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Report Reference ID:	147485-2TRFWL
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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>Load Systems International Inc. 4495 Blvd Hamel, Suite 110, Quebec, QC, Canada G1P 2J7</p>
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Apparatus:	Angle Length Sensor and Pressure Transducer
FCC ID:	QVBGS001
Model:	GS012
Model Variant:	GS035

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:	David Duchesne, Senior EMC Specialist	May 4, 2010
Reviewed by:	<p>_____</p> <p>Andrey Adelberg, Senior Wireless/EMC Specialist</p>	May 5, 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

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Section 1: Report summary

1.1 Test specification

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

In the configuration tested, the EUT was found compliant.

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.

See “Summary of test results” for full details.

1.3 Exclusions

None

1.4 Registration 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

1.6 Test location

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

1.7 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 Test results

Part	Test description	Verdict
General requirements for FCC Part 15		
§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	Not applicable
Specific requirements for FCC Part 15 Subpart C, 15.247		
§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 Applicable
§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	Not Applicable
§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	Pass
§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	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	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not Applicable
Notes: None		

Section 3: Equipment under test (EUT) details

3.1 Sample information

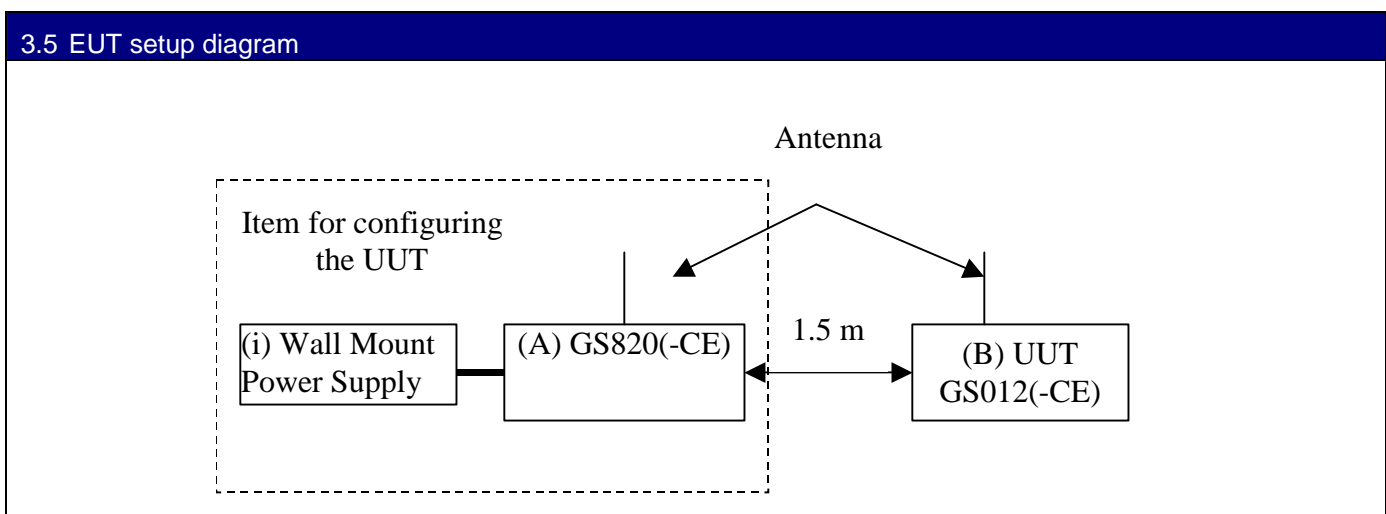
Receipt date:	April 12, 2010
Nemko sample number:	Item # 3

3.2 EUT information

Type of Equipment:	Wireless Weighing and Monitoring System
Product:	Angle Length Sensor and Pressure Transducer
FCC ID:	QVBGS001
Model:	GS012
Model Variant:	GS035
Serial number:	None (pre-production sample)
Manufacturer	
Load Systems International Inc. 4495 Blvd Hamel, Suite 110, Quebec, QC, Canada G1P 2J7	
EUT description and theory of operation	
The EUT is an angle and length sensor used in cranes application.	

3.3 EUT technical specifications	
Operating band:	902–928 MHz
Operating frequency:	903–927MHz
Modulation type:	FSK
Occupied bandwidth:	1.13 MHz
Emission designator:	1M13F1D
Antenna data/type:	Detachable antenna Description: 1/4 wave monopole Gain: 0.5 dBi MFG: Load Systems International Inc Part #: TA011
Power source	Internal 3.6 VDC Primary lithium-thionyl chloride (Li-SOCl ₂) battery

3.4 Operation of the EUT during testing
 The EUT was modified to transmit continuously. Custom firmware for continuous emission. GS012 firmware version: B0152_V2005



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

Model GS012 was assessed as a representative sample.

Client declared that the Pressure Transducer, model GS035 is electrically identical with the same electromagnetic emissions and electromagnetic compatibility characteristics as model: GS012.

A description of the differences between the tested model and those that are declared similar are as follows:

- The input circuit is different on both models:
 - GS012 has an angle sensor circuit and a magnet detector circuit used as an encoder for length measurement.
 - GS035 has an analog circuit for low voltage signal measurement.
- Both models share the same PCB, core circuit, RF transceiver and enclosure.

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

Section 5: Test conditions

5.1 Power source and ambient temperatures

<p>Normal temperature, humidity and air pressure test conditions</p>	<p>Temperature: 15–30 °C Relative humidity: 20–75 % Air pressure: 86–106 kPa</p> <p>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.</p>
<p>Power supply range:</p>	<p>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.</p>

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.



Section 7: Test equipment

Test equipment list

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	Mar. 09/11
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
50 Coax cable	HUBER + SUHNER	None	FA002013	Sep. 02/10
50 Coax cable	HUBER + SUHNER	None	FA002074	July 07/10
1-18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct. 07/10
Spectrum Analyzer	Rohde & Schwarz	FSP	FA001920	Apr. 24/10

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



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Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
Test name: Clause 15.31(e) Variation of power source			
Test date: April 13, 2010		Test engineer: David Duchesne	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.

Test data

All tests were performed with new battery.



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Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
Test name: Clause 15.31(m) Number of operating frequencies			
Test date: April 13, 2010		Test engineer: David Duchesne	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

Test data

The frequency band is 24 MHz therefore number of operating frequencies is 3

Low frequency / channel	903 MHz
Mid frequency / channel	915 MHz
High frequency / channel	927 MHz

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data	Product: Angle Length Sensor and Pressure Transducer	
	Test name: Clause 15.203 Antenna requirement		
	Test date: April 13, 2010	Test engineer: David Duchesne	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.

Test data

EUT is designed so that the end user may replace a broken antenna. (The EUT has a non-standard antenna jack or electrical connector)



 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
	Test name: Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques			
	Test date: April 14, 2010		Test engineer: David Duchesne	
	Verdict: Pass		Supply input: Internal Battery	
	Temperature: 23.1 °C	Air pressure: 1022.8 mbar	Relative humidity: 26 %	
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 300 kHz/1 MHz RBW/VBW
- The span was wider than RBW.

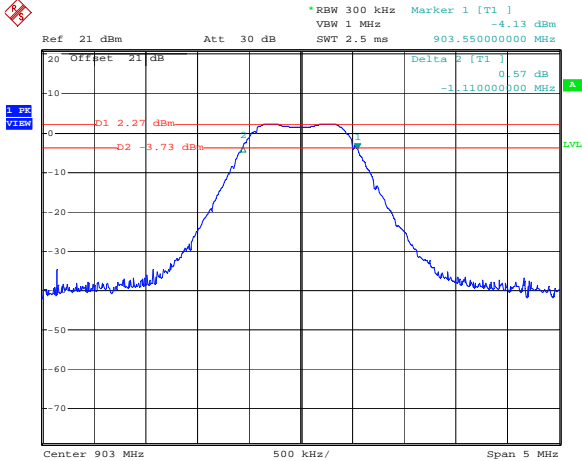


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Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
Test name: Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques			
Test date: April 14, 2010		Test engineer: David Duchesne	
Verdict: Pass		Supply input: Internal Battery	
Temperature: 23.1 °C	Air pressure: 1022.8 mbar	Relative humidity: 26 %	
Specification: FCC Part 15 Subpart C			

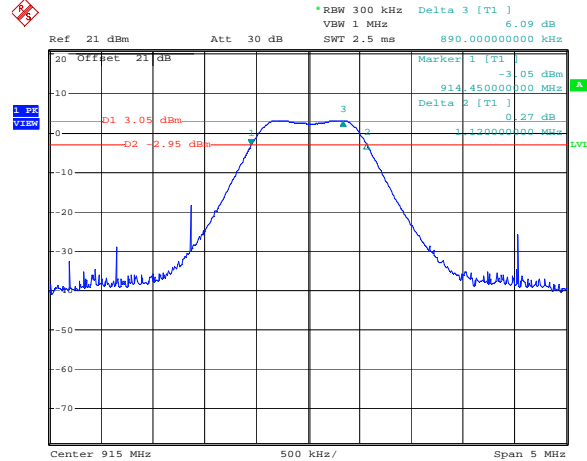
Test data

6 dB bandwidth on Low channel:



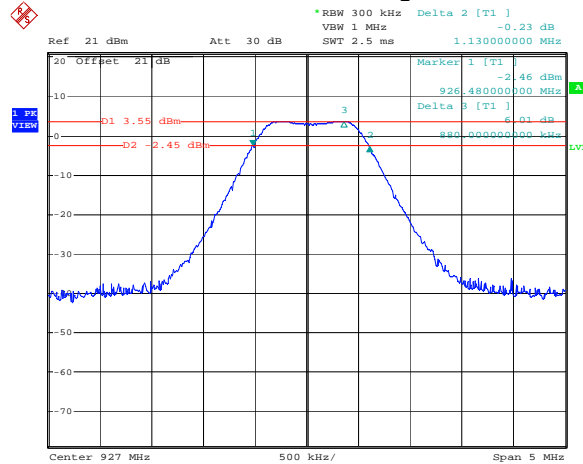
Date: 14.APR.2010 07:14:48

6 dB bandwidth on Mid channel:



Date: 14.APR.2010 07:18:23

6 dB bandwidth on High channel:



Date: 14.APR.2010 07:23:29

Frequency, MHz	6 dB bandwidth, MHz	Limit, MHz	Margin, MHz
903	1.11	> 0.5	0.61
915	1.12	> 0.5	0.62
927	1.13	> 0.5	0.63



Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
Test name: Clause 15.247(b)(3) and (4) Maximum peak output power for systems using digital modulation			
Test date: May 4, 2010		Test engineer: David Duchesne	
Verdict: Pass		Supply input: Internal Battery	
Temperature: 25 °C	Air pressure: 992.7 mbar	Relative humidity: 39 %	
Specification: FCC Part 15 Subpart C			

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

§ 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:
- (3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands: 1 W. As an alternative to a peak power measurement, compliance with the 1 W 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 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

The test was performed using FCC guidelines of “Measurement of digital transmission systems operating under section 15.247”, from March 23, 2005.

- Power option 1 was used for the power output measurements
- RBW was set wider than emission bandwidth
- Output power was measured using a spectrum analyzer with a Peak detector of 3 MHz RBW /10 MHz VBW.
- Automatic settings were used for analyzer sweep time.



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Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
Test name: Clause 15.247(b)(3) and (4) Maximum peak output power for systems using digital modulation			
Test date: May 4, 2010		Test engineer: David Duchesne	
Verdict: Pass		Supply input: Internal Battery	
Temperature: 25 °C	Air pressure: 992.7 mbar	Relative humidity: 39 %	
Specification: FCC Part 15 Subpart C			

Test data

Conducted output power

Frequency (MHz)	Conducted output power (dBm)	Limit (dBm)	Margin (dB)
903	10.49	30.0	19.51
915	10.76	30.0	19.24
927	10.72	30.0	19.28

EIRP calculation

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)
903	10.99	36.0	25.01
915	11.26	36.0	24.74
927	11.22	36.0	24.78

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

Antenna gain = 0.5 dBi

Maximum output power = 10.76 dBm

Limit = 30 dBm

Maximum EIRP = 11.26 dBm

Limit = 36 dBm



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Section 8: Testing data

Product: Angle Length Sensor and Pressure Transducer

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

Test date: May 4, 2010

Test engineer: David Duchesne

Verdict: Pass

Supply input: Internal Battery

Temperature: 25 °C

Air pressure: 992.7 mbar

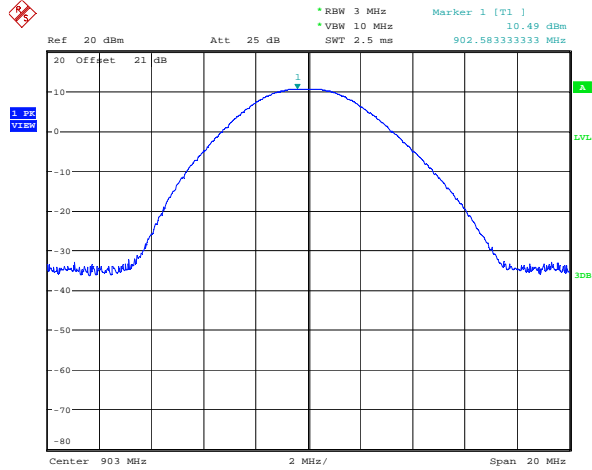
Relative humidity: 39 %

Specification: FCC Part 15 Subpart C

Test data, continued

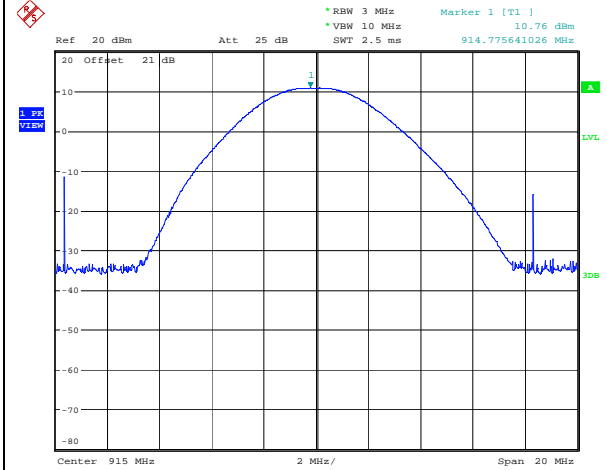
Conducted spectral plots

Low channel



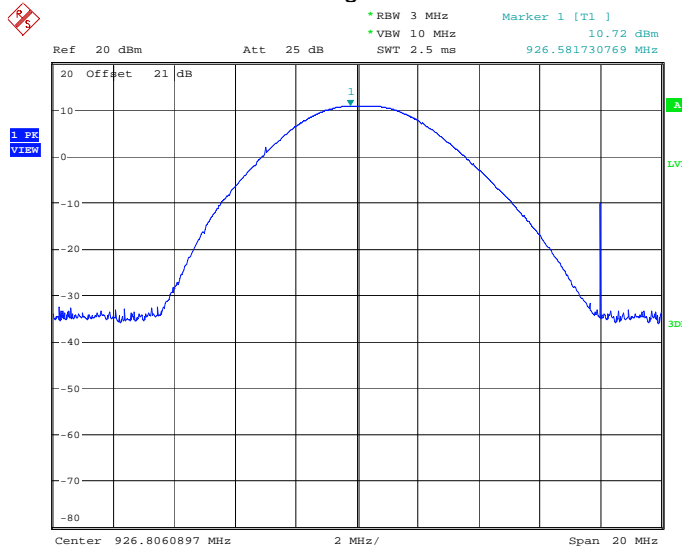
Date: 4.MAY.2010 11:35:45

Mid channel




Date: 4.MAY.2010 11:33:45

High channel



Date: 4.MAY.2010 11:30:54

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
	Test name: Clause 15.247(d) Spurious emissions			
	Test date: May 4, 2010		Test engineer: David Duchesne	
	Verdict: Pass		Supply input: Internal Battery	
	Temperature: 25 °C	Air pressure: 992.7 mbar	Relative humidity: 39 %	
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)).

Special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.

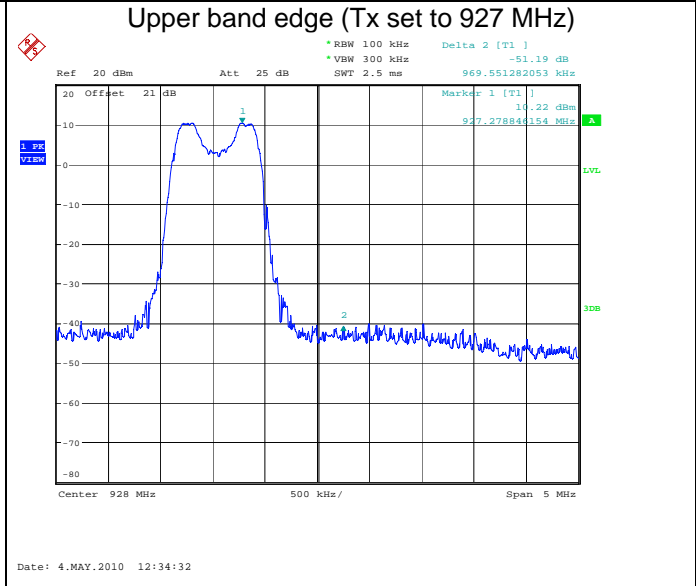
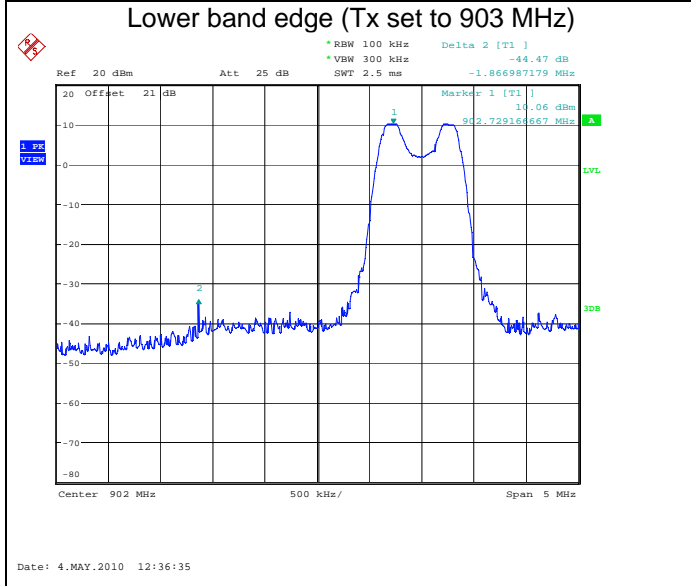


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Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
Test name: Clause 15.247(d) Spurious emissions			
Test date: May 4, 2010		Test engineer: David Duchesne	
Verdict: Pass		Supply input: Internal Battery	
Temperature: 25 °C	Air pressure: 992.7 mbar	Relative humidity: 39 %	
Specification: FCC Part 15 Subpart C			

Test data

Conducted measurement





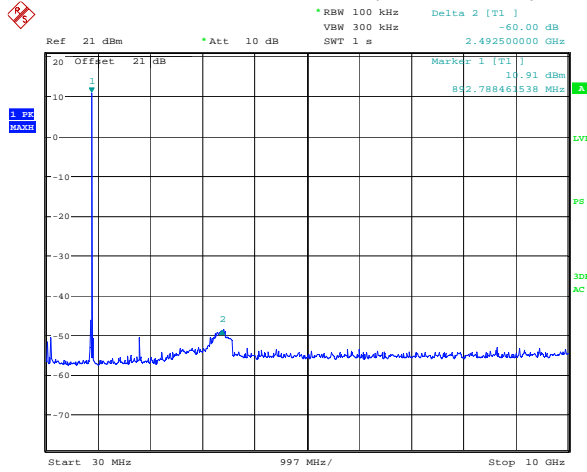
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Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
Test name: Clause 15.247(d) Spurious emissions			
Test date: May 4, 2010		Test engineer: David Duchesne	
Verdict: Pass		Supply input: Internal Battery	
Temperature: 25 °C	Air pressure: 992.7 mbar	Relative humidity: 39 %	
Specification: FCC Part 15 Subpart C			

Test data, continued

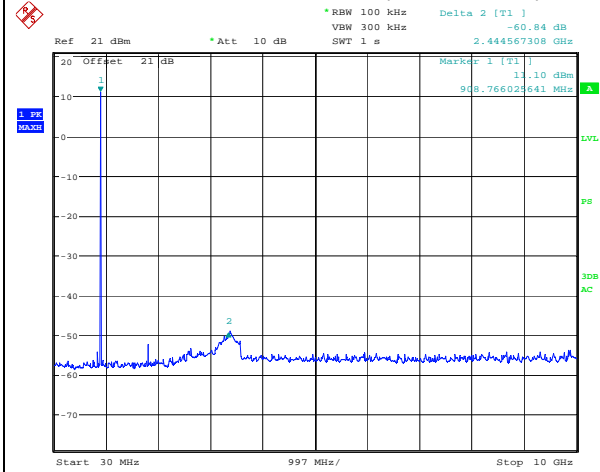
Conducted measurement

30 MHz to 10 GHz (Low channel)



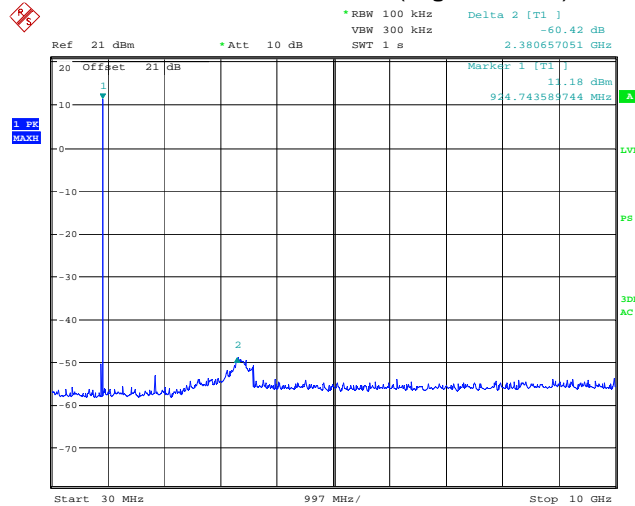
Date: 4.MAY.2010 15:42:20

30 MHz to 10 GHz (Mid channel)



Date: 4.MAY.2010 15:43:31

30 MHz to 10 GHz (High channel)




Date: 4.MAY.2010 15:46:20

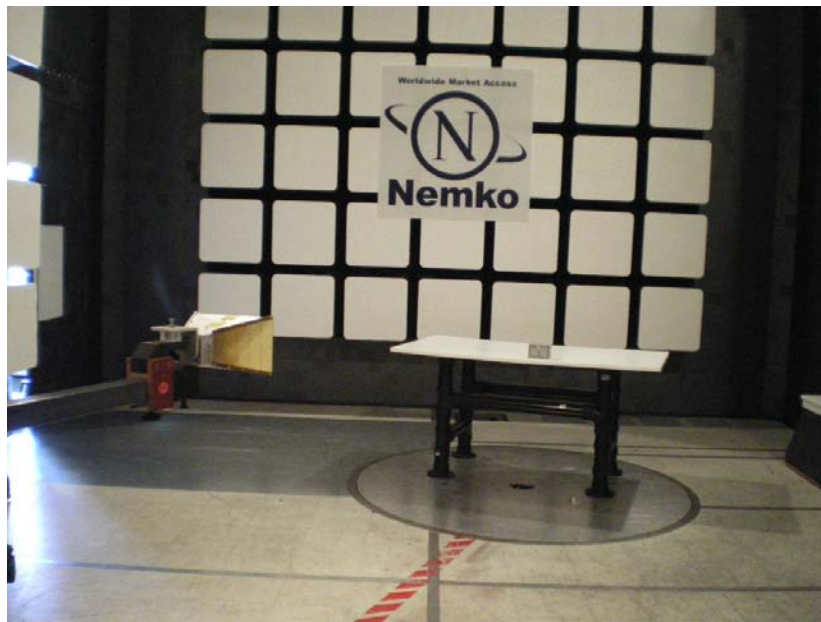
Radiated Measurements


No emissions were detected within 10 dB of limit inside the 15.205 Restricted bands.

- All measurements were performed at a distance of 3 m.
- All measurements performed:
 - within 30–1000 MHz range: using a peak detector with 100 kHz/300 kHz RBW/VBW,
 - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
 - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data	Product: Angle Length Sensor and Pressure Transducer		
	Test name: Clause 15.247(d) Spurious emissions			
	Test date: May 4, 2010		Test engineer: David Duchesne	
	Verdict: Pass		Supply input: Internal Battery	
	Temperature: 25 °C	Air pressure: 992.7 mbar	Relative humidity: 39 %	
Specification: FCC Part 15 Subpart C				

Setup photos



 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
	Test name: Clause 15.247(e) Power spectral density for digitally modulated devices			
	Test date: May 4, 2010		Test engineer: David Duchesne	
	Verdict: Pass		Supply input: Internal Battery	
	Temperature: 25 °C	Air pressure: 992.7 mbar	Relative humidity: 39 %	
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

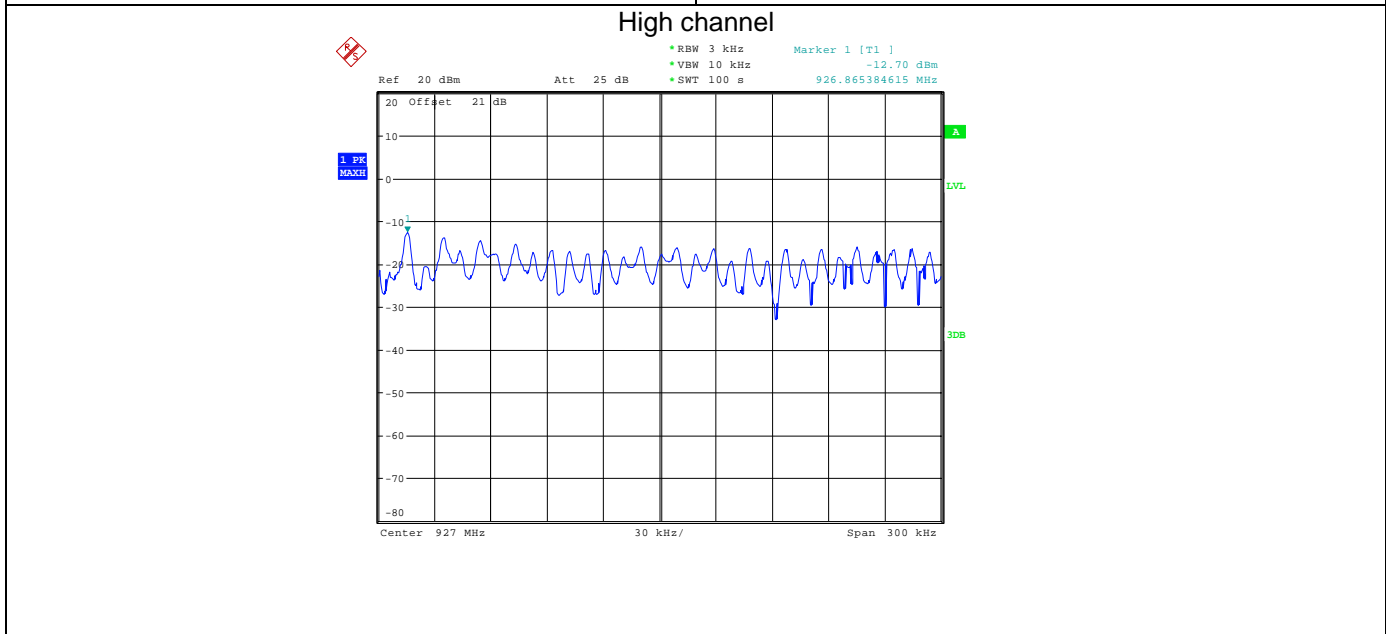
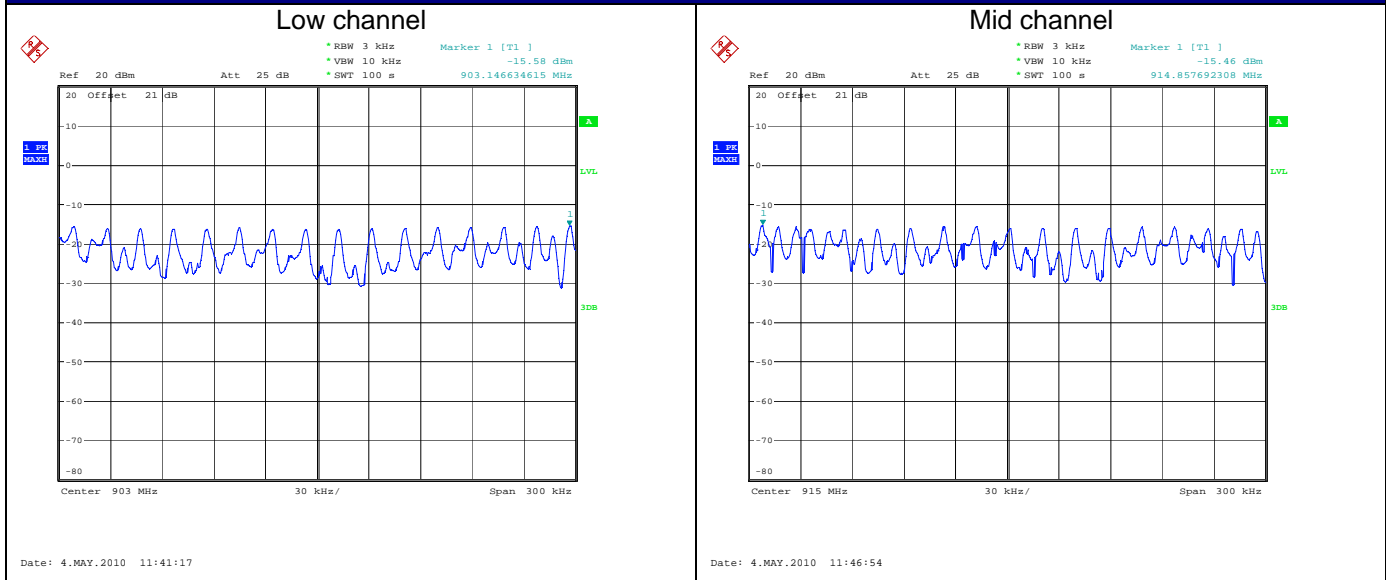
- PSD option 1 was used since output power option 1 was used.
- Emission peak was located and zoomed in. RBW was set to 3 kHz, VBW was set > RBW.
- Sweep time was set to Span/3 kHz. Peak level was measured.



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

Section 8: Testing data		Product: Angle Length Sensor and Pressure Transducer	
Test name: Clause 15.247(e) Power spectral density for digitally modulated devices			
Test date: May 4, 2010		Test engineer: David Duchesne	
Verdict: Pass		Supply input: Internal Battery	
Temperature: 25 °C	Air pressure: 992.7 mbar	Relative humidity: 39 %	
Specification: FCC Part 15 Subpart C			

Test data

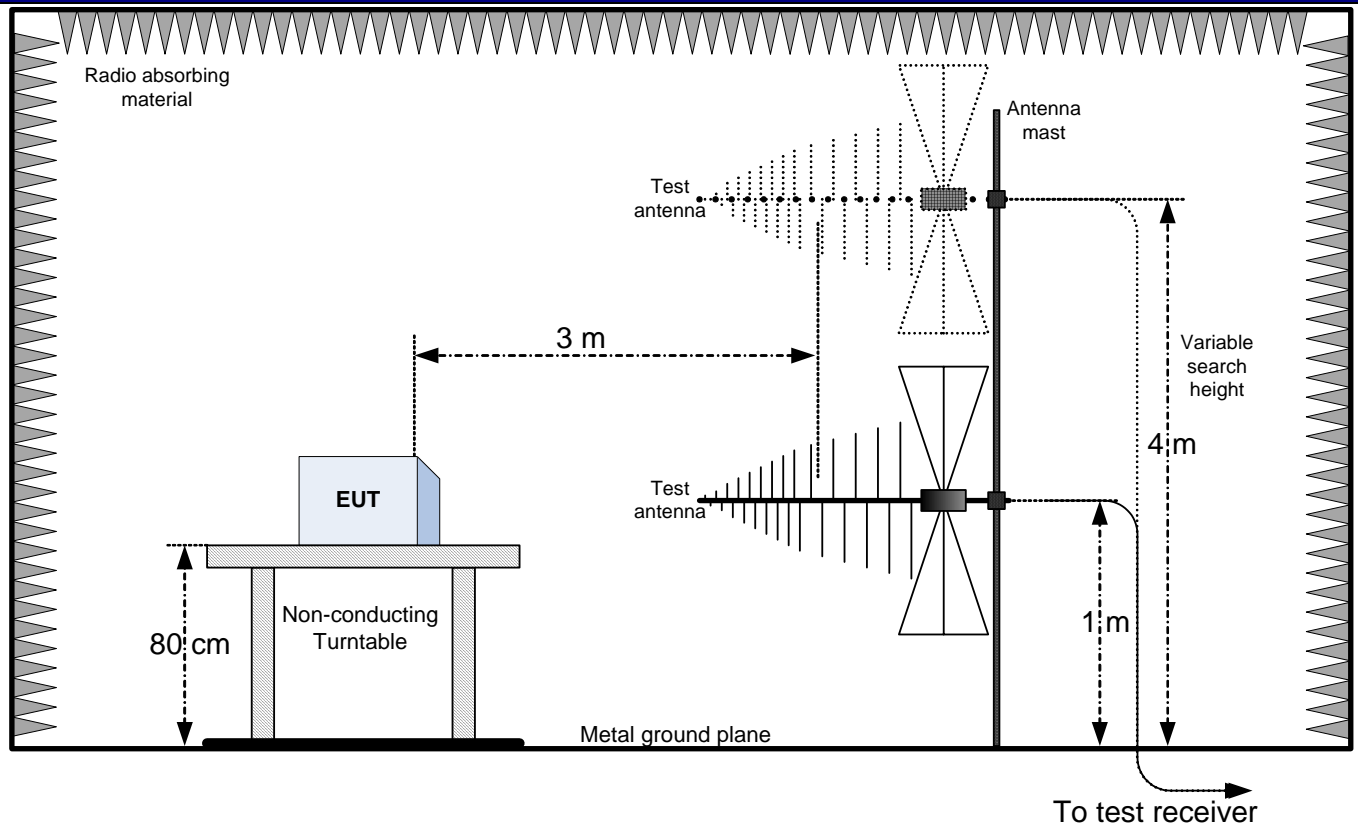


Frequency, MHz	PSD, dBm/3 kHz	Limit, dBm/3 kHz	Margin, dB
903	-15.58	8.0	23.58
915	-15.46	8.0	23.46
927	-12.70	8.0	20.70

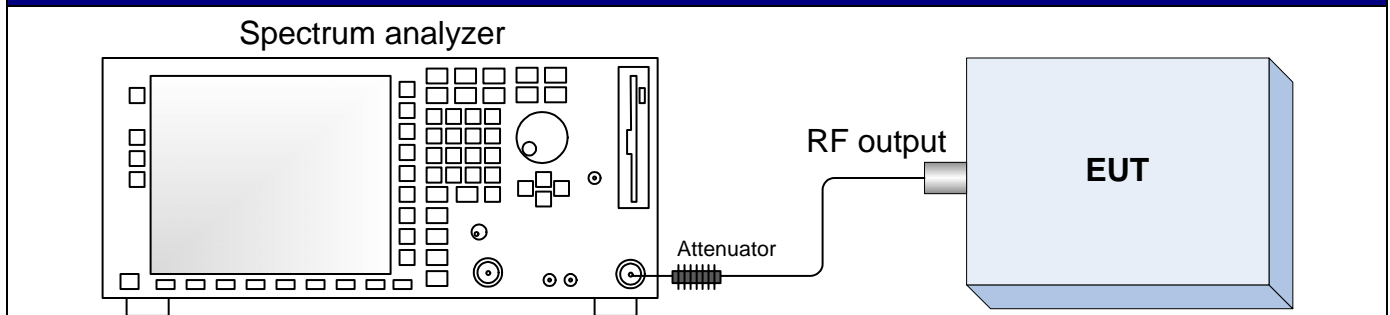
Sweep time = Span/RBW
 Sweep time = (300 kHz/3 kHz)
 Sweep time = 100 s

Section 8: Block diagrams of test set-ups

Radiated emissions set-up



Antenna port measurements set-up



Section 9: EUT photos

EUT front view



EUT rear view



EUT side view



EUT side view

