

**Nemko Test Report:** 117149-1R1TRFWL

**Applicant:** Mark IV Industries Ltd.  
6020 Ambler Drive  
Misissauga, ON  
L4W 2P1

**Apparatus:** G4P Transponder

**FCC ID:** JQU802001

**In Accordance With:** FCC Part 90 Subpart M  
Intelligent Transportation Systems Radio Service

**Authorized By:**



Andrey Adelberg, EMC/Wireless Specialist

**Date:** February 12, 2009

**Total Number of Pages:** 17

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## Section 1 : Report Summary

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.

The assessment summary is as follows:

<b>Apparatus Assessed:</b>	G4P Transponder
<b>Specification:</b>	FCC Part 90 Subpart M
<b>Compliance Status:</b>	Complies
<b>Exclusions:</b>	None
<b>Non-compliances:</b>	None
<b>Report Release History:</b>	Revision 1 – re-evaluation of the ERP values
<b>Test Location:</b>	Nemko Canada Inc. 303 River Road Ottawa, Ontario K1V 1H2
<b>Registration Number:</b>	176392 (3m Semi-Anechoic Chamber)
<b>Tests Performed By:</b>	Jason Nixon, Wireless/Telecom Specialist
<b>Test Dates:</b>	November 11 to 12, 2008, February 11, 2009

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

### 2.1 Identification of Equipment Under Test (EUT)

The following information identifies the EUT under test:

Type of Equipment:	LMS Transponder Tag
Brand Name:	Mark IV Industries
Model Name or Number:	G4P Transponder
Serial Number:	None (Conducted sample)
Nemko Sample Number:	1
FCC ID:	JQU802001
Date of Receipt:	November 10, 2008

Type of Equipment:	LMS Transponder Tag
Brand Name:	Mark IV Industries
Model Name or Number:	G4P Transponder
Serial Number:	None (Radiated sample)
Nemko Sample Number:	2
FCC ID:	JQU802001
Date of Receipt:	November 10, 2008

### 2.2 Accessories

No accessories were used during this assessment.

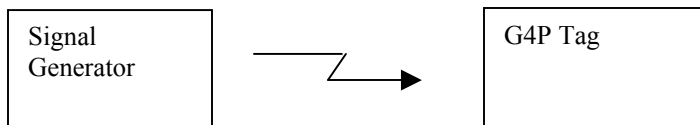
### 2.3 EUT Description

The EUT is a LMS tag that transmits once it receives a stimulus signal from a reader.

## 2.4 Technical Specifications of the EUT

<b>Operating Band:</b>	908-928MHz
<b>Operating Frequency:</b>	915MHz
<b>Modulation:</b>	On-Off Keying of a Manchester encoded data stream
<b>Occupied Bandwidth:</b>	9.024MHz
<b>Emission Designator:</b>	K1D
<b>Antenna Data:</b>	Internal antenna etched on the PCB
<b>Power Supply Requirements:</b>	3.6 VDC Lithium Battery

## 2.5 EUT Setup diagram



## 2.6 Operation of the EUT during testing

On receiving a 20usec CW pulse at 915.75MHz the EUT will respond within 105usec.

## 2.7 Modifications incorporated in the EUT

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

## **Section 3 : Test Conditions**

### **3.1 Specifications**

The apparatus was assessed against the following specifications:

FCC Part 2 Subpart J, Equipment Authorization Procedures  
FCC Part 90 Private Land Mobile Radio Services

### **3.2 Deviations From Laboratory Test Procedures**

No deviations were made from laboratory test procedures.

### **3.3 Test Environment**

All tests were performed under the following environmental conditions:

Temperature range	:	15 – 30 °C
Humidity range	:	20 - 75 %
Pressure range	:	86 - 106 kPa
Power supply range	:	+/- 5% of rated voltages

### **3.4 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.

### 3.5 Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Cal. Date	Next Cal.
Spectrum Analyzer	Rohde & Schwarz	FSU46	FA001877	Aug 28/08	Aug 28/09
Signal Generator	Rohde & Schwarz	SMR40	FA001879	Aug 13/08	Aug 13/09
Frequency Counter	HP	5352B	FA001915	Dec 3/07	Dec 3/08
Temperature Chamber	Thermotron	SM-16C	FA001030	NCR	NCR
Multimeter	Fluke	16	FA001831	Jan 14/08	Jan 14/09
Air probe	Fluke	None	FA001248	NCR	NCR
10dB Directional Coupler	Pasternack	PE2214-10	FA002106	COU	COU
3m EMI Test Chamber	TDK	SAC-3	FA002047	May 06/08	May 06/09
Bilog	Sunol	JB3	FA002108	Jan. 21/09	Jan. 21/09
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR	NCR
Controller	Sunol	SC104V	FA002060	NCR	NCR
Mast	Sunol	TLT2	FA002061	NCR	NCR
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 07/07	Dec. 07/08
50 Coax cable	HUBER + SUHNER	None	FA002022	July 07/08	July 07/09
50 Coax cable	HUBER + SUHNER	None	FA002074	July 07/08	July 07/09
Horn Antenna #2	EMCO	3115	FA000825	Jan. 15/08	Jan. 15/09
1 – 18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 2/08	Oct 2/09

COU – Calibrate on Use

NCR – No Calibration Required

## Section 4 : Results Summary

This section contains the following:

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)

### 4.1 FCC Part 90 : Test Results

Clause	Test Method	Test Description	Required	Result
90.205	2.1046	Output power	Y	PASS
90.207	2.1047	Modulation Characteristics	N	
90.209	2.1049	Occupied bandwidth	Y	PASS
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	Y	PASS
90.214	—	Transient Behavior	N	
90.219	—	Use of boosters	N	

Notes:



## Appendix A : Part 90 Test Results

### Clause 90.205(1) Power and antenna height limits

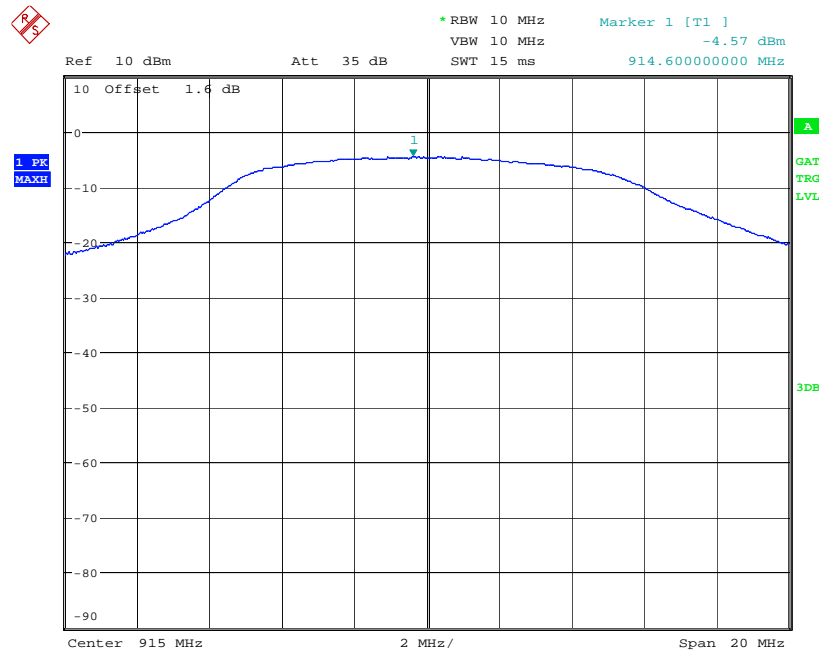
902–928 MHz. LMS systems operating pursuant to subpart M of this part in the 902–927.25 MHz band will be authorized a maximum of 30 watts ERP. LMS equipment operating in the 927.25–928 MHz band will be authorized a maximum of 300 watts ERP. ERP must be measured as peak envelope power. Antenna heights will be as specified in §90.353(h).

**Test Results:** Pass

#### Additional Observations:

Both conducted measurement and radiated measurement were performed. The EUT was tested with a fresh battery.

#### Conducted Results



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### Radiated Output Power Measurement (ERP)

The EUT was test with a fresh battery. The EUT was assessed on two mounting positions. The Manufacturer provides instructions to mount the product in a horizontal orientation on a windshield. Since the angle of the windshield cannot be controlled by the Manufacturer two positions were assessed.

The signal substitution method was used to determine the output power level (ERP).

The radiated test was performed using a Peak Detector with 10MHz / 10 MHz RBW/VBW, at a distance of 3 meters.

#### Radiated Output Power (ERP)

Frequency (MHz)	Ant.	Pol. H/V	RCVD Signal (dBμV)	Signal Substitution Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Orientation
915.0	JB3	H	69.32	-76.71	-7.39	44.8	52.19	Back
915.0	JB3	V	58.20	-74.39	-16.19	44.8	60.99	Back
915.0	JB3	H	68.38	-76.71	-8.33	44.8	53.13	Horizontal
915.0	JB3	V	60.26	-74.39	-14.13	44.8	58.93	Horizontal

RF Output Signal Level (ERP)= Receiver Signal Level + Signal Substitution Factor.

Signal Substitution Factor = Reference signal level from signal generator

- Reference signal level received from spectrum analyzer reading
- +Antenna gain
- Cable loss



### Clause 90.210(k) Emission masks

*Emission Mask K* —(1) *Wideband multilateration transmitters.* For transmitters authorized under subpart M to provide forward or reverse links in a multilateration system in the subbands 904–909.75 MHz, 921.75–927.25 MHz and 919.75–921.75 MHz, and which transmit an emission occupying more than 50 kHz bandwidth: in any 100 kHz band, the center frequency of which is removed from the center of authorized sub-band(s) by more than 50 percent of the authorized bandwidth, the power of emissions shall be attenuated below the transmitter output power, as specified by the following equation, but in no case less than 31 dB:

$$A=16+0.4(D-50)+10 \log B \text{ (attenuation greater than 66 dB is not required)}$$

Where:

- A = attenuation (in decibels) below the maximum permitted output power level
- D = displacement of the center frequency of the measurement bandwidth from the center frequency of the authorized sub-band, expressed as a percentage of the authorized bandwidth B
- B = authorized bandwidth in megahertz.

(2) *Narrowband forward link transmitters.* For LMS multilateration narrowband forward link transmitters operating in the 927.25–928 MHz frequency band the power of any emission shall be attenuated below the transmitter output power (P) in accordance with following schedule:

On any frequency outside the authorized sub-band and removed from the edge of the authorized sub-band by a displacement frequency ( $f_d$  in kHz): at least  $116 \log ((f_d+10)/6.1)$  dB or  $50 + 10 \log (P)$  dB or 70 dB, whichever is the lesser attenuation.

(3) *Other transmitters.* For all other transmitters authorized under subpart M that operate in the 902–928 MHz band, the peak power of any emission shall be attenuated below the power of the highest emission contained within the licensee's sub-band in accordance with the following schedule:

- (i) On any frequency within the authorized bandwidth: Zero dB.
- (ii) On any frequency outside the licensee's sub-band edges:  $55 + 10 \log(P)$  dB, where (P) is the highest emission (watts) of the transmitter inside the licensee's sub-band.

(4) In the 902–928 MHz band, the resolution bandwidth of the instrumentation used to measure the emission power shall be 100 kHz, except that, in regard to paragraph (2) of this section, a minimum spectrum analyzer resolution bandwidth of 300 Hz shall be used for measurement center frequencies with 1 MHz of the edge of the authorized subband. The video filter bandwidth shall not be less than the resolution bandwidth.

(5) Emission power shall be measured in peak values.

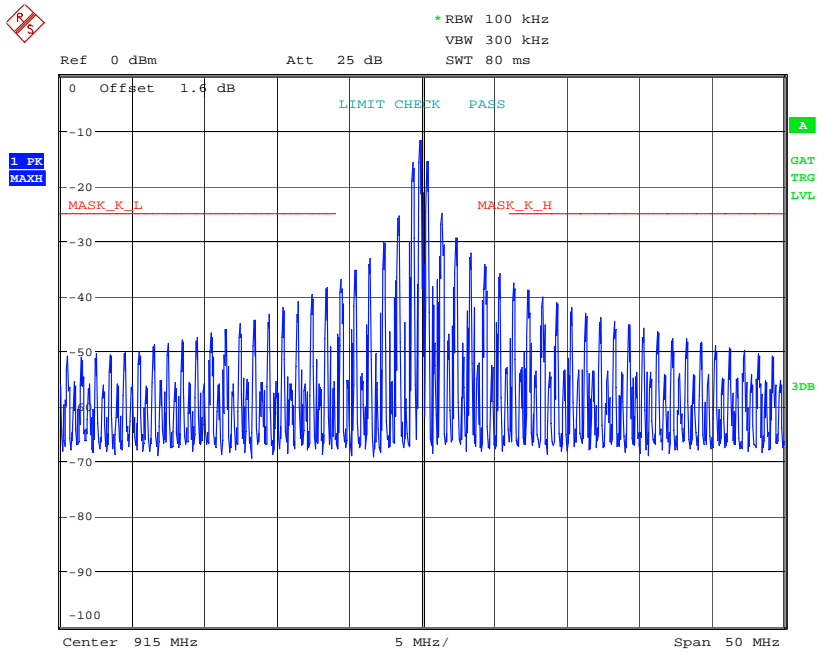
(6) The LMS sub-band edges for non-multilateration systems for which emissions must be attenuated are 902.00, 904.00, 909.5 and 921.75 MHz.

**Test Results:** Pass

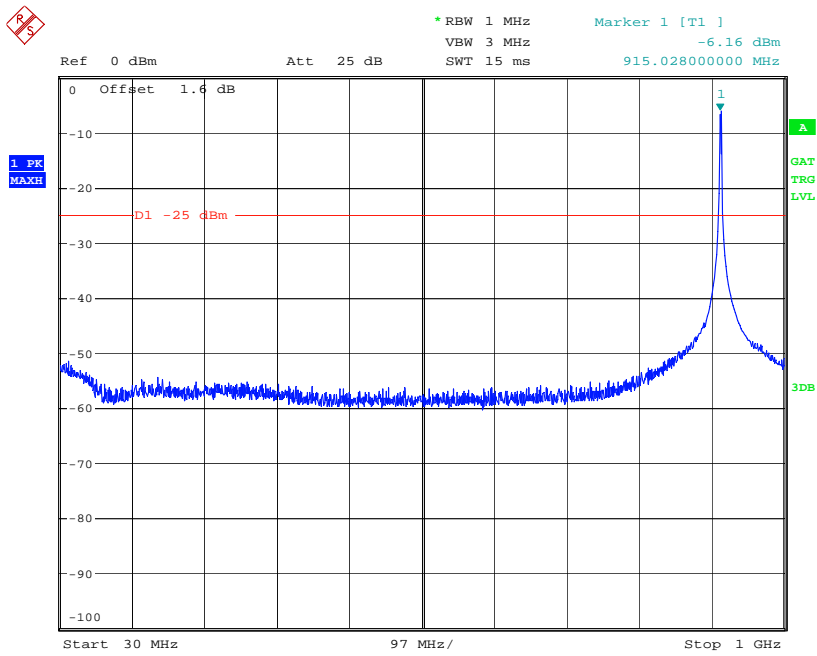
**Additional Observations:**

Both conducted measurement and radiated measurement have been performed for spurious emission test.

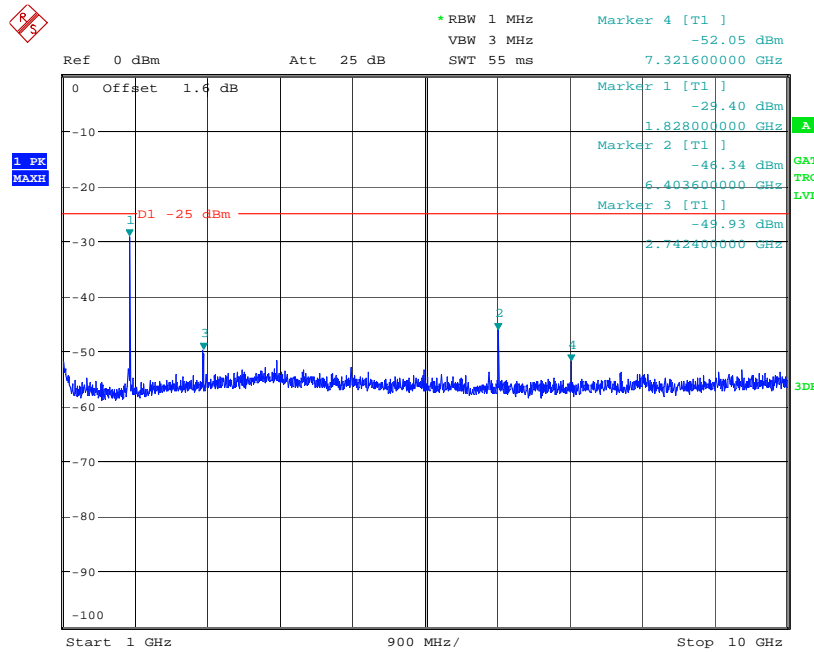
The EUT was tested with a fresh battery



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### Radiated Test Results

Frequency (MHz)	Ant.	Pol. H/V	RCVD Signal (dBμV)	Amp gain (dB)	Signal Substitution Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1830	Horn 2	H	74.55	-46.4	-68.5	-40.45	-25	15.45
1830	Horn 2	V	70.65	-46.4	-68.0	-43.75	-25	18.75

Emission Level (ERP)= Receiver Signal Level + Amp Gain + Signal Substitution Factor.

Signal Substitution Factor = Reference signal level from signal generator  
 -Reference signal level received from spectrum analyzer reading  
 +Antenna gain  
 -Cable loss

### Additional Observations:

The Spectrum was searched from 30 MHz to 10 GHz.

The EUT was measured on three orthogonal axis with a fresh new battery.

All measurements were performed using a Peak Detector with 100kHz RBW below 1GHz and a 1MHz RBW above 1GHz at a distance of 3 meters.

**Clause 90.213 Frequency Stability**

<b>Minimum Frequency Stability [Parts per million (ppm)]</b>			
<b>Frequency range (MHz)</b>	<b>Fixed and base stations</b>	<b>Mobile stations</b>	
		<b>Over 2 watts output power</b>	<b>2 watts or less output power</b>
902-928 <sup>13</sup>	2.5	2.5	2.5

<sup>13</sup>Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.

**Test Results:** Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.

<b>Condition</b>	<b>Frequency (Hz)</b>	<b>Offset (ppm)</b>
+50°C	914795437.5	-71.17
+40°C	914818687.5	-45.76
+30°C	914833937.5	-29.09
+20°C	914860550.0	—
+10°C	914836250.0	-26.56
0°C	914826812.5	-36.88
-10°C	914808750.0	-56.62
-20°C	914805562.5	-60.10
-30°C	914795750.0	-70.83

The EUT was assessed with fresh new battery.

## Appendix B : Setup Photographs

### Radiated Spurious Emissions Setup:

Back



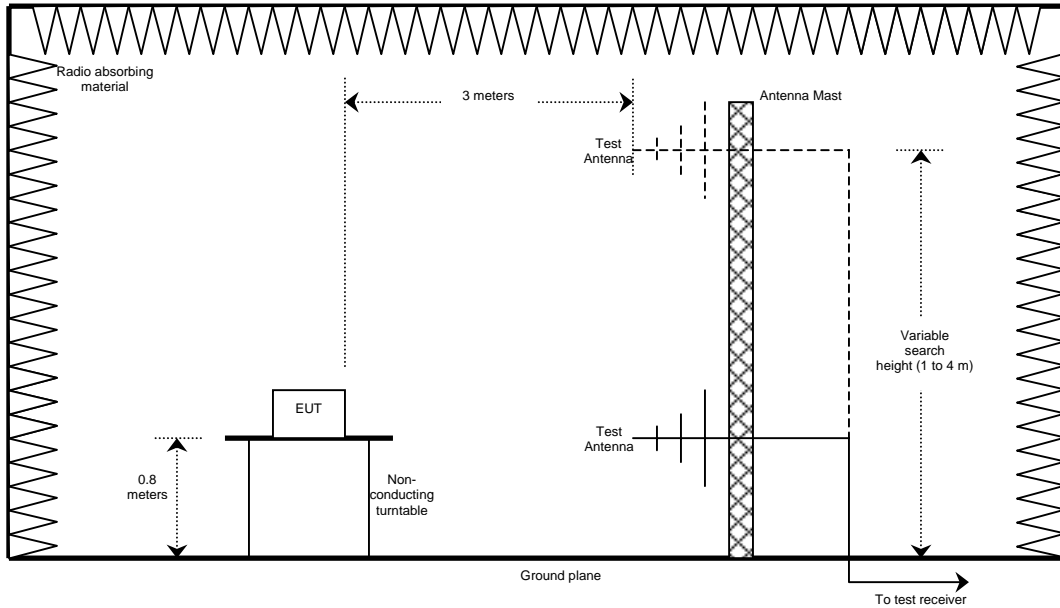
Horizontal



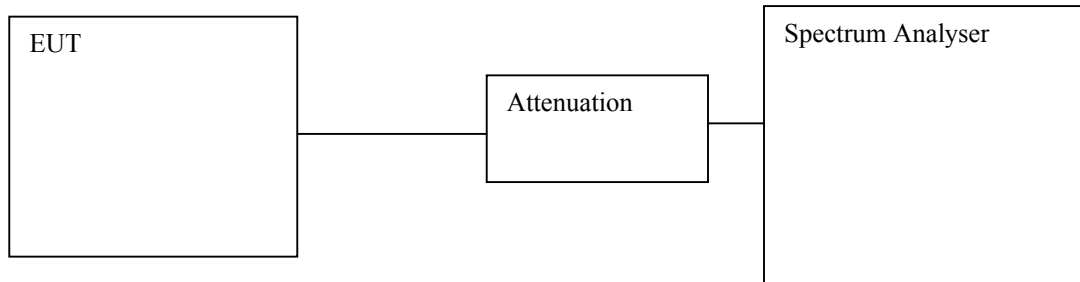


## Appendix C : Block Diagram of Test Setups

### Test Site For Radiated Emissions



### Conducted Emissions, Output power, Occupied Bandwidth



### Frequency Stability

