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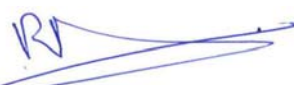
Report Reference ID:	152568-2R1TRFWL
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Test specification:	<p>Title 47 - Telecommunication Chapter I - Federal Communications Commission Subchapter A - General Part 15 - Radio Frequency Devices Subpart C - Intentional Radiators</p> <p>§15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz</p>
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Applicant:	<p>SMART Technologies ULC. 3636 Research Road NW Calgary, AB T2L 1Y1 Canada</p>
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Apparatus:	SMART Response XE
Model:	03-00182
FCC ID:	QCISRP03

Testing laboratory:	<p>Nemko Canada Inc. 303 River Road Ottawa, ON, Canada K1V 1H2</p> <p>Telephone: (613) 737-9680 Facsimile: (613) 737-9691</p>
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	Name and title	Date
Tested by:	Andrey Adelberg, Senior Wireless/EMC Specialist	August 17, 2010
Reviewed by:	 Richard Brazeau, Laboratory Manager	August 17, 2010



Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada.
 The tests included in this report are within the scope of this accreditation.



Nemko Canada Inc.
303 River Rd, Ottawa, ON, Canada, K1V 1H2

Product: SMART Response XE

Table of contents

Section 1: Report summary	3
1.1 Test specification	3
1.2 Statement of compliance	3
1.3 Exclusions.....	3
1.4 Registration number	3
1.5 Test report revision history.....	3
1.6 Limits of responsibility.....	3
Section 2: Summary of test results	4
2.1 FCC Part 15 Subpart C – Intentional Radiators, test results.....	4
Section 3: Equipment under test (EUT) and application details.....	5
3.1 Applicant details.....	5
3.2 Modular equipment	5
3.3 Product details	5
3.4 Application purpose	5
3.5 Composite/related equipment.....	6
3.6 Sample information.....	6
3.7 EUT technical specifications	6
3.8 Operation of the EUT during testing	6
3.9 EUT setup diagram.....	7
Section 4: Engineering considerations.....	8
4.1 Modifications incorporated in the EUT	8
4.2 Deviations from laboratory tests procedures.....	8
4.3 Technical judgment.....	8
Section 5: Test conditions	9
5.1 Power source and ambient temperatures	9
Section 6: Measurement uncertainty	10
Section 7: Test equipment	11
7.1 Test equipment list.....	11
Section 8: Testing data.....	12
8.1 Clause 15.31(e) Variation of power source.....	12
8.2 Clause 15.31(m) Number of operating frequencies	13
8.3 Clause 15.203 Antenna requirement	14
8.4 Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques	15
8.5 Clause 15.247(b) Maximum peak conducted output power	18
8.6 Clause 15.247(d) Spurious emissions	22
8.7 Clause 15.247(e) Power spectral density for digitally modulated devices.....	33
Section 8: Block diagrams of test set-ups.....	36
Section 9: EUT photos.....	37

Section 1: Report summary

1.1 Test specification

Specifications

FCC Part 15 Subpart C, 15.247

Operation within the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz.

1.2 Statement of compliance

Compliance

In the configuration tested the EUT was found compliant

Yes No

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15; Subpart C. Radiated tests were conducted in accordance with ANSI C63.4-2003.

1.3 Exclusions

Exclusions

None

1.4 Registration number

Test site FCC ID number

176392 (3 m Semi anechoic chamber)

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued
R1TRF	Applicant name correction from SMART Technologies Inc to SMART Technologies ULC.

1.6 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.

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Section 2: Summary of test results

2.1 FCC Part 15 Subpart C – Intentional Radiators, test results

General requirements for FCC Part 15

Part	Test description	Verdict
§15.31(e)	Variation of power source	Pass
§15.31(m)	Number of operating frequencies	Pass
§15.203	Antenna requirement	Pass
§15.207(a)	Conducted limits	N/A

Specific requirements for FCC Part 15 Subpart C, 15.247

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	N/A
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	N/A
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	N/A
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§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	N/A
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	N/A
§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	N/A
§15.247(b)(4)	Maximum peak output power	Pass
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	N/A
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	N/A
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Pass
§15.247(f)	Time of occupancy for hybrid systems	N/A

Notes: None



Section 3: Equipment under test (EUT) and application details

3.1 Applicant details

Applicant complete business name	Name:	SMART Technologies ULC.
	Federal Registration Number (FRN):	0006983860
	Grantee code	QCI
Mailing address	Address:	3636 Research Road NW
	City:	Calgary
	Province/State:	AB
	Post code:	T2L 1Y1
	Country:	Canada

3.2 Modular equipment

a) Single modular approval	Single modular approval Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
b) Limited single modular approval	Limited single modular approval Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>

3.3 Product details

FCC ID	Grantee code:	QCI
	Product code:	SPR03
Equipment class	DTS – Digital Transmission system	
Description of product as it is marketed	The Response XE product is a classroom interactive response system consisting of remote units and a receiver (coordinator) unit. Communication between the receiver and remote is performed using a wireless interface based on the IEEE 802.15.4 protocol in the 2.4 GHz band at 250 kbps. The remote is a handheld battery-powered device with an LCD screen and keypad. The hardware implements antenna diversity with 2 integrated inverted-F antennas. (These antennas are mirrors of each other and can not transmit simultaneously). The typical range is specified to be 100 m under normal operating conditions (open lecture hall), and a minimum of 30 m under worst case operating conditions (obstructions and antenna cross polarization). The user powers on the remote using the power button located on the top of the unit.	
	Model name/number:	03-00182
	Serial number:	Prototype

3.4 Application purpose

Type of application	<input checked="" type="checkbox"/> Original certification <input type="checkbox"/> Change in identification of presently authorized equipment Original FCC ID: _____ Grant date: _____ <input type="checkbox"/> Class II permissive change or modification of presently authorized equipment
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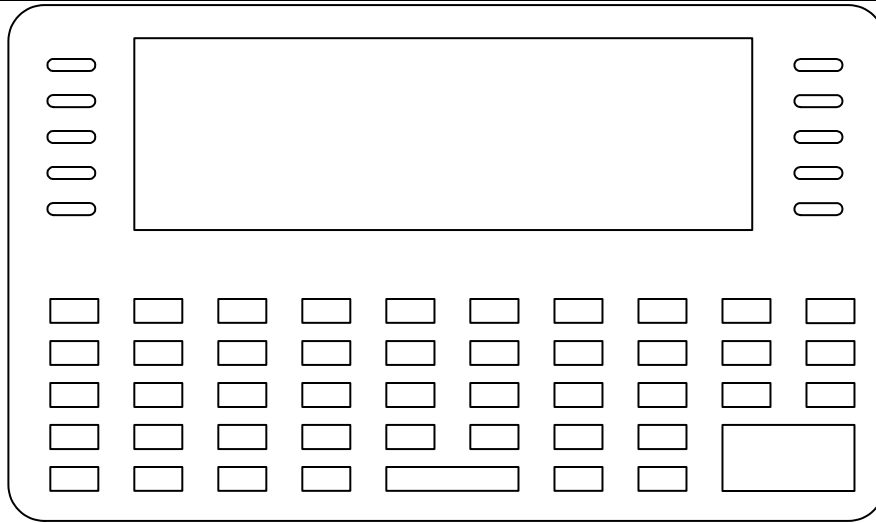
3.5 Composite/related equipment	
a) Composite equipment	The EUT is a composite device subject to an additional equipment authorization Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
b) Related equipment	The EUT is part of a system that operates with, or is marketed with, another device that requires an equipment authorization Yes <input type="checkbox"/> No <input type="checkbox"/>
c) Related FCC ID	If either of the above is "yes": <input type="checkbox"/> has been granted under the FCC ID(s) listed below: <input type="checkbox"/> is in the process of being filled under the FCC ID(s) listed below: <input type="checkbox"/> is pending with the FCC ID(s) listed below: <input type="checkbox"/> has a mix of pending and granted statuses under the FCC ID(s) listed below: i FCC ID: ii FCC ID:

3.6 Sample information	
Receipt date:	June 24 and July 19, 2010
Nemko sample ID number:	1 (Beta v.1) and 6 (Beta v.2)

3.7 EUT technical specifications	
Operating band:	2400–2483.5 MHz
Operating frequency:	2405–2480 MHz
Modulation type:	Offset-QPSK
Occupied bandwidth:	1.23 MHz (6 dB BW)
Channel spacing:	5 MHz
Emission designator:	G1D
Antenna type:	Two integral diversity antennas, 3.3 dBi Permanent fixed antenna, which may be built-in, (Equipment does not have an external 50 Ω RF connector)
Power source:	6 VDC from 4×Type "AAA" batteries

3.8 Operation of the EUT during testing	
Details:	A special firmware load specific for regulatory testing has been provided to Nemko. This firmware transmits with 100 % duty cycle on low, mid, high channels. It also provides a receive-only mode, and a mode that emulates a 17 % system duty cycle.

3.9 EUT setup diagram



Section 4: Engineering considerations

4.1 Modifications incorporated in the EUT

Modifications

Modifications performed to the EUT during this assessment
 None Yes , performed by Client or Nemko
 Details:

4.2 Deviations from laboratory tests procedures

Deviations

Deviations from laboratory test procedures
 None Yes - details are listed below:

4.3 Technical judgment

Judgment

Changes between Beta v.1 and Beta v.2:

- None of the RF circuitry is being affected by the changes. The adjustments are for ESD and robustness.
- Reroute lines away from battery springs that make contact to the PCB.
 - keypad lines,
 - SPI bus lines and
 - JTAG lines. (JTAG lines are not active during normal operation. They are used only as test mode lines in manufacturing).
- Power button pins swapped (GND and switched signal pins are swapped).
- Add footprints for ESD protection. The ESD diodes will not be populated until deemed required.
- Removed 0 Ω resistor connecting 3.3 V regulator enable to V_{in} .
- Added test point to this area.
- Increased plane pullback from 0.5 mm to 2.5 mm on internal GND and PWR planes.
 - Internal plane copper is not present in the antenna and antenna trace areas.

Section 5: Test conditions

5.1 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.

Section 6: 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.




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Section 7: Test equipment

7.1 Test equipment list

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	Mar. 09/11
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR
Controller	Sunol	SC104V	FA002060	NCR
Antenna Mast	Sunol	TLT2	FA002061	NCR
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Jan. 14/11
Bilog Antenna	Sunol	JB3	FA002108	Jan. 18/11
Horn Antenna #2	EMCO	3115	FA000825	Jan. 18/11
1-18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 07/10
Horn 18-26.5 GHz	Electro-Metrics	SH-50/60-1	FA000479	COU
18-26 GHz Amplifier	NARDA	BBS-1826N612	FA001550	COU

Note: N/A = Not applicable, NCR = No cal required, COU = Cal on use

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: SMART Response XE
	Test name: Clause 15.31(e) Variation of power source		
	Test date: June 29, 2010	Test engineer: Andrey Adelberg	Verdict: Pass
	Specification: FCC Part 15 Subpart A		

Section 8: Testing data

8.1 Clause 15.31(e) Variation of power source

§ 15.31 Measurement standards.

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

Special notes

None

Test data

– All tests were performed with new battery.



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Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.31(m) Number of operating frequencies			
Test date: June 29, 2010		Test engineer: Andrey Adelberg	Verdict: Pass
Specification: FCC Part 15 Subpart A			

8.2 Clause 15.31(m) Number of operating frequencies

§ 15.31 Measurement standards.

(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz and less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom


Special notes

None

Test data

The frequency band is 83.5 MHz therefore number of operating frequencies is 3.

Low frequency / channel	2405 MHz
Mid frequency / channel	2445 MHz
High frequency / channel	2480 MHz

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data	Product: SMART Response XE	
	Test name: Clause 15.203 Antenna requirement		
	Test date: July 20, 2010	Test engineer: Andrey Adelberg	Verdict: Pass
	Specification: FCC Part 15 Subpart C		

8.3 Clause 15.203 Antenna requirement

§ 15.203 Antenna requirement.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

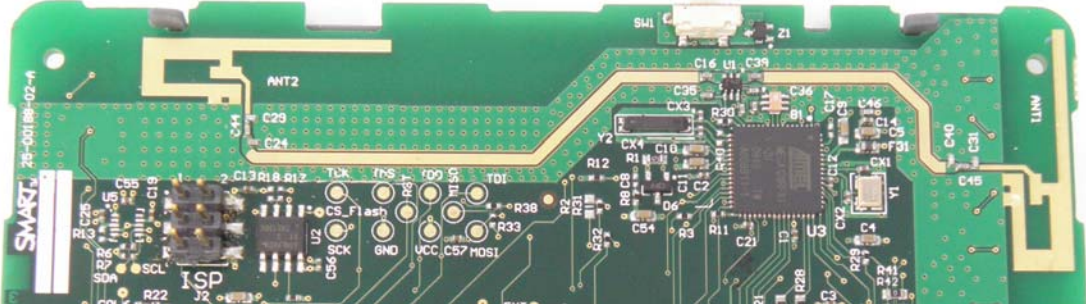
Special notes


None

Test data

The EUT uses a non-detachable/printed antenna to the intentional radiator.

Detailed photo of printed antennas



 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: SMART Response XE	
	Test name: Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques			
	Test date: June 29, 2010		Test engineer: Andrey Adelberg	
	Verdict: Pass		Supply input: Batteries	
	Temperature: 23 °C	Air pressure: 1006 mbar	Relative humidity: 35 %	
Specification: FCC Part 15 Subpart C				

8.4 Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

- (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:
- (2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Special notes

The peak detector was used with 100 kHz/300 kHz RBW/VBW
The span was wider than emission bandwidth.



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Section 8: Testing data

Product: SMART Response XE

Test name: Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques

Test date: June 29, 2010

Test engineer: Andrey Adelberg

Verdict: Pass

Supply input: Batteries

Temperature: 23 °C

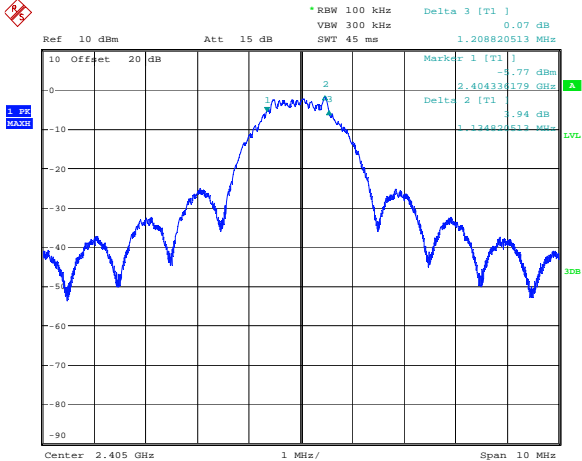
Air pressure: 1006 mbar

Relative humidity: 35 %

Specification: FCC Part 15 Subpart C

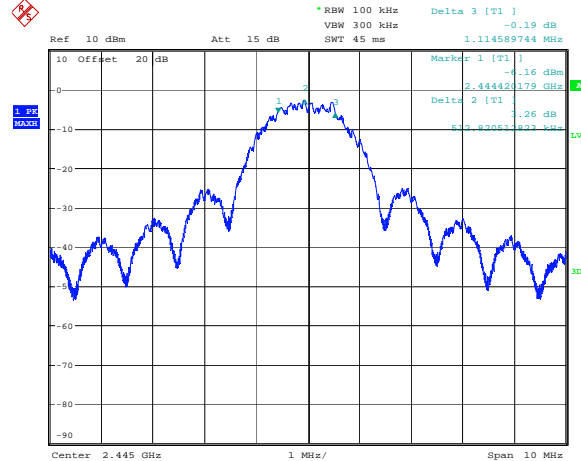
Test data

Low channel, antenna 1



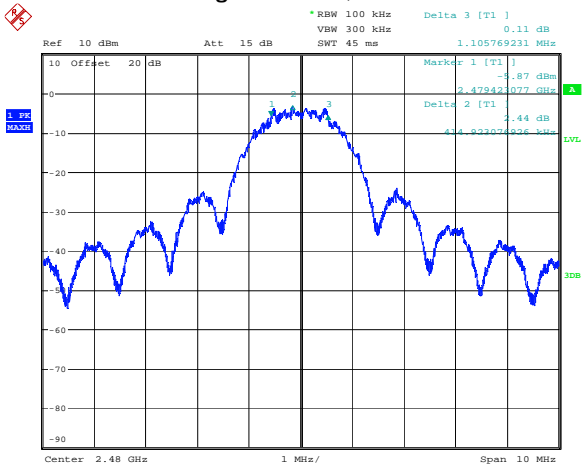
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Mid channel, antenna 1



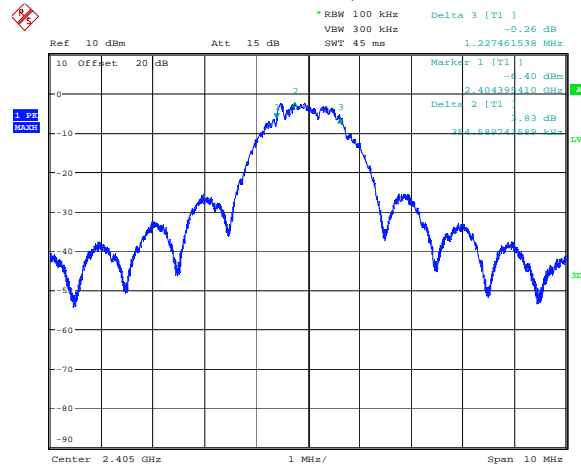
Date: 29.JUN.2010 11:45:30

High channel, antenna 1



Date: 29.JUN.2010 11:46:28

Low channel, antenna 2



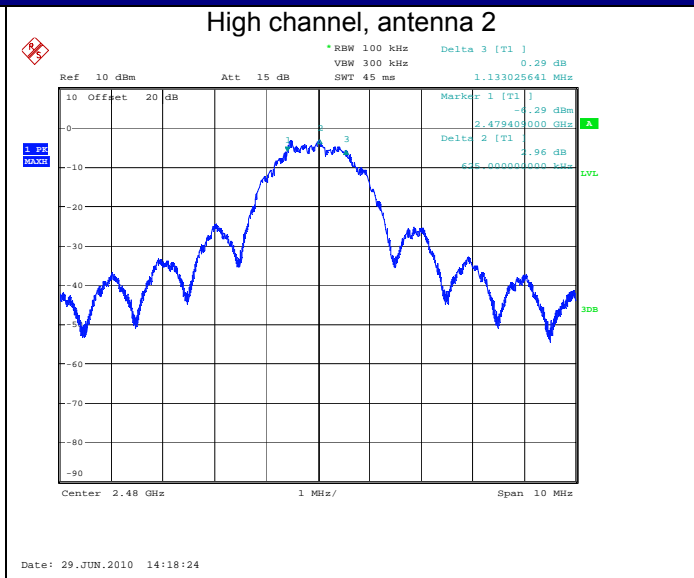
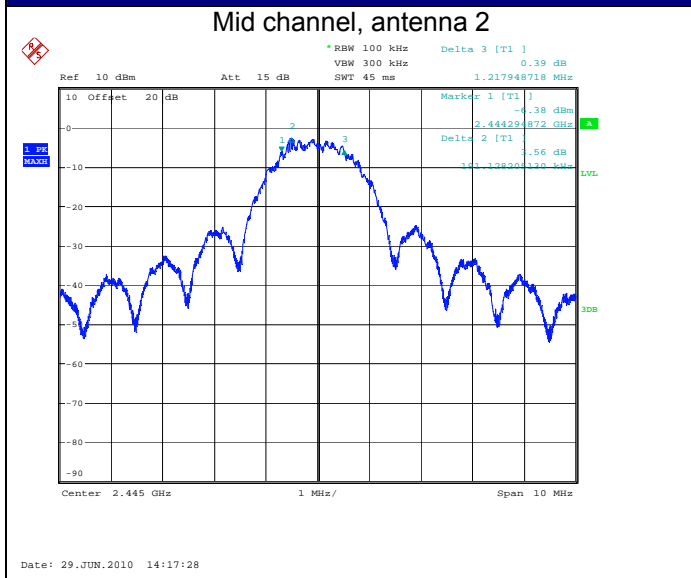
Date: 29.JUN.2010 14:16:21




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Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques			
Test date: June 29, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 23 °C	Air pressure: 1006 mbar	Relative humidity: 35 %	
Specification: FCC Part 15 Subpart C			

Test data, continued



Frequency (MHz)	6 dB bandwidth (MHz)	Limit (MHz)	Margin (MHz)
Antenna 1			
2405	1.208	> 0.5	0.708
2445	1.114	> 0.5	0.614
2480	1.105	> 0.5	0.605
Antenna 2			
2405	1.227	> 0.5	0.727
2445	1.217	> 0.5	0.717
2480	1.133	> 0.5	0.633

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: SMART Response XE	
	Test name: Clause 15.247(b)(3) and (4) Maximum peak output power for systems using digital modulation			
	Test date: June 29, 2010		Test engineer: Andrey Adelberg	
	Verdict: Pass		Supply input: Batteries	
	Temperature: 25 °C	Air pressure: 1005 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C				

8.5 Clause 15.247(b) Maximum peak conducted output power

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

- (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. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.
 - (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.
 - (3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
 - (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
 - (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.
 - (ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.
 - (iii) Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Special notes

None



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Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(b)(3) and (4) Maximum peak output power for systems using digital modulation			
Test date: June 29, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 25 °C	Air pressure: 1005 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data

Section (3) Results

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

- The test was performed conducted, using guidelines of ANSI C63.10-2009, Clause 6.10.2.1 and 6.10.2.2.
- Power option 1 was used for the power output measurements: RBW was set wider than emission bandwidth.

Conducted output power:

Frequency (MHz)	Conducted output power (dBm)	Limit (dBm)	Margin (dB)
Antenna 1			
2405	0.63	30.0	29.37
2445	-0.02	30.0	30.02
2480	-0.89	30.0	30.89
Antenna 2			
2405	0.43	30.0	29.57
2445	-0.04	30.0	30.04
2480	-0.62	30.0	30.62

EIRP calculation:

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Antenna 1			
2405	3.93	36.0	32.07
2445	3.28	36.0	32.72
2480	2.41	36.0	33.59
Antenna 2			
2405	3.73	36.0	32.27
2445	3.26	36.0	32.74
2480	2.68	36.0	33.32

EIRP = Conducted output power [dBm] + antenna gain [dBi]

Antenna gain = 3.3 dBi

Maximum output power = 0.63 dBm

Limit = 30 dBm

Maximum EIRP = 3.93 dBm

Limit = 36 dBm



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Section 8: Testing data

Product: SMART Response XE

Test name: Clause 15.247(b)(3) and (4) Maximum peak output power for systems using digital modulation

Test date: June 29, 2010

Test engineer: Andrey Adelberg

Verdict: Pass

Supply input: Batteries

Temperature: 25 °C

Air pressure: 1005 mbar

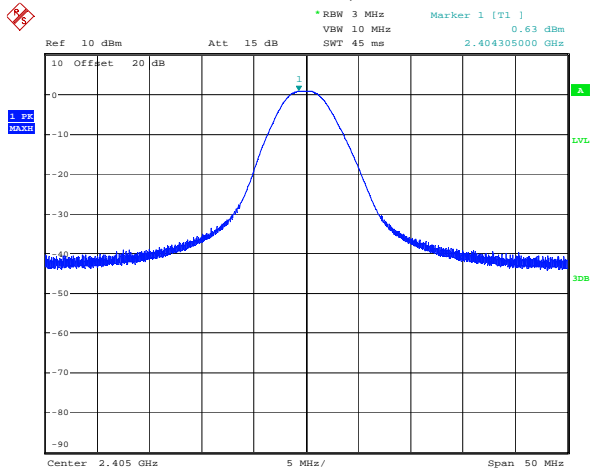
Relative humidity: 36 %

Specification: FCC Part 15 Subpart C

Test data, continued

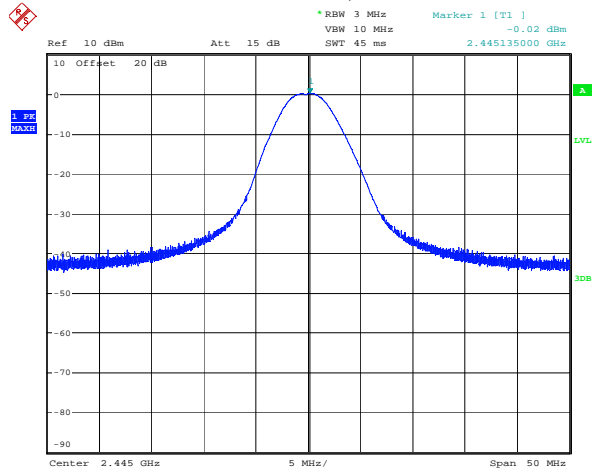
Section (3) Results, continued

Low channel, antenna 1



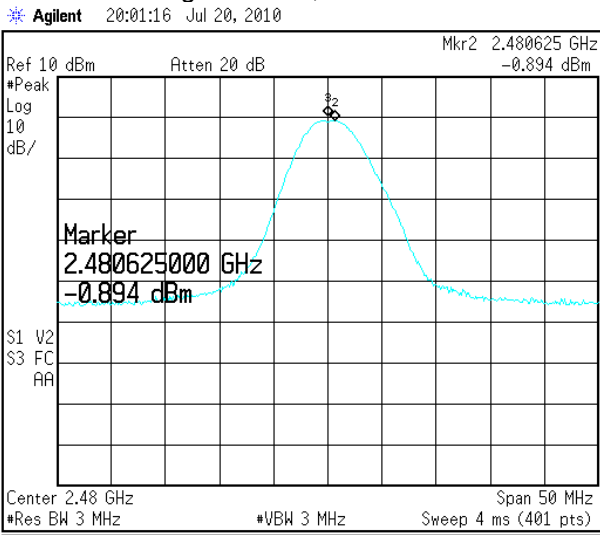
Date: 29 JUN.2010 11:50:14

Mid channel, antenna 1



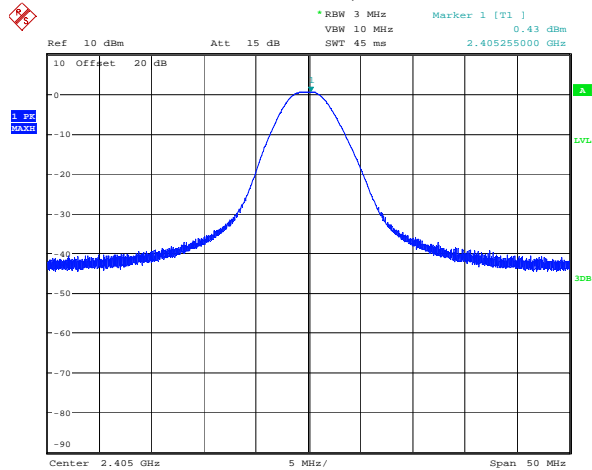
Date: 29 JUN.2010 11:50:46

High channel, antenna 1



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Low channel, antenna 2



Date: 29 JUN.2010 14:20:25

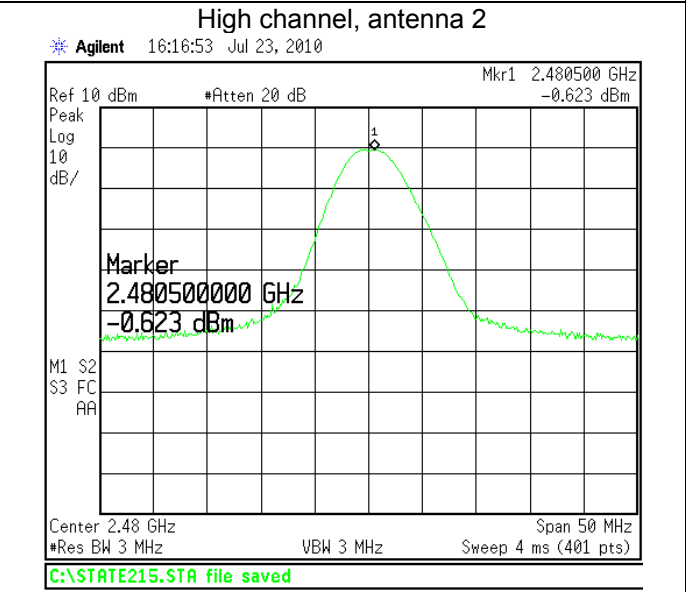
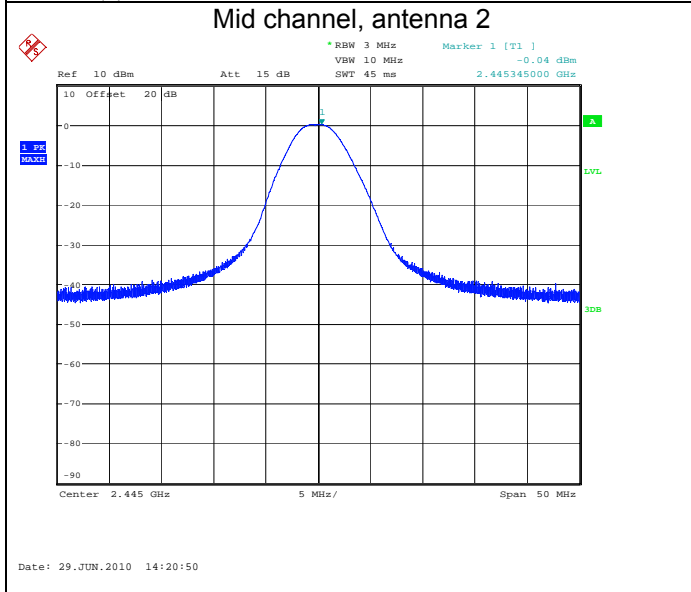



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Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(b)(3) and (4) Maximum peak output power for systems using digital modulation			
Test date: June 29, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 25 °C	Air pressure: 1005 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

Section (3) Results, continued



 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: SMART Response XE	
	Test name: Clause 15.247(d) Spurious emissions			
	Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
	Verdict: Pass		Supply input: Batteries	
	Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
	Specification: FCC Part 15 Subpart C			

8.6 Clause 15.247(d) Spurious emissions

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

- (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)).



Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(d) Spurious emissions			
Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Special notes

§15.209 – Radiated emission limits

Frequency (MHz)	Field strength		Measurement distance (m)
	(μ V/m)	(dB μ V/m)	
0.009–0.490	2400/F	67.6–20log(F)	300
0.490–1.705	24000/F	87.6–20log(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:
- F = fundamental frequency in kHz
 - 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.

§15.205 – Restricted bands of operation

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			

- The spectrum was searched from 30 MHz to the 10th harmonic.
- The EUT was measured on three orthogonal axis.
- All radiated measurements were performed at a distance of 3 m.
- All radiated measurements were performed:
 - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
 - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
 - and using a duty cycle/average factor for average results calculations.



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Section 8: Testing data

Product: SMART Response XE

Test name: Clause 15.247(d) Spurious emissions

Test date: June 29 and July 20, 2010

Test engineer: Andrey Adelberg

Verdict: Pass

Supply input: Batteries

Temperature: 24 and 26 °C

Air pressure: 1006 and 1004 mbar

Relative humidity: 36 %

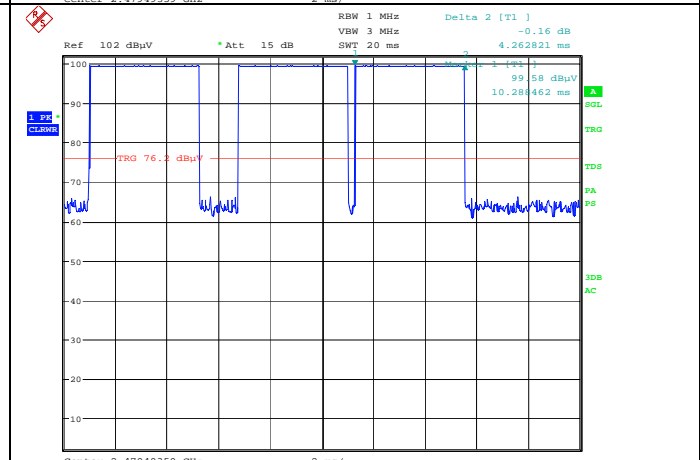
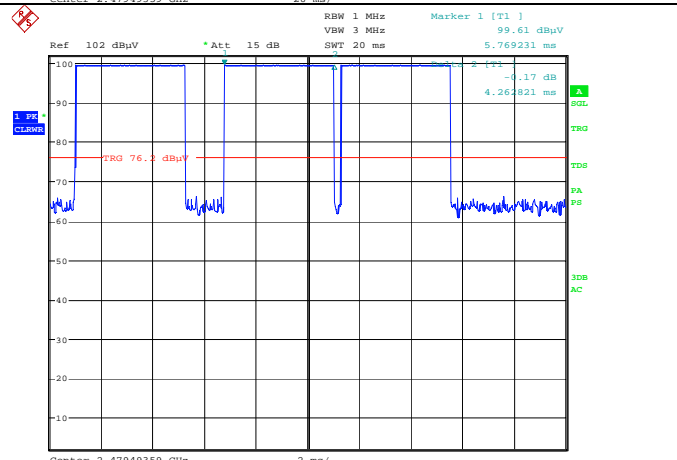
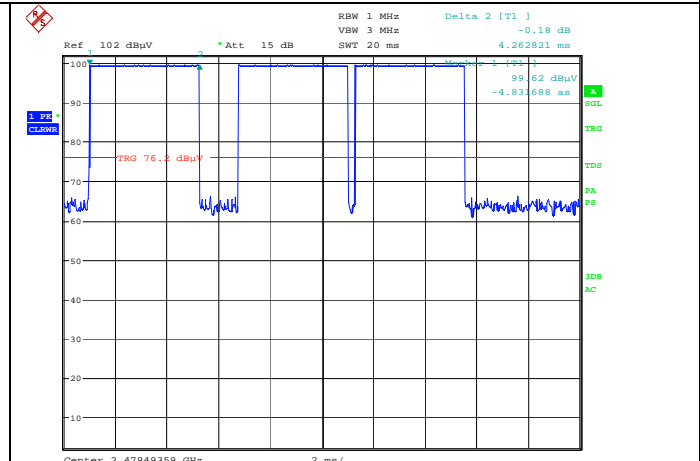
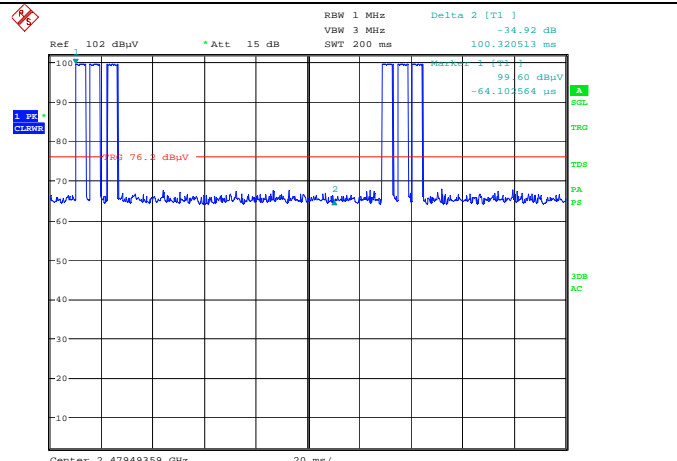
Specification: FCC Part 15 Subpart C

Test data

Duty cycle/average factor calculations

§15.35(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

Duty cycle/average factor calculations for high channel:



$$\text{Duty cycle/ average factor} = 20 \times \log_{10} \left(\frac{T_{x_{100ms}}}{100ms} \right)$$

$$\text{Duty cycle factor: } 20 \times \log(3 \times 4.263 / 100) = -17.86 \text{ dB}$$



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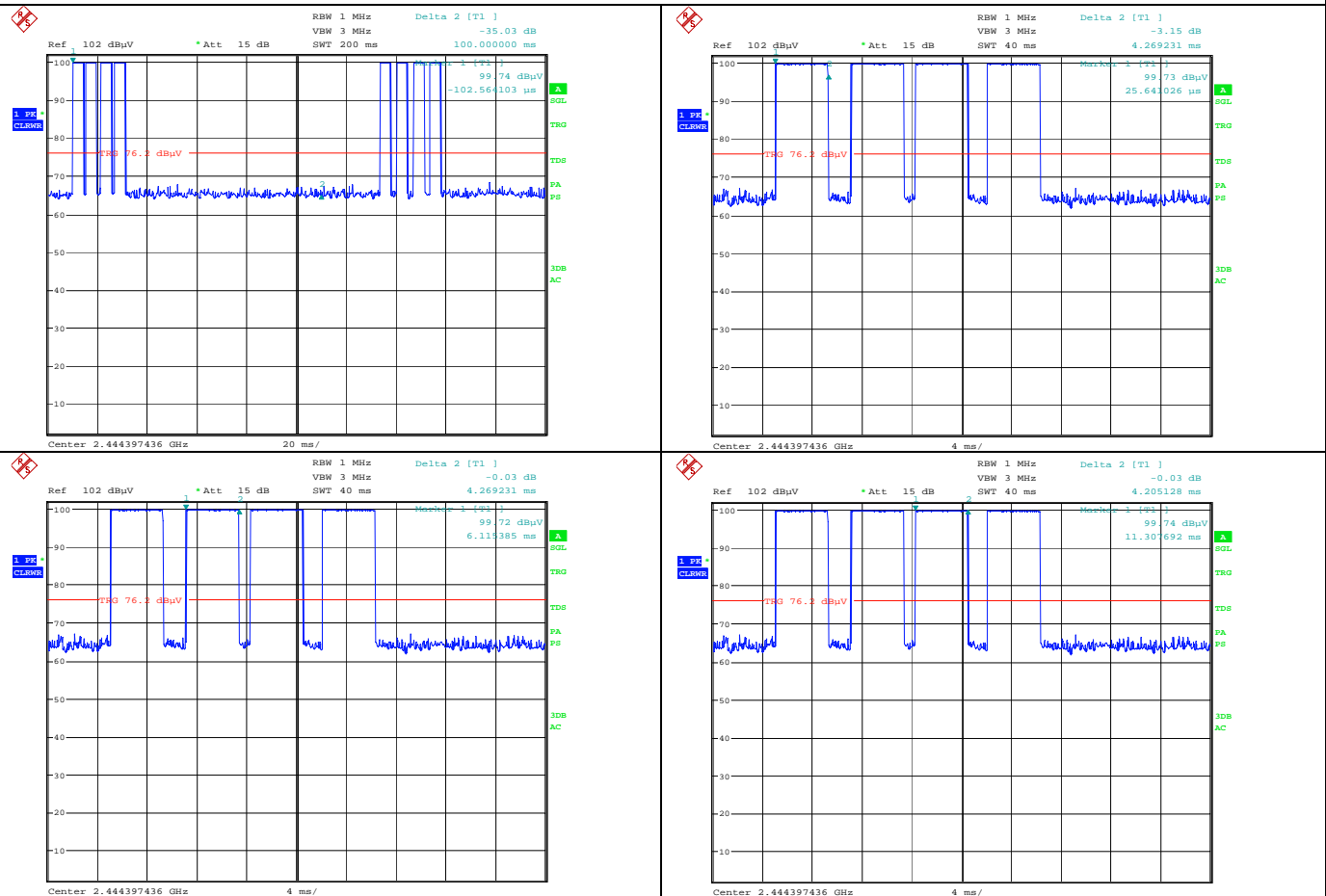
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Test name: Clause 15.247(d) Spurious emissions			
Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

Duty cycle/average factor calculations

§15.35(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

Duty cycle/average factor calculations for any channel except for high channel:



$$Duty\ cycle/average\ factor = 20 \times \log_{10} \left(\frac{T_{x_{100ms}}}{100ms} \right)$$

$$Duty\ cycle\ factor: 20 \times \log(4 \times 4.269/100) = -15.35\ dB$$



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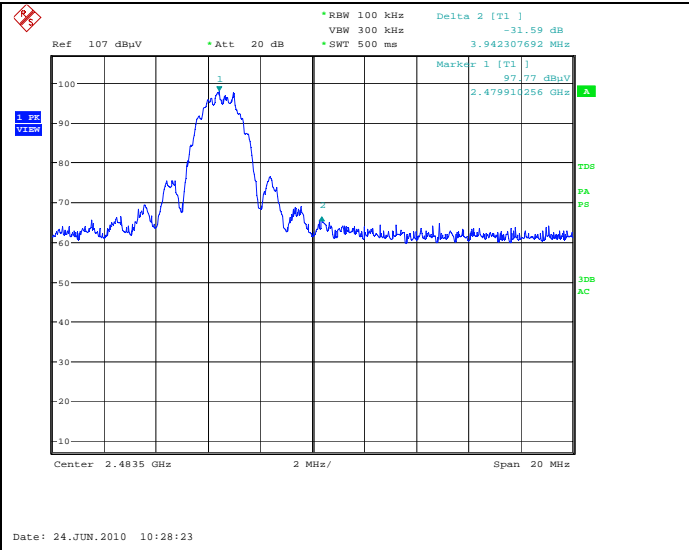
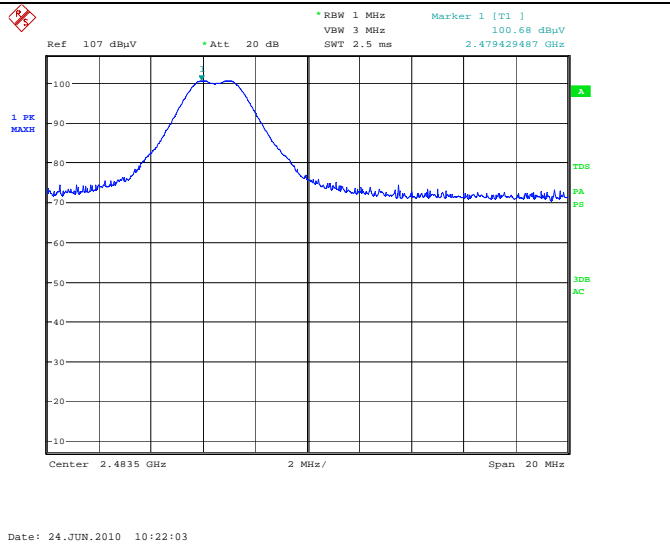
Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(d) Spurious emissions			
Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

Beta v.1:

Marker-delta measurement for 2.4835 GHz Band Edge

Measured field strength for high channel at antenna 1 in 1 MHz/3 MHz RBW/VBW = 100.68 dBµV/m



Delta marker = -31.59 dB

Therefore, Peak Field Strength = 100.68 dBµV/m – 31.59 dB (Delta marker) = 69.09 dBµV/m

Limit = 74 dBµV/m

Average Field Strength = 69.09 dBµV/m – 17.86 dB (Duty cycle correction factor) = 51.23 dBµV/m

Limit = 54 dBµV/m



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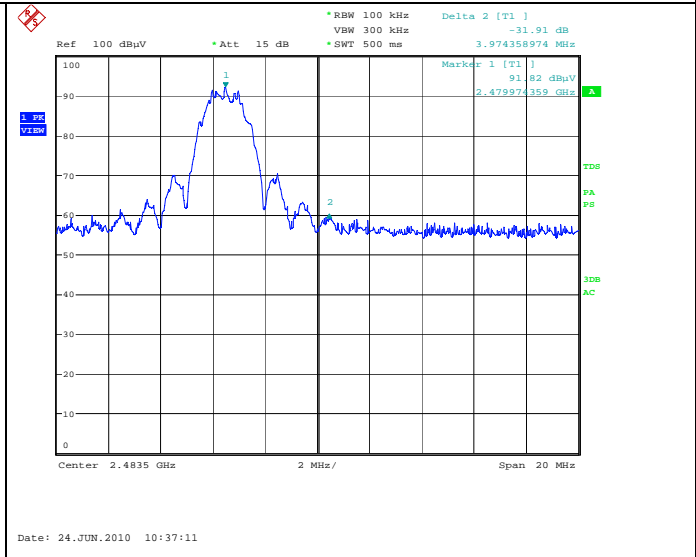
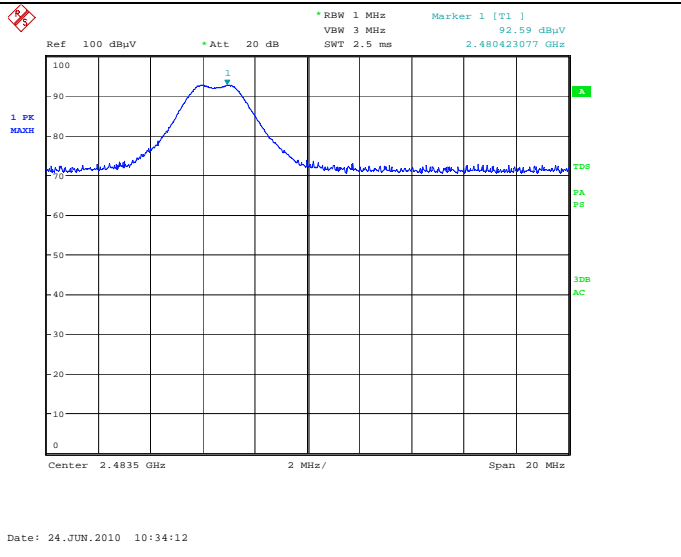
Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(d) Spurious emissions			
Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

Beta v.1:

Marker-delta measurement for 2.4835 GHz Band Edge

Measured field strength for high channel at antenna 2 in 1 MHz/3 MHz RBW/VBW = 92.59 dBµV/m



Delta marker = -31.91 dB

Therefore, Peak Field Strength = 92.59 dBµV/m - 31.91 dB (Delta marker) = 60.68 dBµV/m

Limit = 74 dBµV/m

Average Field Strength = 60.68 dBµV/m - 17.86 dB (Duty cycle correction factor) = 42.82 dBµV/m

Limit = 54 dBµV/m



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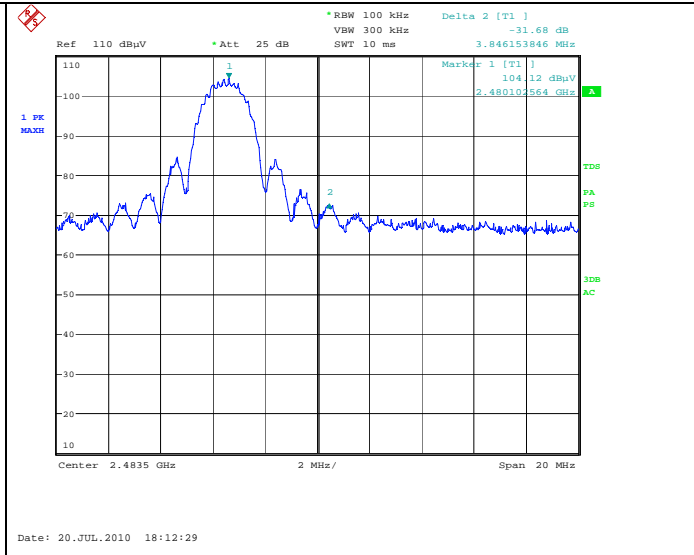
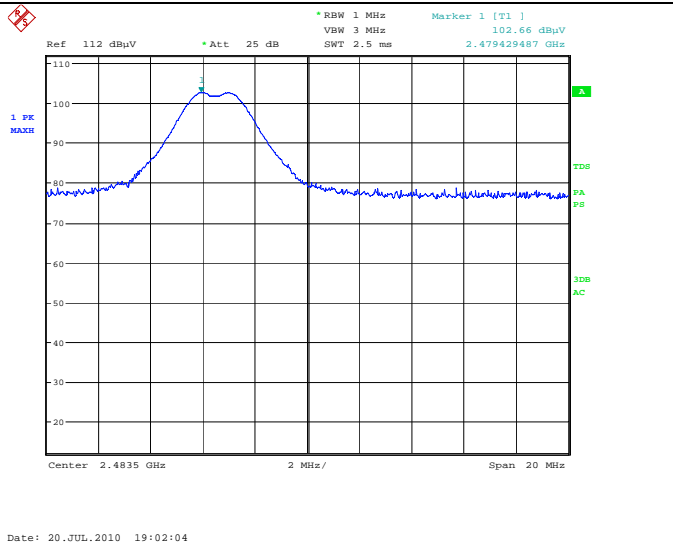
Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(d) Spurious emissions			
Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

Beta v.2:

Marker-delta measurement for 2.4835 GHz Band Edge

Measured field strength for high channel at antenna 1 in 1 MHz/3 MHz RBW/VBW = 102.66 dBµV/m



Delta marker = -31.68 dB

Therefore, Peak Field Strength = 102.66 dBµV/m - 31.68 dB (Delta marker) = 70.98 dBµV/m

Limit = 74 dBµV/m

Average Field Strength = 70.98 dBµV/m - 17.86 dB (Duty cycle correction factor) = 53.12 dBµV/m

Limit = 54 dBµV/m



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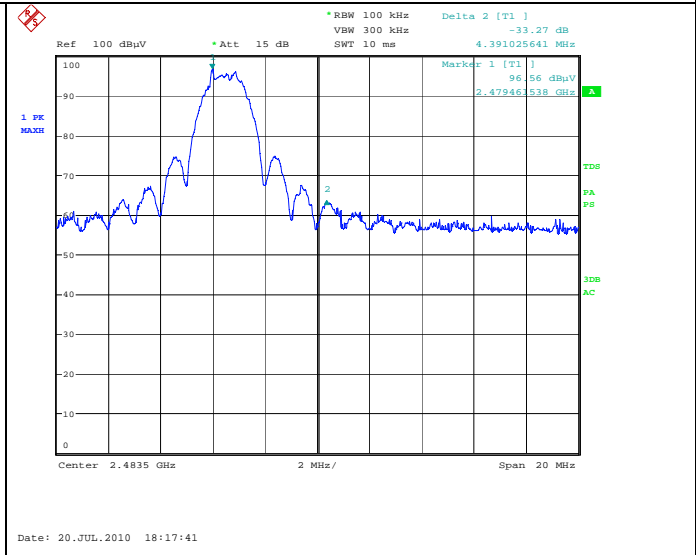
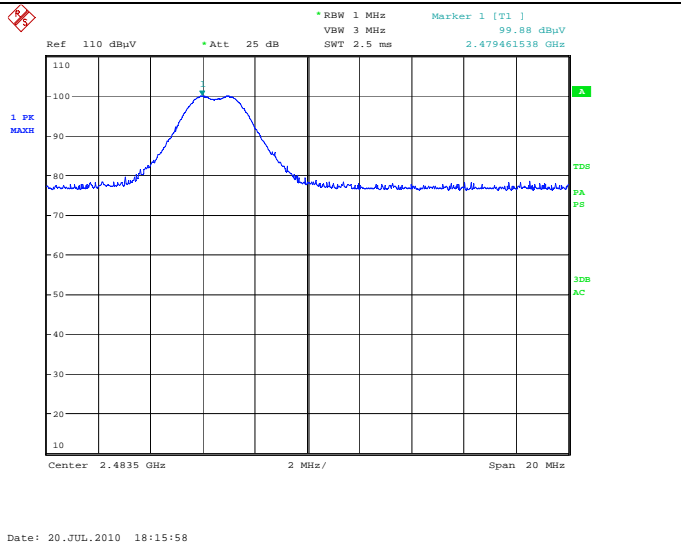
Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(d) Spurious emissions			
Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

Beta v.2:

Marker-delta measurement for 2.4835 GHz Band Edge

Measured field strength for high channel at antenna 2 in 1 MHz/3 MHz RBW/VBW = 99.88 dBµV/m



Delta marker = -33.27 dB

Therefore, Peak Field Strength = 99.88 dBµV/m - 33.27 dB (Delta marker) = 66.61 dBµV/m

Limit = 74 dBµV/m

Average Field Strength = 66.61 dBµV/m - 17.86 dB (Duty cycle correction factor) = 48.75 dBµV/m

Limit = 54 dBµV/m

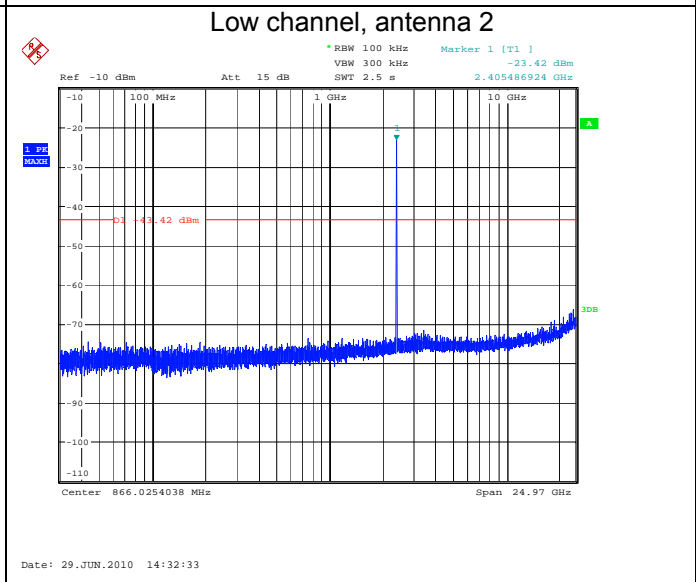
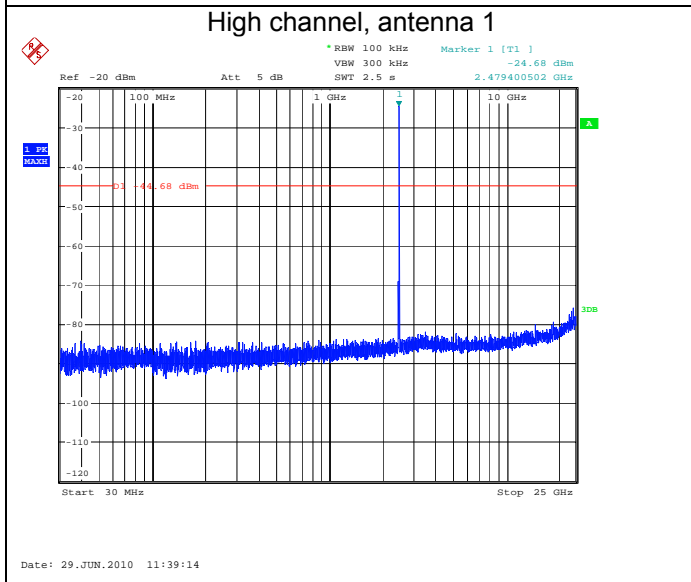
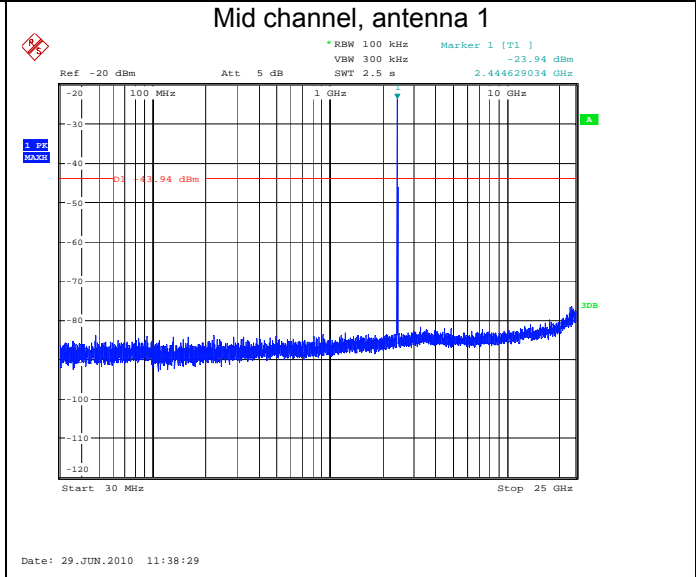
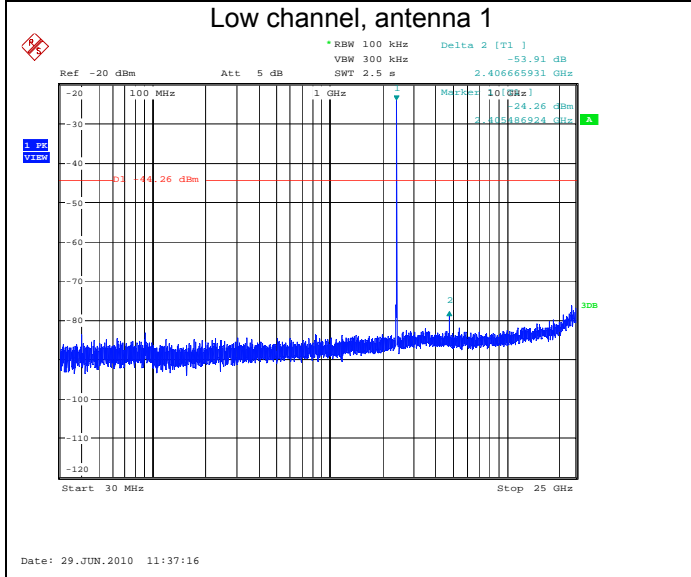


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Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(d) Spurious emissions			
Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

Conducted measurement



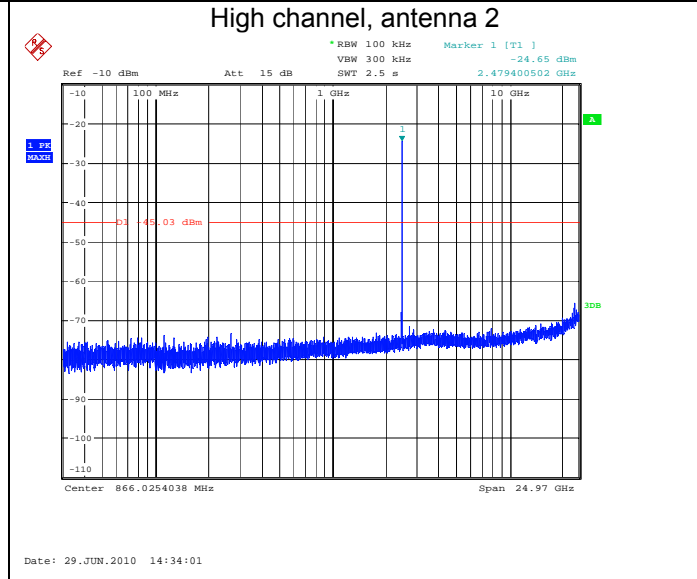
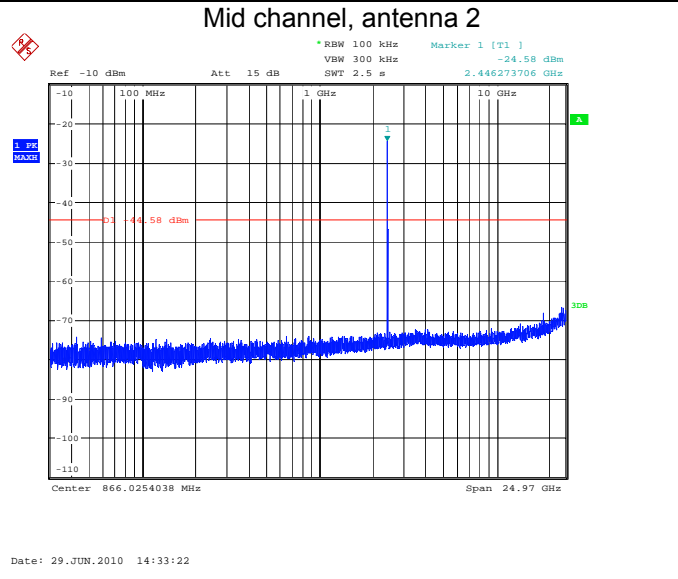


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Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(d) Spurious emissions			
Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

Conducted measurement, continued




Radiated emissions measurements results


Tabular data, Beta v.1

Frequency (MHz)	Peak field strength (dBμV/m)	Peak limit (dBμV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBμV/m)	Avg limit (dBμV/m)	Avg margin (dB)
Antenna 1							
Low channel							
4809.05	53.69	74.00	20.31	15.35	38.34	54.00	15.66
Mid channel							
4888.96	55.37	74.00	18.63	15.35	40.02	54.00	13.98
High channel							
4958.89	62.88	74.00	11.12	17.86	45.02	54.00	8.98
Antenna 2							
Low channel							
4810.83	57.64	74.00	16.36	15.35	42.29	54.00	11.71
7213.33	54.71	74.00	19.29	15.35	39.36	54.00	14.64
Mid channel							
4888.92	61.06	74.00	12.94	15.35	45.71	54.00	8.29
7333.53	56.92	74.00	17.08	15.35	41.57	54.00	12.43
High channel							
4958.88	63.73	74.00	10.27	17.86	45.87	54.00	8.13
7441.35	58.10	74.00	15.90	17.86	40.24	54.00	13.76

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: SMART Response XE	
	Test name: Clause 15.247(d) Spurious emissions			
	Test date: June 29 and July 20, 2010		Test engineer: Andrey Adelberg	
	Verdict: Pass		Supply input: Batteries	
	Temperature: 24 and 26 °C	Air pressure: 1006 and 1004 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C				

Tabular data, Beta v.2							
Frequency (MHz)	Peak field strength (dBµV/m)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
Antenna 1							
Low channel							
4809.05	54.89	74.00	19.11	15.35	39.54	54.00	14.46
Mid channel							
4888.96	55.70	74.00	18.30	15.35	40.35	54.00	13.65
High channel							
4958.89	53.51	74.00	20.49	17.86	35.65	54.00	18.35
Antenna 2							
Low channel							
4810.83	55.11	74.00	18.89	15.35	39.76	54.00	14.24
Mid channel							
4888.92	55.44	74.00	18.56	15.35	40.09	54.00	13.91
High channel							
4958.88	55.43	74.00	18.57	17.86	37.57	54.00	16.43
Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.							

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: SMART Response XE	
	Test name: Clause 15.247(e) Power spectral density for digitally modulated devices			
	Test date: June 29, 2010		Test engineer: Andrey Adelberg	
	Verdict: Pass		Supply input: Batteries	
	Temperature: 25 °C	Air pressure: 1005 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C				

8.7 Clause 15.247(e) Power spectral density for digitally modulated devices

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

- (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Special notes

- The test was performed using guidelines of ANSI C63.10-2009, Clause 6.11.2.
- PSD option 1 was used since output power option 1 was used.
- Emission peak was located and zoomed in. RBW was set to 3 kHz, VBW was set > RBW. Sweep time was set to Span/3 kHz. Peak level was measured.



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Section 8: Testing data

Product: SMART Response XE

Test name: Clause 15.247(e) Power spectral density for digitally modulated devices

Test date: June 29, 2010

Test engineer: Andrey Adelberg

Verdict: Pass

Supply input: Batteries

Temperature: 25 °C

Air pressure: 1005 mbar

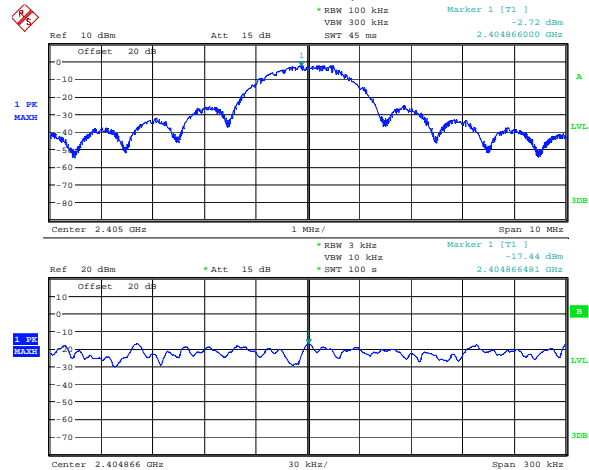
Relative humidity: 36 %

Specification: FCC Part 15 Subpart C

Test data

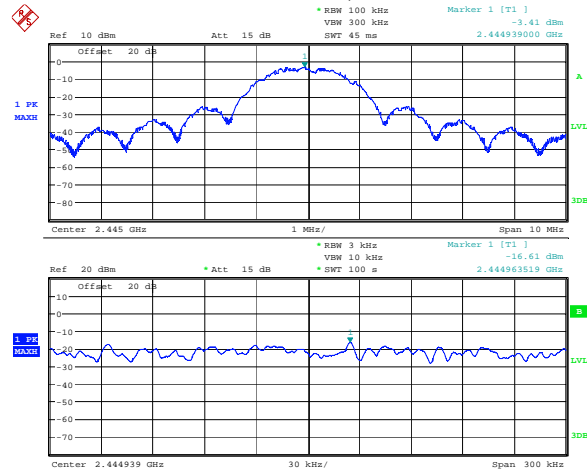
Conducted measurement

Low channel, antenna 1



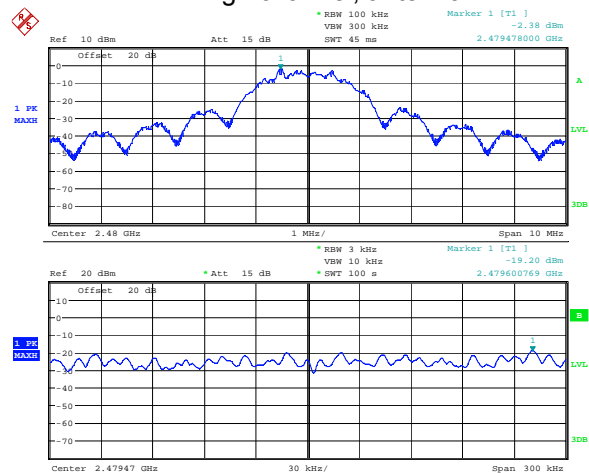
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Mid channel, antenna 1



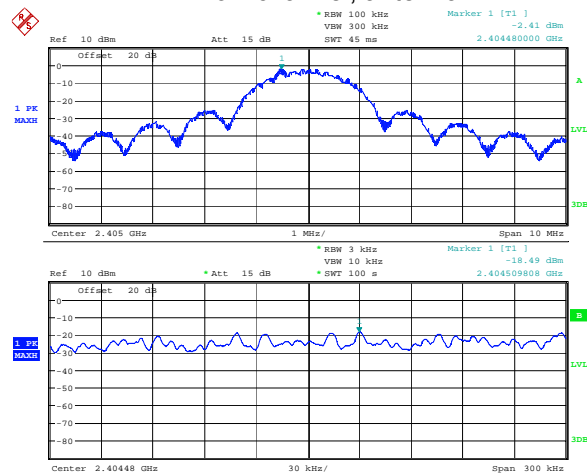
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High channel, antenna 1



Date: 29.JUN.2010 11:58:39

Low channel, antenna 2



Date: 29.JUN.2010 14:29:54

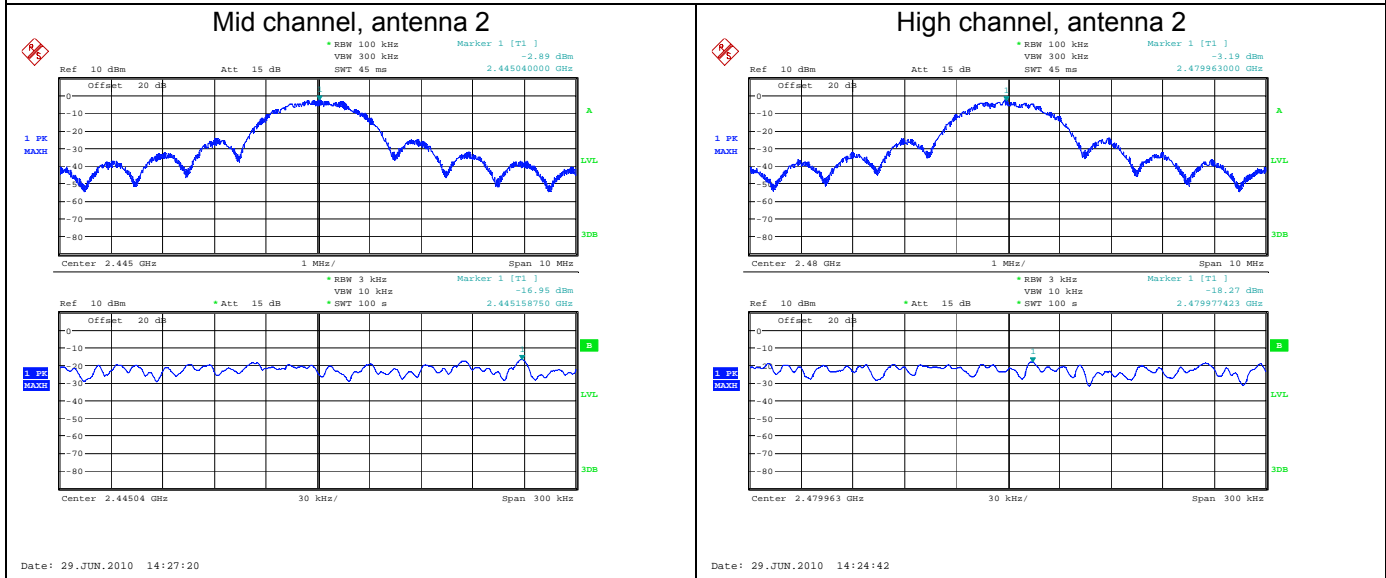


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Section 8: Testing data		Product: SMART Response XE	
Test name: Clause 15.247(e) Power spectral density for digitally modulated devices			
Test date: June 29, 2010		Test engineer: Andrey Adelberg	
Verdict: Pass		Supply input: Batteries	
Temperature: 25 °C	Air pressure: 1005 mbar	Relative humidity: 36 %	
Specification: FCC Part 15 Subpart C			

Test data

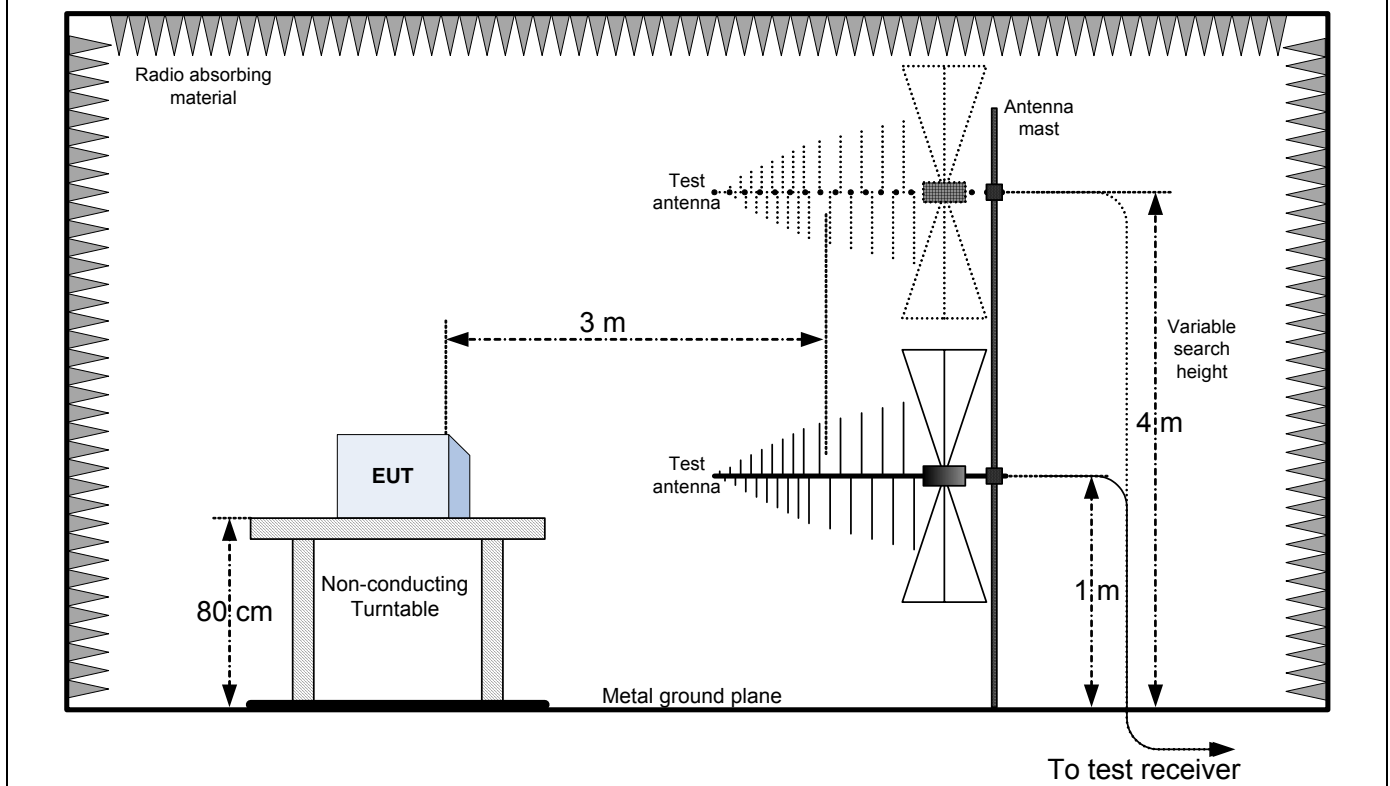
Conducted measurement



Channel	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
Antenna 1			
Low	-17.77	8.0	25.77
Mid	-16.61	8.0	24.61
High	-19.20	8.0	27.20
Antenna 2			
Low	-18.49	8.0	26.49
Mid	-16.95	8.0	24.95
High	-18.27	8.0	26.27

Section 8: Block diagrams of test set-ups

Radiated emissions set-up



Section 9: EUT photos

EUT



EUT

