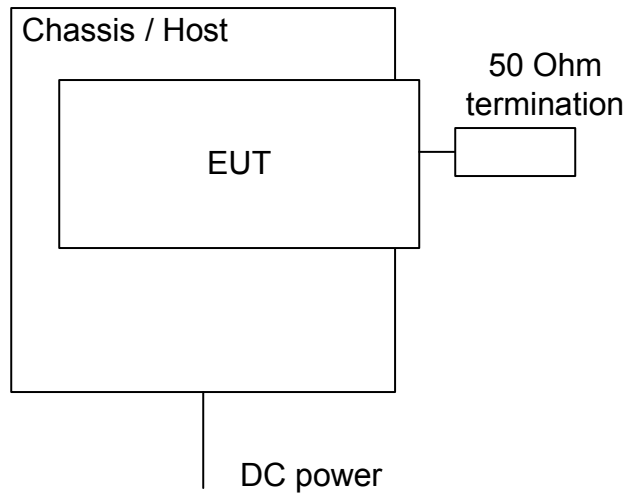
The SDR-T-001-UHF Exciter is a low power output (6–26 dBm), calibrated constant power across the band, synthesized wide carrier frequency adjustment (74 MHz), analog baseband to digital IQ radio transmitter use in the P4 UHF (403–512 MHz) 100W 12.5/25 kHz channel digital base station unit.

2.4 Technical specifications of the EUT

Frequency bands:	406.10000–454.00000 MHz 456.00000–467.53750 MHz 467.73750–512.00000 MHz				
Operating frequencies:	<u>12.5 kHz channel:</u> 406.10625–453.99375 MHz 456.00625–467.53125 MHz 467.74375–511.99375 MHz		<u>25 kHz channel:</u> 406.11250–453.98750 MHz 456.01250–467.52500 MHz 467.76150–511.98750 MHz		
Modulation type:	<u>12.5 kHz channel:</u> 32 kbps 16-lvl FSK, 24 kbps 8-lvl FSK, 21.6 kbps 8-lvl FSK, 16/14.4 kbps 4-lvl FSK, 9.6/8 kbps 2-lvl FSK		<u>25 kHz channel:</u> 64 kbps 16-lvl FSK, 48/43.2 kbps 8-lvl FSK, 32/25.6/19.2 kbps 4-lvl FSK, 19.2/9.6 kbps 2-lvl FSK		
Channel bandwidth:	12.5 kHz and 25 kHz				
Antenna type:	Detachable/ External Antenna Removable antenna supplied and type tested with the radio equipment (Equipment that has an external 50 Ω RF connector)				
Power source:	10–16 VDC external				
Emission designator:	Channel BW (kHz)	Bit Rate (kbps)	Pulse shape and modulation type	Occupied Bandwidth (Hz)	Emission designator
	24	SRRC 8-lvl FSK	8167	8K30F1D	
	21.6	SRRC 8-lvl FSK	8000	8K10F1D	
	16	SRRC 4-lvl FSK	7667	7K80F1D	
	14.4	SRRC 4-lvl FSK	8000	8K10F1D	
	9.6	DGMSK 2-lvl FSK	8000	8K10F1D	
	25	8	DGMSK 2-lvl FSK	8167	8K30F1D
		64	SRRC 16-lvl FSK	16000	16K1F1D
		48	SRRC 8-lvl FSK	15670	15K8F1D
		43.2	SRRC 8-lvl FSK	15670	15K8F1D
		32	SRRC 4-lvl FSK	16000	16K1F1D
		25.6	SRRC 4-lvl FSK	14588	14K7F1D
		19.2	SRRC 4-lvl FSK	15799	15K9F1D
	19.2	DGMSK 2-lvl FSK	14443	14K6F1D	
9.6	DGMSK 2-lvl FSK	13613	13K8F1D		

Section 2: Equipment under test, continued

2.5 EUT setup diagram



2.6 Operation of the EUT during testing

The EUT was set to transmit continuously on the selected channels

2.7 Modifications incorporated in the EUT

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



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Section 3: Test conditions

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Section 3: Test conditions

3.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

3.2 Test conditions, power source and ambient temperatures

Normal temperature, humidity and air pressure test conditions	Temperature: 15–30 °C Relative humidity: 20–75 % Air pressure: 86–106 kPa When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.
Power supply range:	The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.



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Section 3: Test conditions

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Section 3: Test conditions, continued

3.3 Measurement uncertainty

Nemko Canada measurement uncertainty has been calculated using guidance of UKAS LAB 34:2003 and TIA-603-B Nov 7, 2002. All calculations have been performed to provide a confidence level of 95 % and can be found in Nemko Canada document MU-003.

3.4 Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	May 06/10
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR
Controller	Sunol	SC104V	FA002060	NCR
Mast	Sunol	TLT2	FA002061	NCR
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Jan. 14/11
Spectrum Analyzer	Rohde & Schwarz	FSU	FA001877	Sept. 29/10
Horn Antenna #2	EMCO	3115	FA000825	Jan. 18/11
1 – 18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 07/10
Bilog	Sunol	JB3	FA002108	Jan. 18/11

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use



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Section 4: Result summary

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Specification: FCC 90

Section 4: Result summary

4.1 FCC Part 90: Test results

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N	No : not applicable / not relevant.
Y	Yes : Mandatory i.e. the apparatus shall conform to these tests.
N/T	Not Tested, mandatory but not assessed. (See report summary)

Part	Test method	Test description	Required	Result
§90.205	§2.1046	Output power	N/T	
§90.207	§2.1047	Modulation Characteristics	N/T	
§90.209	§2.1049	Occupied bandwidth	N/T	
§90.210	§2.1051	Spurious Emissions at the antenna terminal	Y	Pass
§90.210	§2.1053	Field strength of spurious radiation	Y	Pass
§90.213	§2.1055	Frequency stability	N/T	
§90.214	–	Transient Behavior	N	
§90.219	–	Use of boosters	N	

Notes: Partial tests were performed according to quote number 14064R.1.



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Appendix A: Test results

Report Number: 141816-1TRFWL

Specification: FCC 90

Appendix A: Test results

Clause 90.210 Spurious emissions at the antenna terminal

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Applicable Emission Masks:

Frequency band (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
421–512	B, D, or E	C, D, or E
All other bands	B	C

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Test date: April 16, 2010

Test results: Pass

Special notes

The EUT does not utilize audio low pass filter.

All spurious measurements were performed using 100 kHz/300 kHz RBW/VBW below 1 GHz and 1 MHz/3 MHz RBW/VBW above 1 GHz.

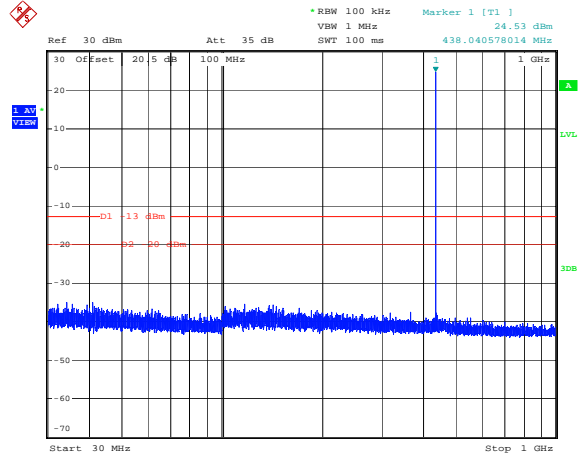


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Clause 90.210 Spurious emissions at the antenna terminal, continued

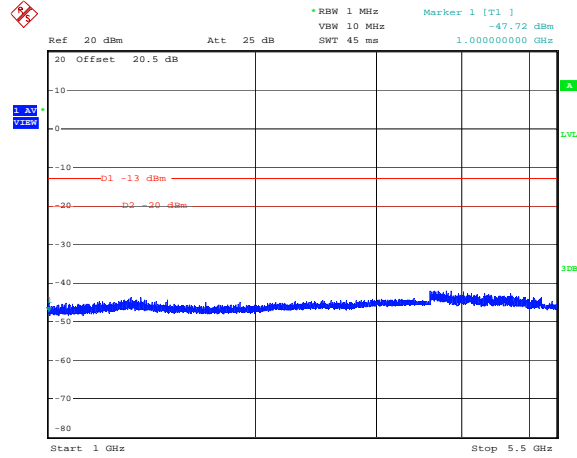
Test data

Low channel



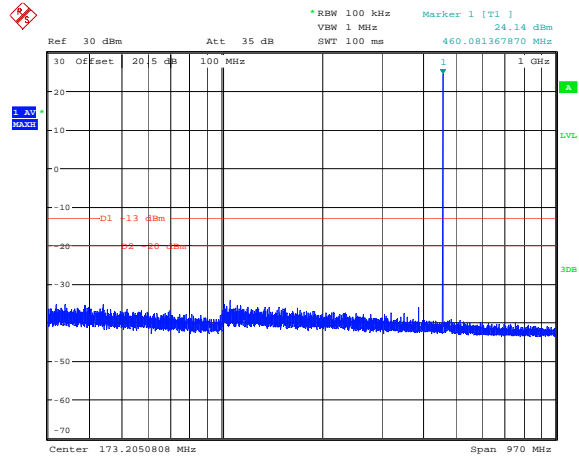
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Low channel



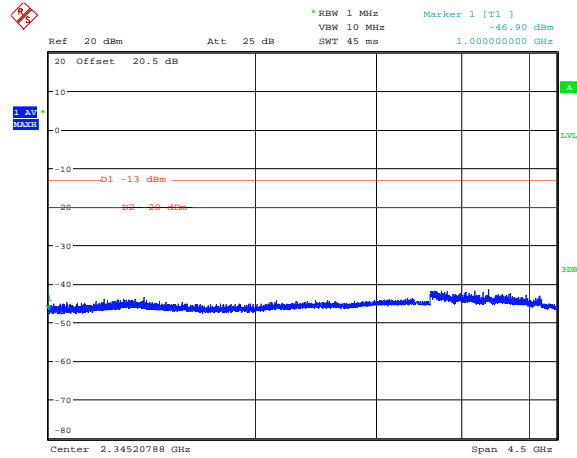
Date: 16.APR.2010 13:35:21

Mid channel



Date: 16.APR.2010 13:47:23

Mid channel



Date: 16.APR.2010 13:50:01

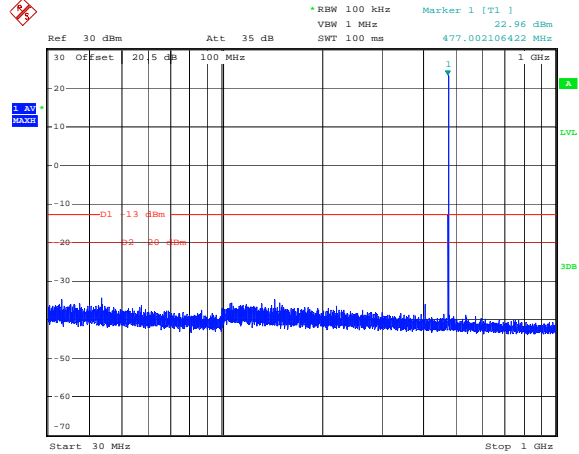


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Clause 90.210 Spurious emissions at the antenna terminal, continued

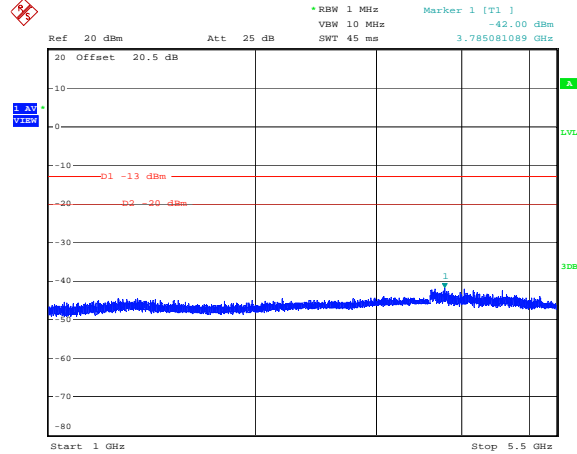
Test data, continued

High channel



Date: 16.APR.2010 13:53:56

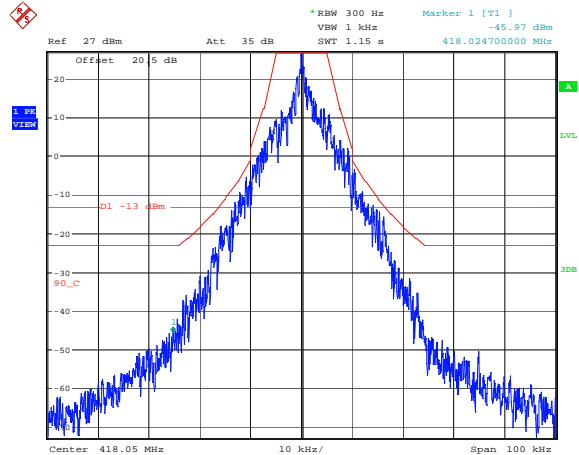
High channel



Date: 16.APR.2010 13:54:30

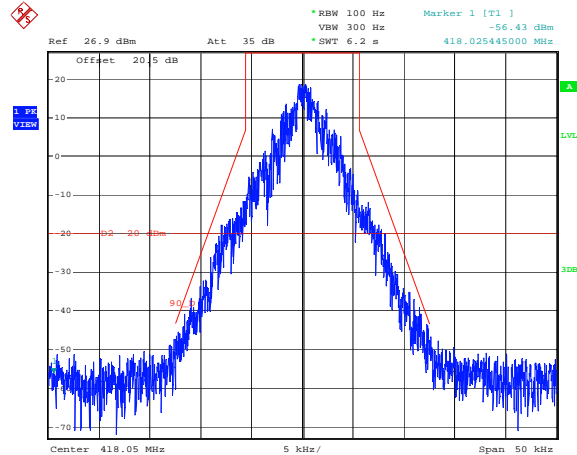
Sample mask plots:

Mask C



Date: 16.APR.2010 14:15:15

Mask D



Date: 16.APR.2010 14:07:19

Emission mask C was performed using 300 Hz/1 kHz RBW/VBW settings
Emission mask D was performed using 100 Hz/300 Hz RBW/VBW settings



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Appendix A: Test results

Report Number: 141816-1TRFWL

Specification: FCC 90

Clause 90.210 Spurious emissions at the antenna terminal, continued

Tabular data

Channels for testing:

<u>12.5 kHz channel</u>			<u>25 kHz channel</u>		
Ch	Frequency	Band	Ch	Frequency	Band
Low:	406.10625 MHz	406.1–454 MHz	Low:	406.1125 MHz	406.1–454 MHz
Mid:	460.00000 MHz	456–467.5375 MHz	Mid:	460.0000 MHz	456–467.5375 MHz
High:	477.00000 MHz	467.73750–512 MHz	High:	477.0000 MHz	467.73750–512 MHz

Notes: both 12.5 and 25 kHz channels were assessed.
Worst case emissions were observed when system was set to 12.5 kHz channel.
Mask D is applicable for 12.5 kHz channel w/o audio LPF – which has a stringent limit line for spurious emissions.

Channel	Frequency, MHz	Level, dBm	Limit, dBm	Margin, dB
Low	477.17	-40.32	-20.00	20.32
Low	1218.09	-43.96	-20.00	23.96
Mid	378.98	-40.03	-20.00	20.03
Mid	1349.87	-40.22	-20.00	20.22
High	406.09	-40.63	-20.00	20.63
High	1410.04	-34.97	-20.00	14.97

Notes: both 12.5 and 25 kHz channels were assessed. Worst case emissions were observed when system was set to 12.5 kHz channel. Mask D is applicable for 12.5 kHz channel w/o audio LPF – which has a stringent limit line for spurious emissions.

Clause 90.210 Field strength of spurious radiation

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

§ 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

- (1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz.
- (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
- (4) Other types of equipment as required, when deemed necessary by the Commission.

Test date: February 18, 2010

Test results: Pass

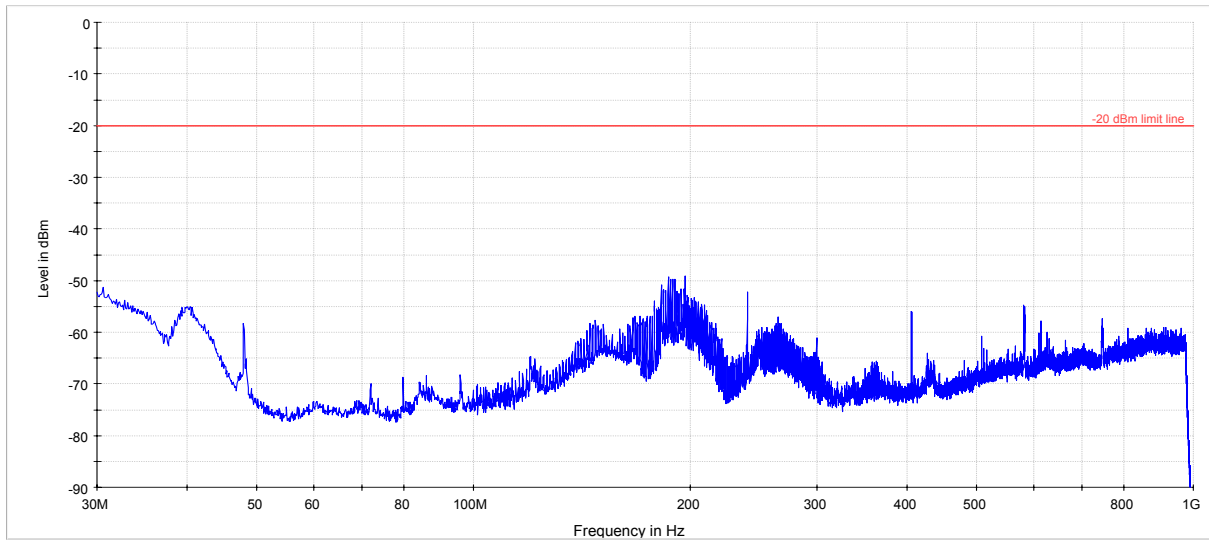
Special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
- All measurements were performed at a distance of 3 m.
- Only the worst data presented in the test report.
- All spurious measurements were performed using 100 kHz/300 kHz RBW/VBW below 1 GHz and 1 MHz/3 MHz RBW/VBW above 1 GHz.
- The results were obtained using substitution method technique.

Clause 90.210 Field Strength of spurious radiation, continued

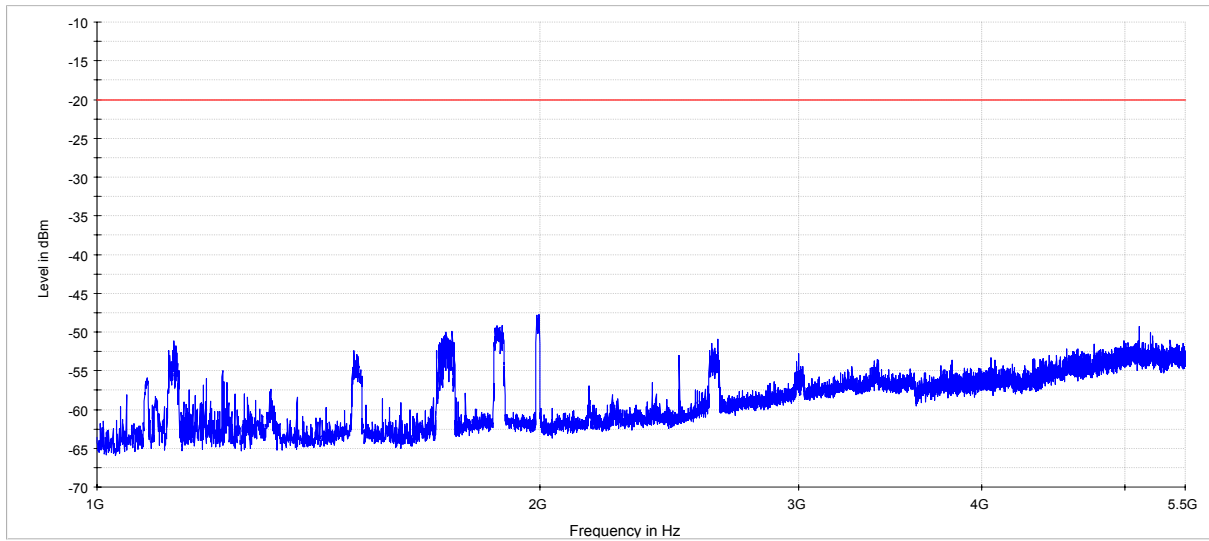
Test data

Low channel



Radiated spurious emissions on P4 with SDR-001-T-403

— MaxPeak-MaxHold
— -20 dBm limit line



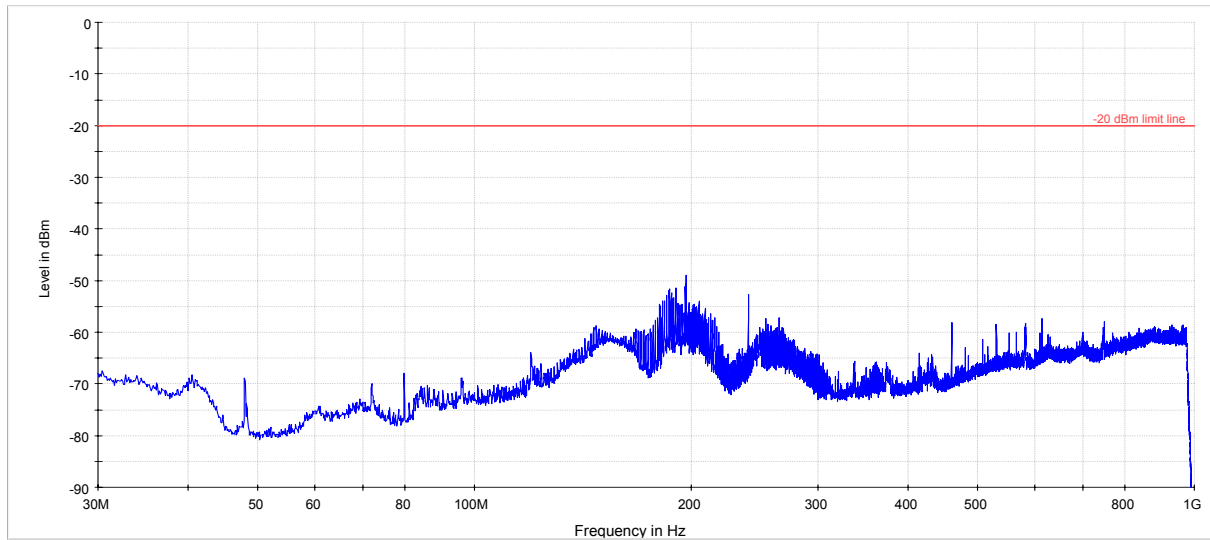
Radiated spurious emissions on P4 with SDR-001-T-403

— MaxPeak-MaxHold
— -20 dBm limit line

Clause 90.210 Field Strength of spurious radiation, continued

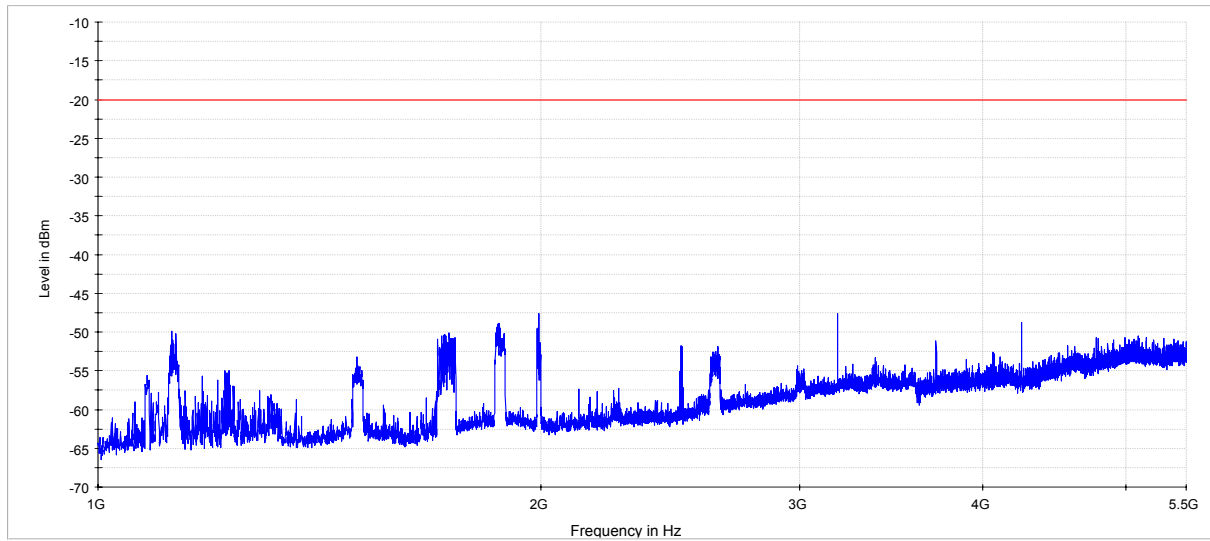
Test data, continued

Mid channel



Radiated spurious emissions on P4 with SDR-001-T-403

— MaxPeak-MaxHold
— -20 dBm limit line



Radiated spurious emissions on P4 with SDR-001-T-403

— MaxPeak-MaxHold
— -20 dBm limit line

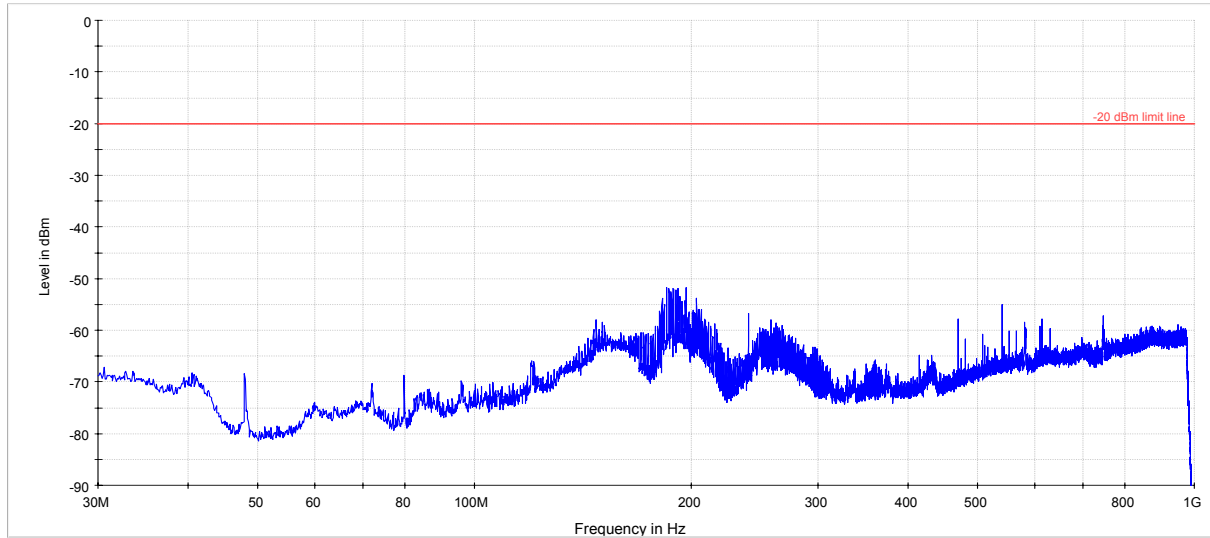


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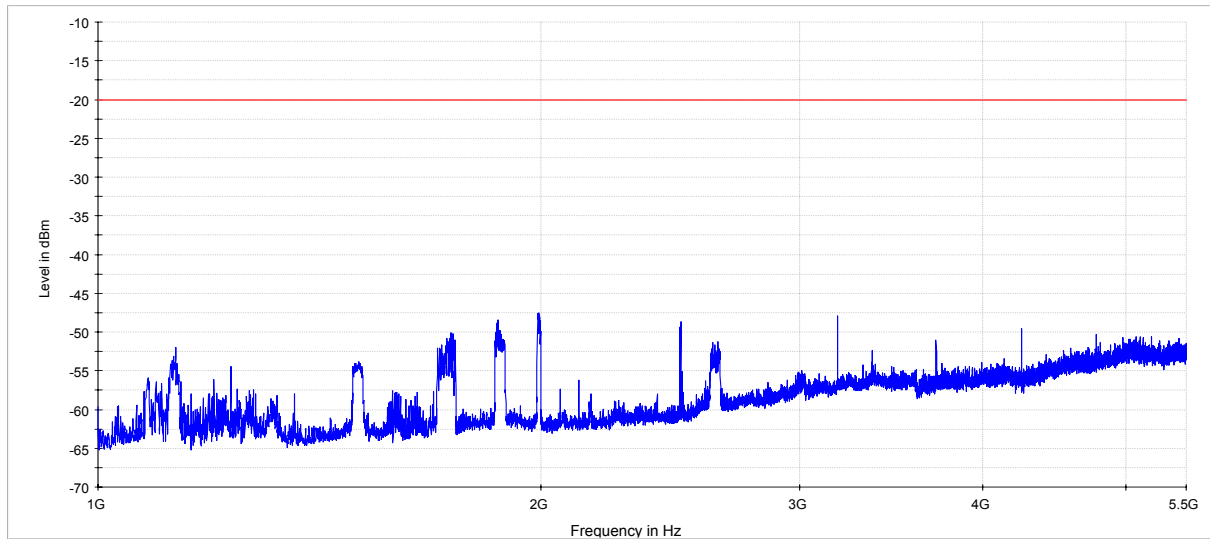
Clause 90.210 Field Strength of spurious radiation, continued

Test data, continued

High channel



Radiated spurious emissions on P4 with SDR-001-T-403
— MaxPeak-MaxHold
— -20 dBm limit line



Radiated spurious emissions on P4 with SDR-001-T-403
— MaxPeak-MaxHold
— -20 dBm limit line

Clause 90.210 Field Strength of spurious radiation, continued

Tabular data

Channels for testing:

<u>12.5 kHz channel</u>			<u>25 kHz channel</u>		
Ch	Frequency	Band	Ch	Frequency	Band
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Mid:	460.00000 MHz	456–467.5375 MHz	Mid:	460.0000 MHz	456–467.5375 MHz
High:	477.00000 MHz	467.73750–512 MHz	High:	477.0000 MHz	467.73750–512 MHz

Notes: both 12.5 and 25 kHz channels were assessed.

Worst case emissions were observed when system was set to 12.5 kHz channel.

Channel	Frequency (MHz)	Field strength (dB μ V/m)	Substitution factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
Low	1990.86	57.69	-113.77	-56.08	-20.00	36.08
Mid	1255.03	59.24	-116.00	-56.76	-20.00	36.76
Mid	1994.57	58.60	-113.77	-55.17	-20.00	35.17
High	4384.17	58.53	-105.20	-46.67	-20.00	26.67

Note: Field strength includes antenna, cable loss, and amplifier factors.

Appendix B: Block diagrams of test set-ups

Radiated emissions set-up

