



Test Report: 5W57768

Applicant: Mark IV Industries Corp.
6020 Ambler Drive
Mississauga, ON
L4W 2P1

Apparatus: G4 Transponder 801630-TAB

FCC ID: JQU 801630

In Accordance With: FCC Part 90
Private Land Mobile Radio Services

Tested By: Nemko Canada Inc.
303 River Road
Ottawa, Ontario
K1V 1H2

Authorized By: 
Sim Jagpal, General Manager

Date: March 7, 2006

Total Number of Pages: 25

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. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.

The assessment summary is as follows:

Apparatus Assessed:	G4 Transponder 801630-TAB
Specification:	FCC Part 90 Private Land Mobile Radio Services
Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None
Report Release History:	Original Release

Author: Roman Kuleba, EMC/Wireless Specialist

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.

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Section 1 : Equipment Under Test

1.1 Product Identification

The Equipment Under Test was identified as follows: G4 Transponder 801630-TAB

1.2 Samples Submitted for Assessment

The following samples of the apparatus have been submitted for type assessment:

Sample No.	Description	Serial No.
1	G4 Transponder, integral antenna disconnected and SMA connector added to TX-output for conducted measurement	# S102
2	G4 Transponder, integral antenna connected (no modifications) for radiated measurement	# PB011
3	G4 Transponder, SMA connector attached to antenna for antenna gain measurement	# PA002

The first samples were received on: December 19, 2005

1.3 Theory of Operation

The G4 Transponder is a part of an automatic vehicle monitoring system. The main components are the G4 Transponder, Reader, Reader Antenna and RF modules. The G4 Transponder is mounted on a vehicle's windshield at a location visible to the Reader antenna.

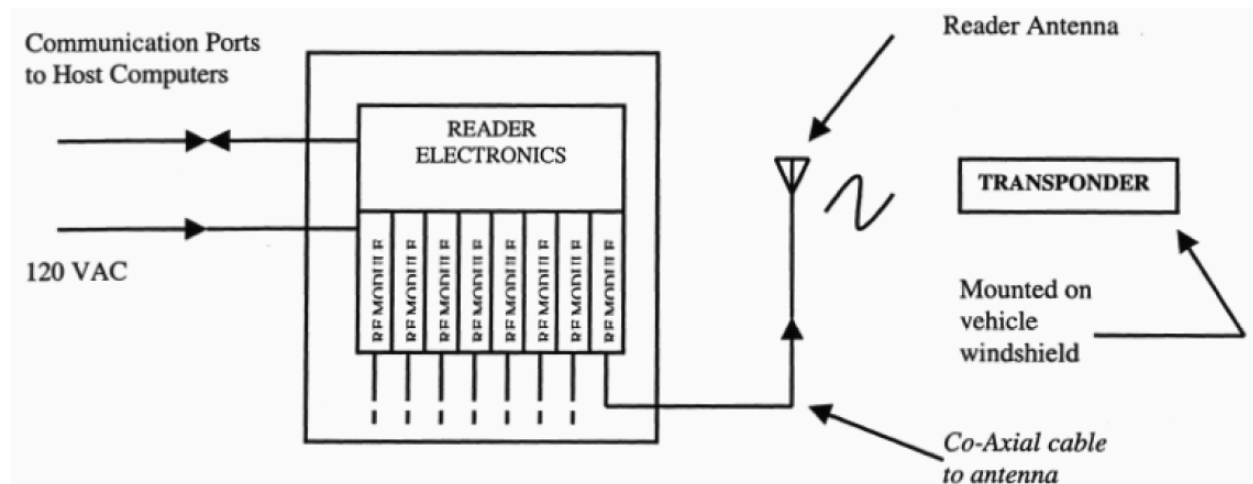
In operation, the Reader via a selected RF module sends out to each antenna 915 MHz modulated with a data stream, thereby establishing an intermittent RF field in each lane of the roadway. When a vehicle equipped with a G4 transponder enters the field, the pulses activate the transponder and cause it to respond with a data transmission on a carrier frequency of 915 MHz.

The transponder antenna is etched on the PCB with its matching circuit, which matches the antenna impedance to the 50 ohms.

1.4 Technical Specifications of the EUT

Manufacturer:	Mark IV Industries Corp.
Operating Frequency:	915 MHz
Emission Designator:	8M04 P1D
Rated Power:	-2.0 dBm
Measured Power:	Conducted: -2.1 dBm EIRP: -2.7 dBm
Modulation:	On-Off Keying (OOK), Data Rate: 500 kbps
Antenna Data:	Internal integrated antenna etched on the PCB Gain: -0.6 dBi (measured)
Power Source:	3.6 VDC Battery

1.5 Block Diagram of the EUT



Section 2 : Test Conditions

2.1 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

2.2 Deviations From Laboratory Test Procedures

No deviations were made from laboratory test procedures.

2.3 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

2.4 Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Last Cal.	Next Cal.
Spectrum Analyzer	Rohde & Schwarz	FSP	FA001920	March 22/05	March 22/06
Spectrum Analyzer	Hewlett-Packard	8566B	FA001309	May 18/05	May 18/06
Spectrum Analyzer Display	Hewlett-Packard	85662A	FA001309	May 18/05	May 18/06
Horn Antenna #1	EMCO	3115	FA000649	Jan. 12/06	Jan. 12/07
Log Periodic Antenna #2	EMCO	3148	FA001355	May 16/05	May 16/06
Biconical (2) Antenna	EMCO	3109	FA000904	Aug. 26/05	Aug. 26/06
1.0 – 2.0 GHz Amplifier	JCA	12-400	FA001498	July 14/05	July 14/06
2.0 – 4.0 GHz Amplifier	JCA	24-600	FA001496	July 14/05	July 14/06
4.0 – 8.0 GHz Amplifier	JCA	48-600	FA001497	July 14/05	July 14/06
5.0 – 18.0 GHz Amplifier	NARDA	DWT-186N23U40	FA001409	COU	COU
Climate Chamber	Thermotron	SM-16C	15649-S	COU	COU

COU – Cal. On Use

NCR – No Cal. Required

Section 3 : Observations

3.1 Modifications Performed During Assessment

No modifications were performed during assessment.

3.2 Record Of Technical Judgements

No technical judgements were made during the assessment.

3.3 EUT Parameters Affecting Compliance

The user of the apparatus could not alter parameters that would affect compliance.

3.4 Test Deleted

No Tests were deleted from this assessment.

3.5 Additional Observations

There were no additional observations made during this assessment.

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 section 3.4 Test deleted)

The results contained in this section are representative of the operation of the apparatus as originally submitted.

4.1 FCC Part 90 : Test Results

Clause	Test Method	Test Description	Required	Result
90.205	2.1046	Output power	Y	Complies
90.207	2.1047	Modulation Characteristics	Y	Complies
90.209	2.1049	Occupied bandwidth	Y	Complies
90.210	2.1051	Spurious Emissions at the antenna terminal	Y	Complies
90.210	2.1053	Field strength of spurious radiation	Y	Complies
90.213	2.1055	Frequency stability	Y	Complies
90.214	—	Transient Behaviour	N	N/A
90.219	—	Use of boosters	N	N/A

Notes:

Appendix A : Test Results

Clause 90.205 Output Power

Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation. Except where otherwise specifically provided for, the maximum power that will be authorized for new stations authorized after August 16, 1995 is as follows in FCC Part 90.205(a) through (r).

Test Conditions:

Sample Number:	1	Temperature:	23 °
Date:	February 9, 2006	Humidity:	36 %
Modification State:	0	Tester:	Roman Kuleba
		Laboratory:	Ottawa

Test Results: Complies.

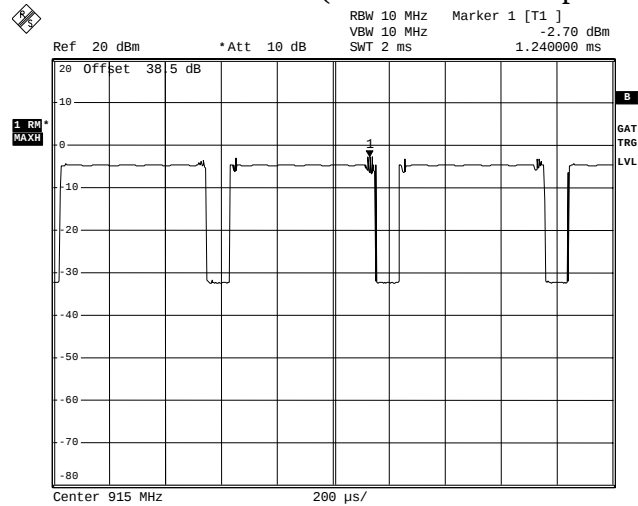
Test Data: See plots and table.

Additional Observations: The EUT was placed on a rotating table and set to transmit with the maximum output power. The highest average output power was measured in a position with the maximum radiation in both polarizations.

Output Power, continued

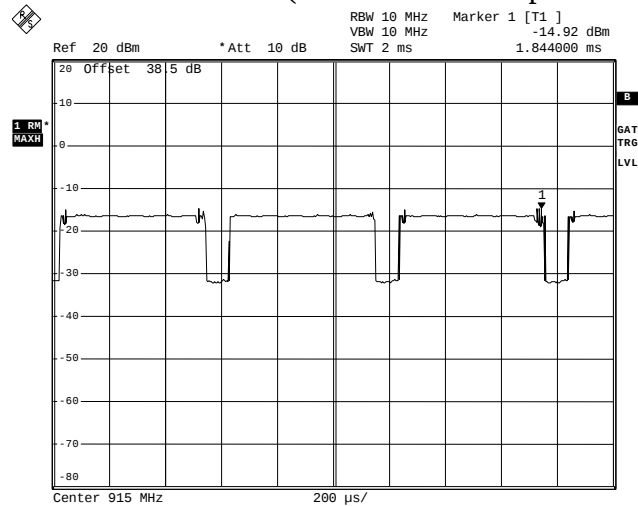
The highest radiated power was measured in a position with the maximum radiation.

Horizontal Polarization (Maximum Envelope Power):



Date: 3.MAR.2006 19:14:17

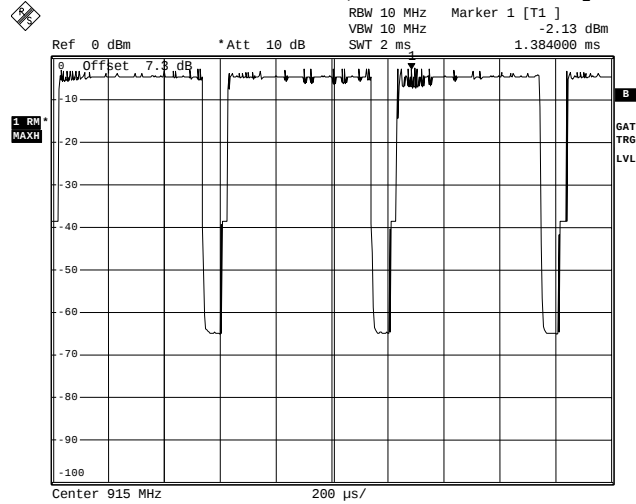
Vertical Polarization (Maximum Envelope Power):



Date: 3.MAR.2006 19:19:53

Output Power, continued

Conducted Measurement (Maximum Envelope Power):



Date: 3.MAR.2006 18:43:09

Test Data:

Polarization Vert./Hor.	Freq. (MHz)	P _{TX-conducted} (dBm)	G _{Ant.} (dBi)	EIRP (dBm)	Rated P _{TX-conducted} (dBm)
Vert.	915	-2.1	-12.8	-14.9	-2.0
Hor.	915	-2.1	-0.6	-2.7	-2.0

The EUT was set to transmit with the maximum output power.
 The highest power was measured.

Clause 90.209 Occupied Bandwidth

(5) Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following Table.

Standard Channel Spacing/Bandwidth

Frequency Band (MHz)	Channel Spacing (kHz)	Authorized Bandwidth (kHz)
Below 25	--	--
25-50	20	20
72-76	20	20
150-174	7.5	20/11.25/6
216-220	6.25	20/11.25/6
220-222	5	4
406-512	6.25	20/11.25/6
806-809/851-854	12.5	20
809-824/854-869	25	20
896-901/935-940	12.5	13.6
902-928	--	--
929-930	25	20
1427-1432	12.5	12.5
2450-2483.5	--	--
Above 2500	--	--

Test Conditions:

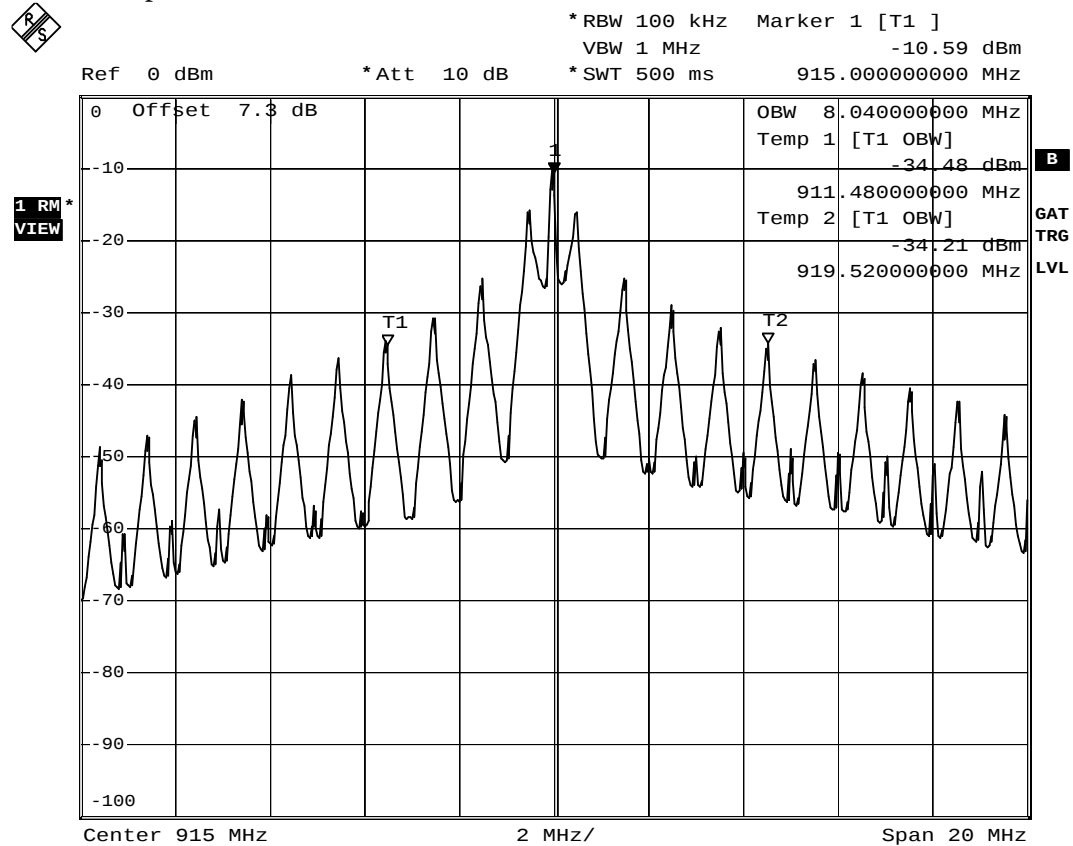
Sample Number:	1	Temperature:	23 °
Date:	February 9, 2006	Humidity:	36 %
Modification State:	0	Tester:	Roman Kuleba
		Laboratory:	Ottawa

Test Results: Complies.

Test Data: The Occupied Bandwidth is 8.04 MHz (see attached plot).

Occupied Bandwidth, continued

99% Occupied Bandwidth



Date: 9.FEB.2006 17:35:13

Clause 90.210 Spurious emissions at the antenna terminal

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

Test Conditions:

Sample Number:	1	Temperature:	23 °
Date:	February 11, 2006	Humidity:	36 %
Modification State:	0	Tester:	Roman Kuleba
		Laboratory:	Ottawa

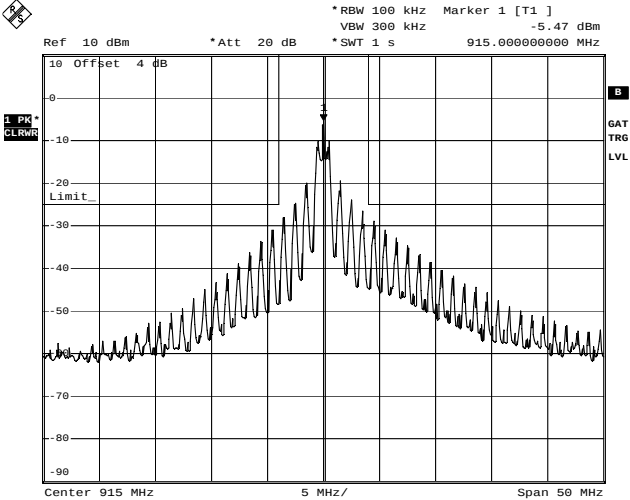
Test Results: Complies

Test Data: See Attached Plots and tables.

Note: The EUT was tested with a fresh battery.
The EUT was searched in 3 orthogonal axes to determine worst-case emissions.
The spectrum was searched for emissions from 30MHz to 10GHz.
Only the worst case has been presented.

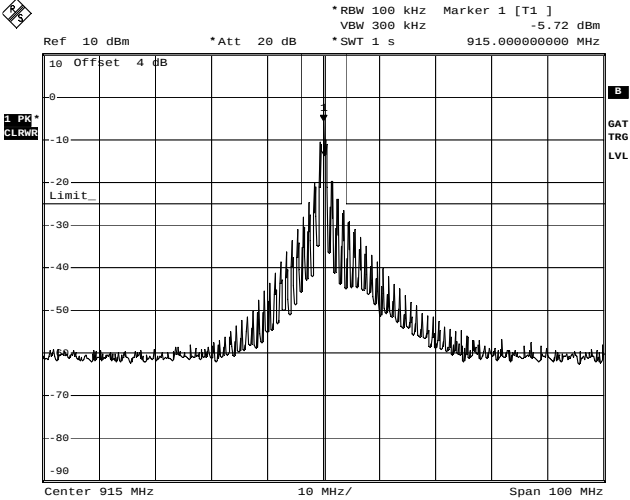
Spurious emissions at the antenna terminal, continued

Conducted Emissions (Mask K):



Date: 11.FEB.2006 00:55:06

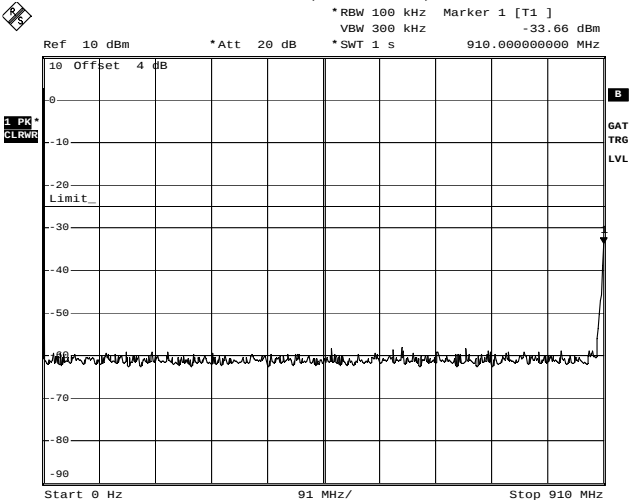
Conducted Emissions (Mask K):



Date: 11.FEB.2006 00:55:45

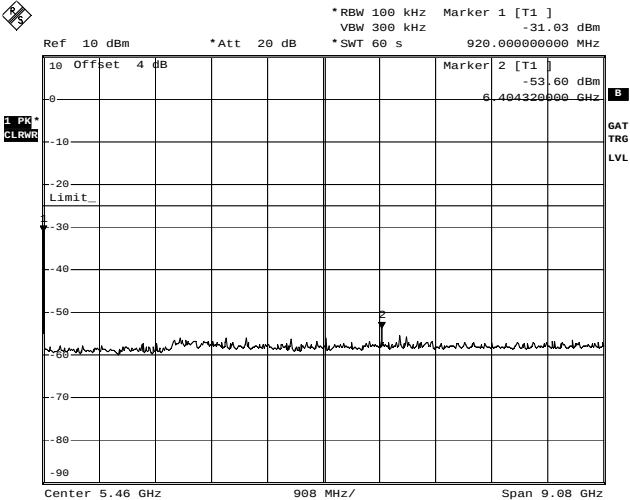
Spurious emissions at the antenna terminal, continued

Conducted Emissions (Mask K):



Date: 11.FEB.2006 00:56:34

Conducted Emissions (Mask K):



Date: 11.FEB.2006 01:01:42

Clause 90.210 Field Strength of spurious radiation

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

Test Conditions:

Sample Number:	1	Temperature:	23 °
Date:	February 11, 2006	Humidity:	36 %
Modification State:	0	Tester:	Roman Kuleba
		Laboratory:	Ottawa

Test Results:

See Attached Table for Results

Additional Observations:

The Spectrum was searched from 30MHz to the 10th Harmonic.

The EUT was measured on three orthogonal axes.

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.

Field Strength of spurious radiation, continued

Frequency (MHz)	Antenna	Polarity	RCVD Signal (dBµV)	Sig. Sub. Factor	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Detector
71.5000	BC2	V	12.3	-88.9	-76.6	-25.0	51.6	Peak
91.5000	BC2	V	17.3	-89.8	-72.5	-25.0	47.5	Peak
187.5000	BC2	V	8.7	-79.9	-71.2	-25.0	46.2	Peak
90.5000	BC2	H	14.5	-89.2	-74.7	-25.0	49.7	Peak
Note 1: Antenna Legend: BC = Biconical, BL = Bilog, LP = Log-Periodic, Horn = Horn, ED = EMCO Dipole								
Note 2: Detector Legend: Q-Peak = 120 kHz RBW, Average = 1.0 MHz RBW								
Below 1GHz, Peak detector with 100 kHz RBW, 100KHz VBW								
Above 1GHz, Peak detector with 1.0MHz RBW, 1.0MHz VBW								

Clause 90.213 Frequency Stability

a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following Table.

Minimum Frequency Stability

parts per million (ppm)

Frequency range (MHz)	Fixed and base stations 2 watts output power	Mobile stations Over power	2 watts or less output
Below 25	100	100	200
25-50	20	20	50
72-76	5	---	50
150-174	50	5	50
216-220	1.0	---	1.0
220-222	0.1	1.5	1.5
421-512	2.5	5	5
806-809	1.0	1.5	1.5
809-824	1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	0.1	1.5	1.5
902-928	2.5	2.5	2.5

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 stability restrictions.

929-930	1.5	---	---
935-940	0.1	1.5	1.5
1427-1435	300	300	300
Above 2450	---	---	---

Test Conditions:

Sample Number:	1	Temperature:	-40 ° to +85 °
Date:	February 10, 2006	Humidity:	0 %
Modification State:	0	Tester:	Roman Kuleba
		Laboratory:	Ottawa

Test Results: See Attached Table.

Test Conditions Ambient Temperature: 23°C
 Extreme Temperature: -30°C to +50°C
 The EUT was tested with a fresh battery.

Test Data: See Attached tables

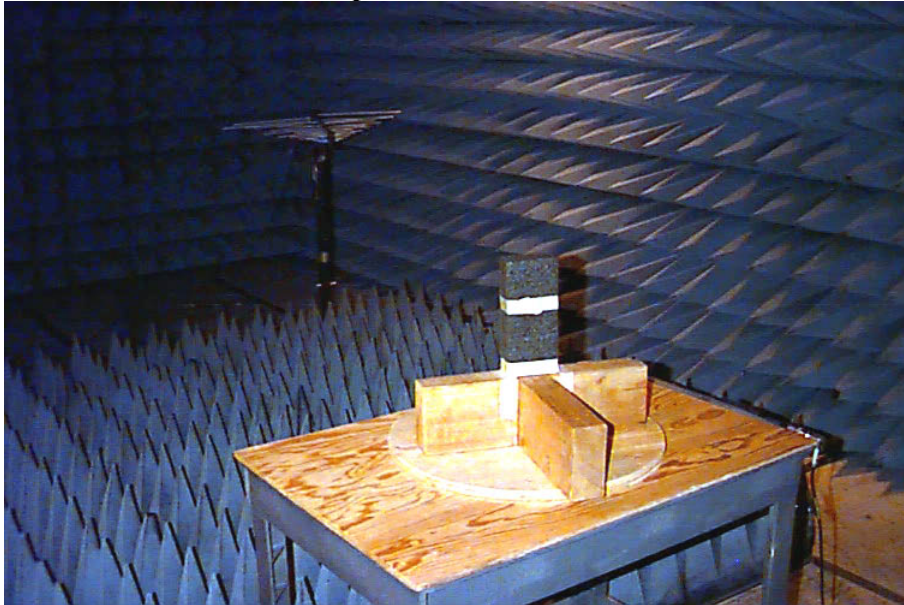
Frequency Stability, continued

Temperature (°C)	Measured Frequency (MHz)
-40	914.872806000
-30	914.904804000
20	914.949810000
50	914.904810000
85	914.837200000

Note: 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 stability restrictions.

Appendix B : Setup Photographs

Radiated Emissions Setup:

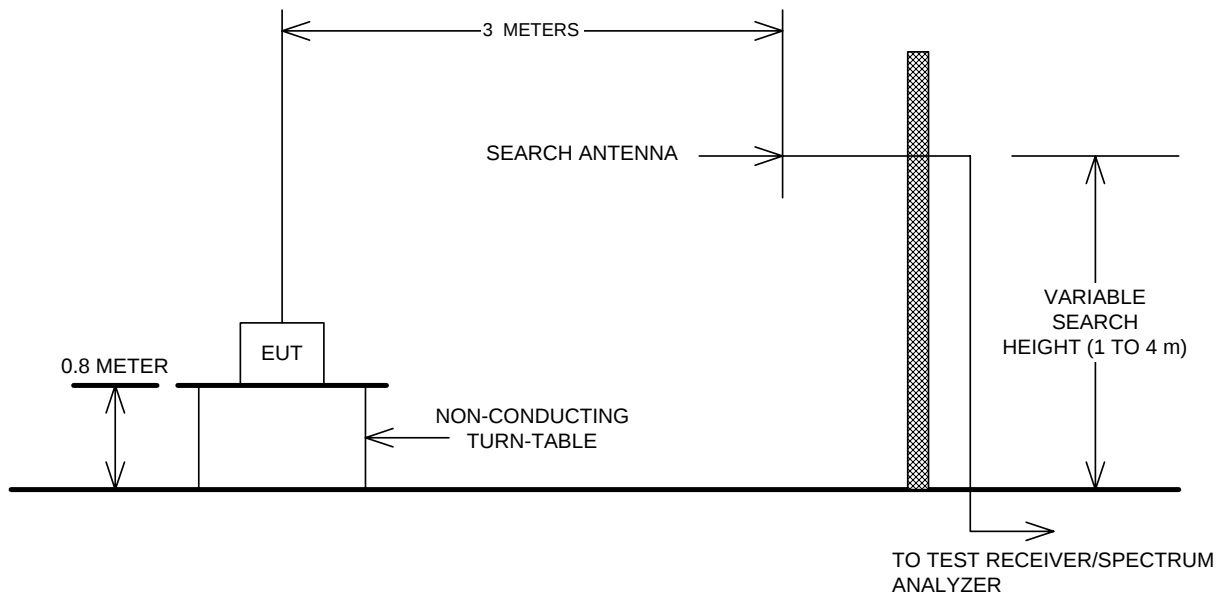


Conducted Emissions Setup:

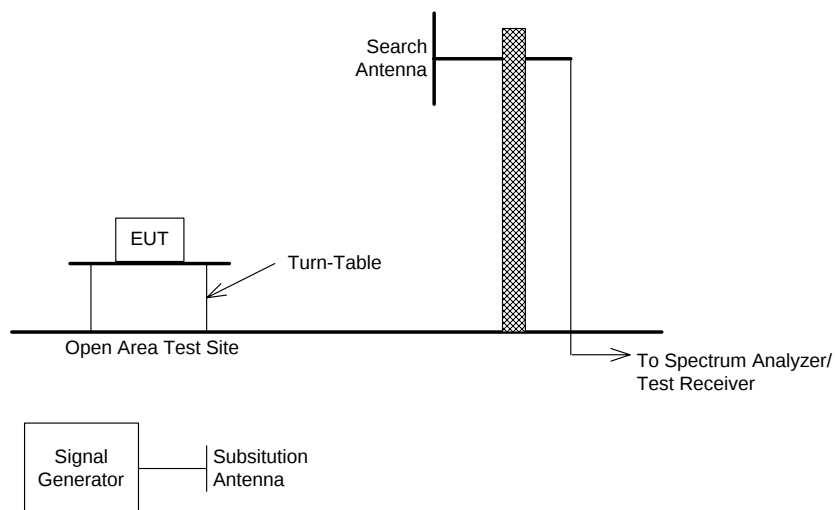


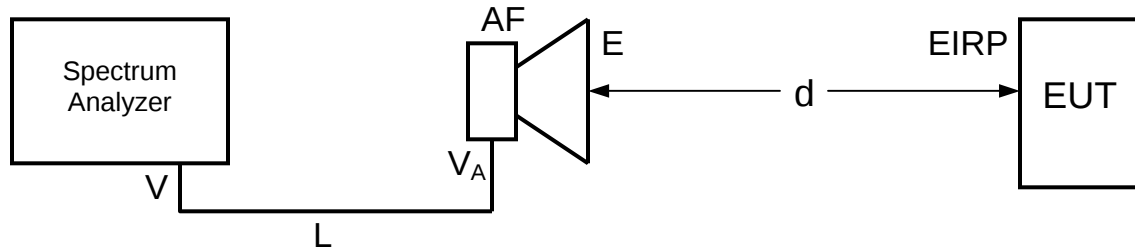
Appendix C : Block Diagram of Test Setups

Test Site for Field Strength of Radiated Emissions



Effective Radiated Power of Spurious Emissions by Substitution Method (TIA/EIA 603)



EIRP of Radiated Emissions (Correction Factor for direct measurement)

$$E(V/m) = \frac{\sqrt{30 \cdot \text{EIRP}(W)}}{d(m)} \Rightarrow E(\text{dB}\mu\text{V/m}) = 90 + 10 \cdot \log_{10} 30 + \text{EIRP}(\text{dBm}) - 20 \cdot \log_{10} d(m)$$

$$E(\text{dB}\mu\text{V/m}) = V(\text{dB}\mu\text{V/m}) + L(\text{dB}) + \text{AF}(\text{dB}) = P_{\text{Read}}(\text{dBm}) + 106.99 + L(\text{dB}) + \text{AF}(\text{dB})$$

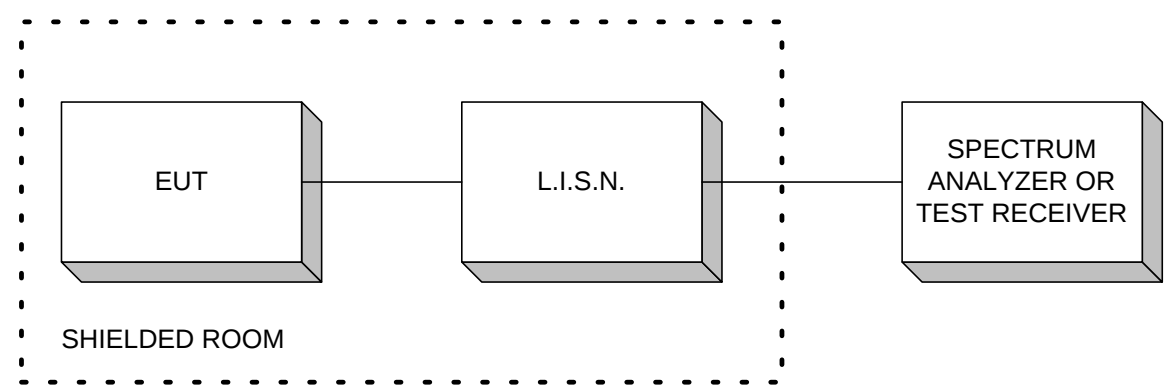
$$\text{EIRP}(\text{dBm}) = P_{\text{Read}}(\text{dBm}) + 2.22 + L(\text{dB}) + \text{AF}(\text{dB}) + 20 \cdot \log_{10} d(m)$$

$$\text{EIRP}(\text{dBm}) = P_{\text{Read}}(\text{dBm}) + \text{Off-set}(\text{dB})$$

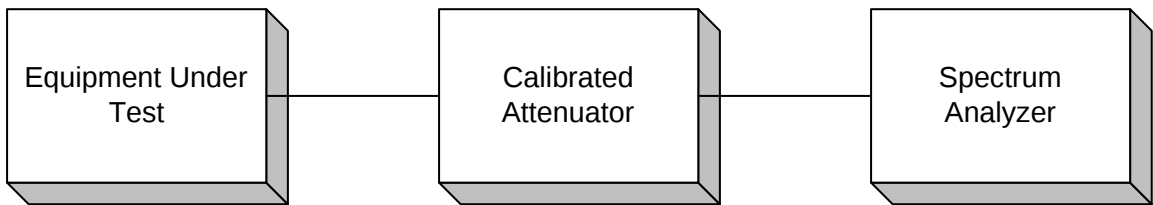
$$\text{Off-set}(\text{dB}) = 2.22 + L(\text{dB}) + \text{AF}(\text{dB}) + 20 \cdot \log_{10} d(m)$$

EIRP :	Equivalent Isotropically Radiated Power transmitted from EUT
E :	Electric Field Strength measured at distance d from EUT
d :	Distance (m)
V :	Voltage at Spectrum Analyzer Input (dB μ V/m)
P _{Read} (dBm) :	Reading on Spectrum Analyzer (dBm)
L :	Cable Loss (dB)
AF :	Antenna Factor (dB)
Off-set :	Off-set Correction Factor (in dB) needed to read EIRP of emissions (in dBm) directly on Spectrum Analyzer

AC Power Lines Conducted Emissions



RF Conducted Emissions



Frequency Stability (Para. No. 2.1055)

