www.nemko.com

| | |
|---|---|
| **Test Report:** | 82657-1R2TRFWL |
| **Applicant:** | Mark IV Industries Corp.<br>6020 Ambler Drive<br>Mississauga ON.<br>L4W 2P1 |
| **Apparatus:** | TDMA V6 Transponder |
| **FCC ID:** | JQU801604 |
| **In Accordance With:** | FCC Part 90<br>Private Land Mobile Radio Services |
| **Tested By:** | Nemko Canada Inc.<br>303 River Road<br>Ottawa, Ontario<br>K1V 1H2 |
| **Authorized By:** | Roman Kuleba, EMC / Wireless Specialist |
| **Date:** | March 22, 2007 |
| **Total Number of Pages:** | 21 |

## 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 is 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:** TDMA V6 Transponder

**Specification:** FCC Part 90 Private Land Mobile Radio Services

**Compliance Status:** Complies

**Exclusions:** None

**Non-compliances:** None

**Report Release History:** Original Release

Author: Heng Lin 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.

# TABLE OF CONTENTS

# Section 1 : Equipment Under Test

## 1.1 Product Identification

The Equipment Under Test was identified as follows:

TDMA V6 Transponder

## 1.2 Samples Submitted for Assessment

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

| Sample No. | Description | Serial No. |
|---|---|---|
| | | |
| 1 | TDMA V6 Transponder | 8A22X-C827 |
| 2 | TDMA V6 Transponder | 8A22X-C817 |
| | | |

The first samples were received on: March 06, 2007

## 1.3 Technical Specifications of the EUT

| | | |
|---|---|---|
| **Manufacturer:** | Mark IV Industries Corp. | |
| **Operating Frequency:** | 914.4MHz – 915.6MHz | |
| **Emission Designator:** | 7M47P1D | |
| **Rated Power:** | 4mW (ERP) | |
| **Measured Power:** | Conducted Output Power:<br>Radiated Output Power (ERP): | 2.91dBm<br>3.9dBm (2.45mW) |
| **Modulation:** | On-Off Keying | |
| **Antenna Data:** | Integral < 3.5 dBi | |
| **Power Source:** | 3.6VDC Lithium Battery | |

# 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 $^{o}$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. | Next Cal. |
|---|---|---|---|---|
| Receiver/Spectrum Analyzer | Rohde & Schwarz | ESU | FA002043 | Oct. 24/07 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | FA001920 | March 17/07 |
| Spectrum Analyzer | Rohde & Schwarz | FSU | FA001877 | May 10/07 |
| Biconical (1) Antenna | EMCO | 3109 | FA000805 | May 03/07 |
| Log Periodic Antenna #2 | EMCO | 3148 | FA001355 | May 16/07 |
| Horn Antenna #2 | EMCO | 3115 | FA000825 | Jan. 30/08 |
| 1.0 – 2.0 GHz Amplifier | JCA | 12-400 | FA001498 | Aug. 02/07 |
| 2.0 – 4.0 GHz Amplifier | JCA | 24-600 | FA001496 | Aug. 02/07 |
| 4.0 – 8.0 GHz Amplifier | JCA | 48-600 | FA001497 | Aug. 02/07 |
| 5.0 – 18.0 GHz Amplifier | NARDA | DWT-186N23U40 | FA001409 | COU |

COU – Calibrate on Use
NCR – No Calibration Required

# Section 3 : Observations

## 3.1 Modifications Performed During Assessment

The EUTs have been modified to transmit continuously with a typical modulated signal of 500kbps. No complex RF activation / triggering is therefore needed.

## 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 | PASS |
| 90.207 | 2.1047 | Modulation Charateristics | 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 surious 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 : Test Results

## Clause 90.205 Output Power

| |
|---|
| 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 |

**Test Conditions:**

| | | | |
|---|---|---|---|
| **Sample Number:** | 1, 2 | **Temperature:** | 24°C |
| **Date:** | Mar. 06, 2007 | **Humidity:** | 51 % |
| **Modification State:** | 0 | **Tester:** | Heng Lin |
| | | **Laboratory:** | Ottawa |

**Test Results:** See plots and table.

**Additional Observations:**

Both conducted measurement and radiated measurement have been performed for output power test.

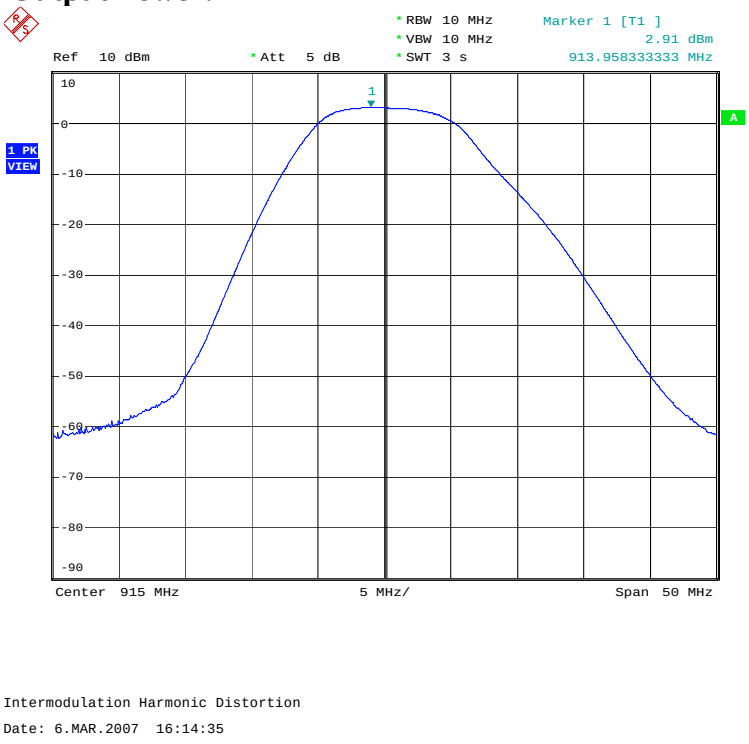
The EUT was tested with a fresh battery.

For radiated measurement, the EUT was searched in 3 orthogonal axes to determine worst-case emissions.

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

Note: The EUT have been modified to transmit continuously with a typical modulated signal of 500kbps. No complex RF activation / triggering is therefore needed.

## Conducted Output Power:




The maximum measured conducted output power = 2.91dBm

## Radiated Output Power (ERP):

| Frequency (MHz) | Antenna | Polarity | RCVD Signal (dBuV) | Sig. Sub. Factor | Emission Level (dBm) | Limit (dBm) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|---|
| 915.0000 | LP1 | H | 76.7 | -72.8 | 3.9 | 44.7 | 40.8 | Peak |
| 915.0000 | LP1 | V | 71.0 | -72.7 | -1.6 | 44.7 | 46.3 | Peak |

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

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 90.209 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 | -- | -- |

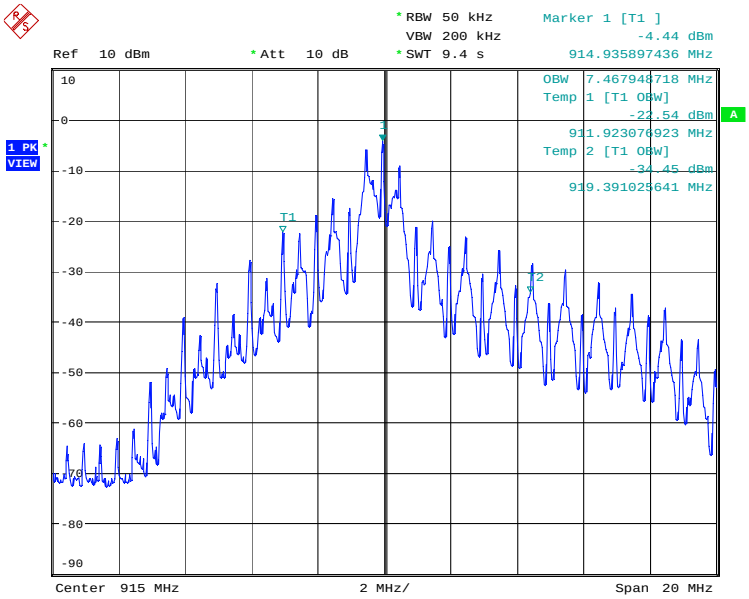
## Test Conditions:

| | | | |
|---|---|---|---|
| **Sample Number:** | 1, 2 | **Temperature:** | 24°C |
| **Date:** | Mar. 06, 2007 | **Humidity:** | 51 % |
| **Modification State:** | 0 | **Tester:** | Heng Lin |
| | | **Laboratory:** | Ottawa |

## Test Results:

The Occupied Bandwidth is 7.47MHz. See Attached Plots.

## 99% Emission Bandwidth:




Intermodulation Harmonic Distortion

Date: 9.MAR.2007 09:26:41

## Clause 90.210 Spurious Emissions

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, 2 | **Temperature:** | 24°C |
| **Date:** | Mar. 06, 2007 | **Humidity:** | 51 % |
| **Modification State:** | 0 | **Tester:** | Heng Lin |
| | | **Laboratory:** | Ottawa |

## Test Results:

See Attached Table for Results

## Additional Observations:

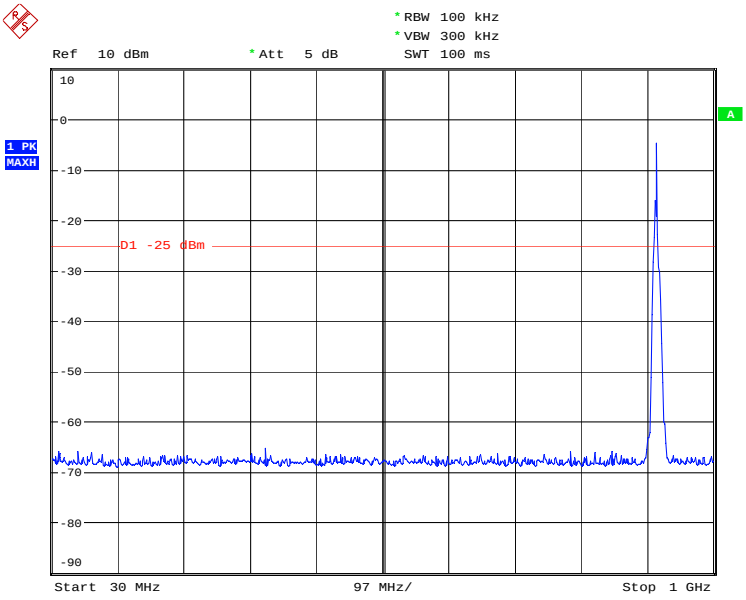
The Spectrum was searched from 30MHz to the 10th Harmonic.

The EUT was tested with a fresh battery.

The EUT was measured on three orthogonal axes.

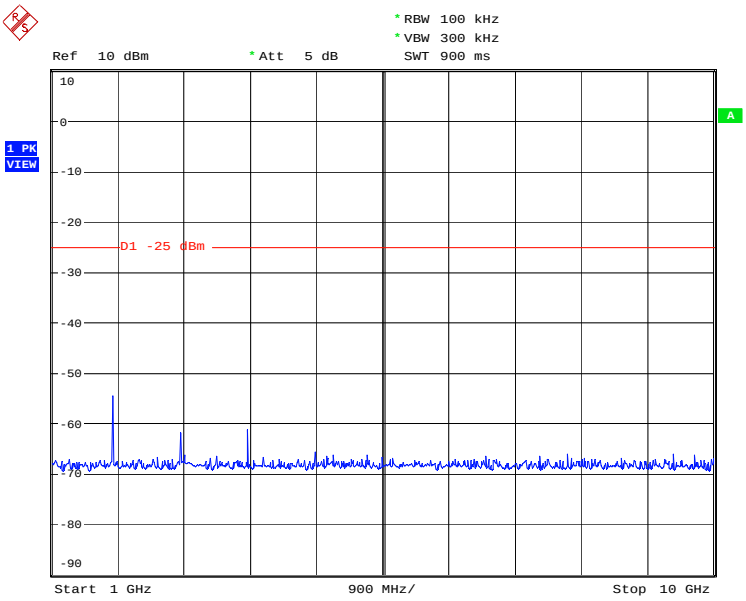
All measurements were performed using a Peak Detector with 100kHz/300kHz RBW/VBW below 1GHz and a 1MHz/3MHz RBW/VBW above 1GHz at a distance of 3 meters.

## Conducted Emissions:




Intermodulation Harmonic Distortion

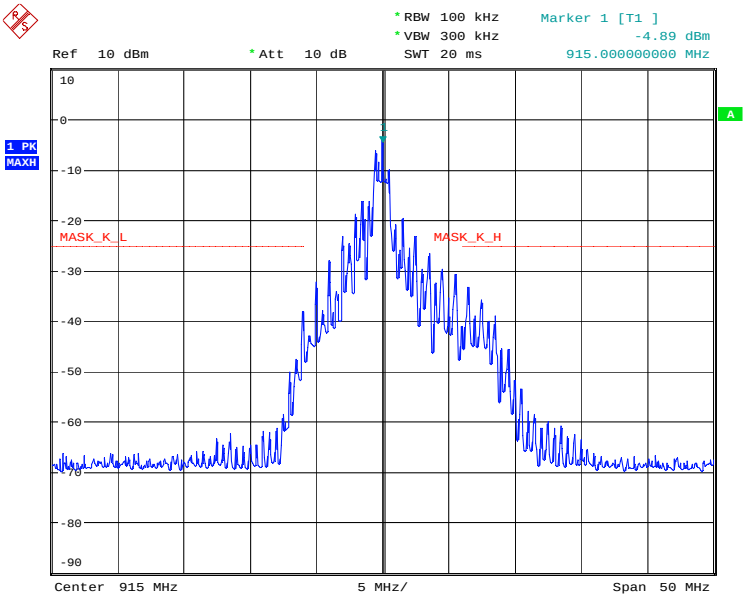
Date: 6.MAR.2007 16:17:43




Intermodulation Harmonic Distortion

Date: 6.MAR.2007 16:16:58

## Emission Mask: K




## Radiated Spurious Emissions (ERP):

| Frequency (MHz) | Antenna | Polarity | RCVD Signal (dBuV) | Sig. Sub. Factor | Emission Level (dBm) | Limit (dBm) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|---|
| 1830.0000 | Horn2 | H | 82.1 | -114.8 | -32.7 | -25.0 | 7.7 | Peak |
| 1830.0000 | Horn2 | V | 87.1 | -115.8 | -28.7 | -25.0 | 3.7 | Peak |
| 2745.0000 | Horn2 | H | 80.2 | -123.6 | -43.4 | -25.0 | 18.4 | Peak |
| 2745.0000 | Horn2 | V | 88.3 | -121.8 | -33.5 | -25.0 | 8.5 | Peak |
| Note 1: Antenna Legend: BC = Biconical, BL = Bilog, LP = Log-Periodic, Horn = Horn, ED = EMCO Dipole | | | | | | | | |

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 90.213 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 |
| 929-930 | 1.5 | --- | --- |
| 935-940 | 0.1 | 1.5 | 1.5 |
| 1427-1435 | 300 | 300 | 300 |
| Above 2450 | --- | --- | --- |

### Test Conditions:

| | | | |
|---|---|---|---|
| **Sample Number:** | 1, 2 | **Temperature:** | 24°C |
| **Date:** | Mar. 07, 2007 | **Humidity:** | 51 % |
| **Modification State:** | 0 | **Tester:** | Heng Lin |
| | | **Laboratory:** | Ottawa |

**Test Results:** See Attached Table.

### Additional Observations:

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

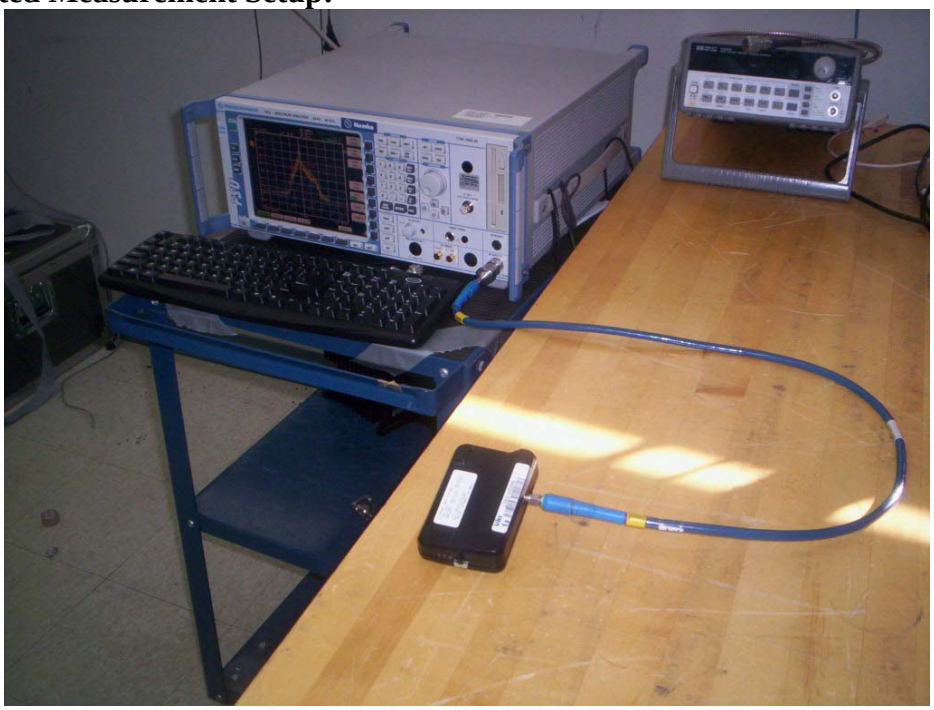
Note: Fixed non-multilateration transmitters with an authorized bandwidth that is more than40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency stability restrictions.

| Temperature ($^{o}$C) | Measured Frequency (MHz) | Frequency Drift (PPM) |
|---|---|---|
| Ambient | 915.021634615 | --- |
| 50 | 914.970192308 | -56.22 |
| 40 | 914.992961538 | -31.34 |
| 30 | 915.010589744 | -12.07 |
| 20 | 915.028378205 | 7.37 |
| 10 | 915.037512821 | 17.35 |
| 0 | 915.046967949 | 27.69 |
| -10 | 915.046006410 | 26.64 |
| -20 | 915.040557692 | 20.68 |
| -30 | 915.029820513 | 8.95 |

# Appendix B : Setup Photographs

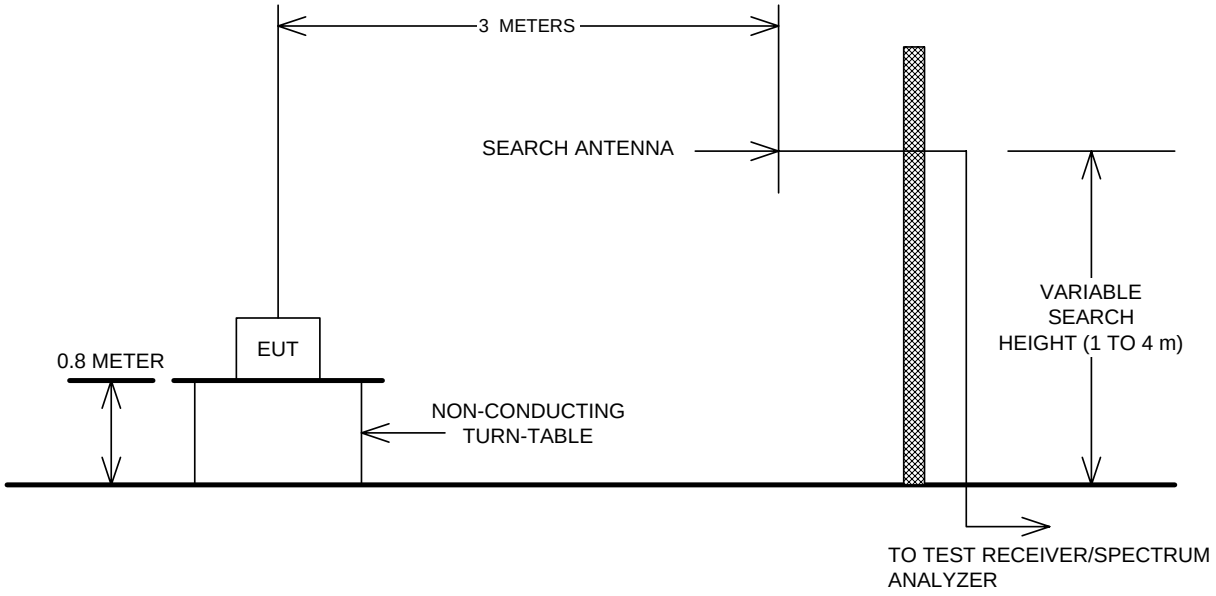
**Radiated Emissions Setup:**

**Conducted Measurement Setup:**

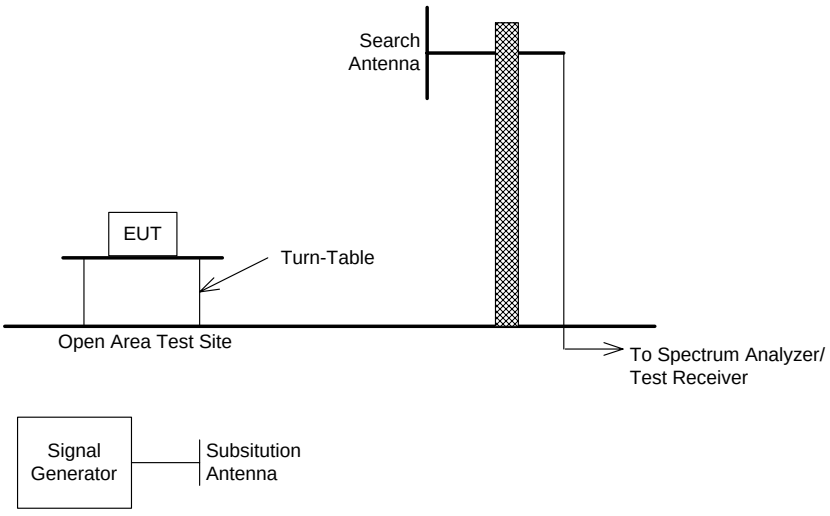


# Appendix C : Block Diagram of Test Setups

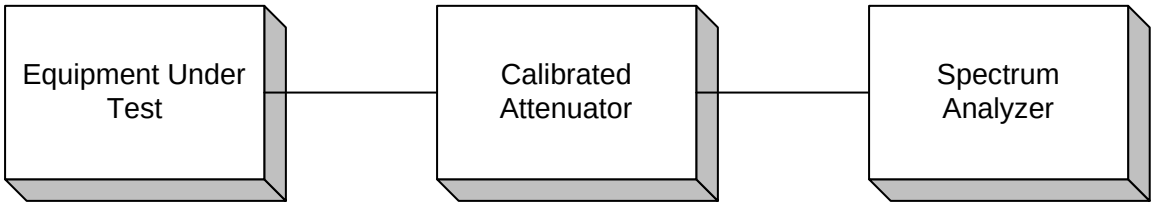
## Test Site for Field Strength of Radiated Emissions




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



## RF Conducted Emissions




## Frequency Stability (Para. No. 2.1055)