



**Nemko Test Report:** 6L0116RUS1

**Applicant:** Banner Engineering  
9714 10<sup>th</sup> Avenue North  
Minneapolis, MN 55441

**Equipment Under Test:** QT50R-74914

**In Accordance With:** **FCC Part 15, Subpart C**  
For Operation Within The Bands 902-928 MHz,  
2435-2465 MHz, 5785-5815 MHz, 10500-10550 MHz,  
24075-24175 MHz Intentional Radiators Used As  
Field Disturbance Sensors Excluding Perimeter  
Protection Systems

**Tested By:** Nemko USA Inc.  
3325 River Road, R.R. 5  
USA, Ontario K1V 1H2

**Authorized By:**

Kevin Rose Wireless Engineer

**Date:** June 31, 2006

**Total Number of Pages** 20

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**Section 1. Summary of Test Results**

Manufacturer: Banner Engineering

Model No.: QT50R-74914

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.245. All tests were conducted using measurement procedure 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.

☐

New Submission

☐

Production Unit

☐

Class II Permissive Change

☒

Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE. [None](#)  
See “ Summary of Test Data”.



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**Summary of Test Data**

| <b>Name of Test</b>           | <b>Paragraph Number</b> | <b>Results</b> |
|-------------------------------|-------------------------|----------------|
| Radiated Emissions            | 15.245                  | Complies       |
| Powerline Conducted Emissions | 15.207                  | Complies       |

**Footnotes For N/A's:**

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## **Section 2.        Equipment Under Test (E.U.T.)**

### **General Equipment Information**

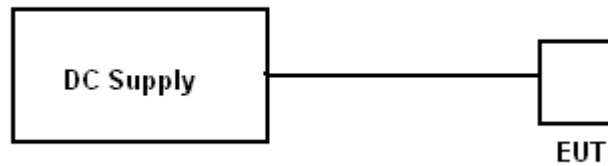
|                                            |                      |
|--------------------------------------------|----------------------|
| <b>Frequency Range:</b>                    | 24.075 to 24.175 GHz |
| <b>Operating Frequency(ies) of Sample:</b> | 24.076 to 24.162 MHz |
| <b>Supply Power Requirement:</b>           | 30 Vdc               |
| <b>Duty Cycle Calculation:</b>             | -12.65 dB            |

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**Description of E.U.T.**

The R-GAGE sensor emits high-frequency radio waves from an internal antenna, which forms a well-defined beam. Some of this emitted energy is reflected back to the receiving antenna. Signal processing electronics determine the distance from the sensor to the vehicle based on the time delay of the return signal. The sensor can be configured to operate like a retro reflective photoelectric sensor if used with a fixed background target.

**Equipment Configuration**

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**Section 3          Radiated Emissions**

|                                  |                    |
|----------------------------------|--------------------|
| NAME OF TEST: Radiated Emissions | PARA. NO.: 15.245  |
| TESTED BY: David Light           | DATE: June 6, 2006 |

**Minimum Standard:**

**Test Results:**                      Complies. The worst-case emission level is 113.6 dB $\mu$ V/m @ 3m at 24.125 GHz. This is 14.4 dB below the specification limit.

**Test Data:**                          See attached table.

Above 1 GHz a spectrum analyzer and low noise amplifier are used to measure emission levels. The spectrum analyzer resolution bandwidth was set to 1 MHz and video bandwidth was 1 MHz.

In the case of handheld equipment, the E.U.T. is rotated in three planes to obtain worst-case results.

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## Test Data - Radiated Emissions



Nemko USA, Inc.

## Dallas Headquarters:

802 N. Kealy  
Lewisville, TX 75057  
Tel: (972) 436-9600  
Fax: (972) 436-2667

## Radiated Emissions Data

Complete X  
Preliminary       Job #: 6L0116 Test #: 2  
Page 1 of 1Client Name : Banner EngineeringEUT Name : R-Gage 24 GHz radar sensorEUT Config.: TxSpecification : 15.245

Reference :

Bicon Ant. #: 760 Temp. (deg. C) : 21Date : 06/07/06Log Ant.#: 759 Humidity (%) : 35Time : 11:00Horn Ant.#: 984 990 EUT Voltage : 30Staff : D. Light985 992 EUT Frequency : dcPhoto ID: NAMixer#: 989-987-986 Phase: OPeak Bandwidth: 1 MHzPreamp # 791 1016 Location: A OATSVideo Bandwidth 1 MHzCable#: 1626 1627 Distance: 3 metersDetector#: 1464

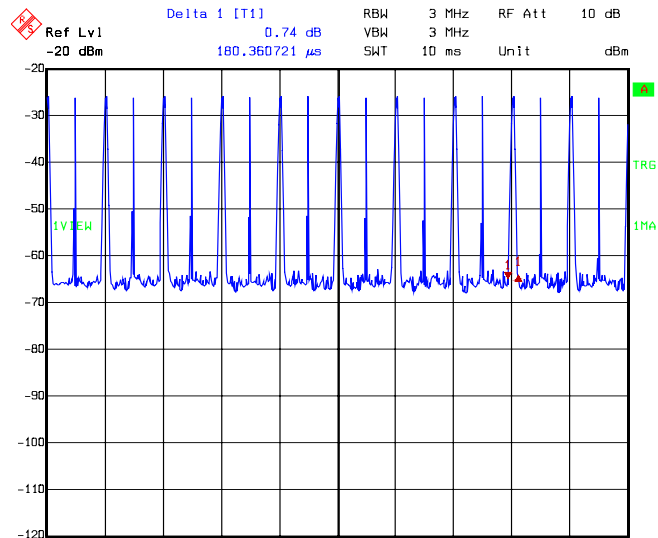
| Meas. Freq. (GHz) | Ant. Pol. (H/V) | Duty Cycle (dB) | Meter Reading (dBuV) | Antenna Factor (dB) | Path Loss (dB) | RF Gain (dB) | Corrected Reading (dBuV/m) | Spec. limit (dBuV/m) | CR/SL Diff. (dB) | Pass Fail Unc. | QP readings Comment |
|-------------------|-----------------|-----------------|----------------------|---------------------|----------------|--------------|----------------------------|----------------------|------------------|----------------|---------------------|
| 24.125            | H               | 0               | 65.9                 | 40.4                | 7.3            | 0.0          | 113.6                      | 128.0                | -14.4            | Pass           | 3 meters            |
| 24.125            | V               | 0               | 56.7                 | 40.4                | 7.3            | 0.0          | 104.4                      | 128.0                | -23.6            | Pass           | 3 meters            |
| 48.25             | H               | -12.16          | 46.3                 | 40.5                | 1.0            | 0.0          | 75.6                       | 111.5                | -35.9            | Pass           | 20 cm               |
| 48.25             | V               | -12.16          | 50.1                 | 40.5                | 1.0            | 0.0          | 79.4                       | 111.5                | -32.1            | Pass           | 20 cm               |
| 72.375            | H               | -12.16          | 50                   | 43.7                | 1.0            | 0.0          | 82.5                       | 111.5                | -29.0            | Pass           | 20 cm               |
| 72.375            | V               | -12.16          | 55                   | 43.7                | 1.0            | 0.0          | 87.5                       | 111.5                | -24.0            | Pass           | 20 cm               |
| 96.5              | H               | -12.16          | 55                   | 46.4                | 1.0            | 0.0          | 90.2                       | 111.5                | -21.3            | Pass           | 20 cm Noise floor   |
| 96.5              | V               | -12.16          | 55                   | 46.4                | 1.0            | 0.0          | 90.2                       | 111.5                | -21.3            | Pass           | 20 cm Noise floor   |

The spectrum was searched from 30 MHz to 100 GHz.

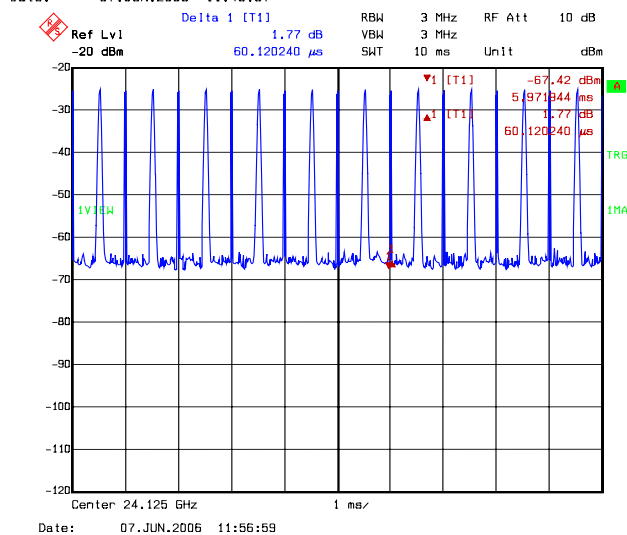
The device was tested +/- 15% standard supply voltage with no effect on output power

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## Duty Cycle Plots



10 mS Plot

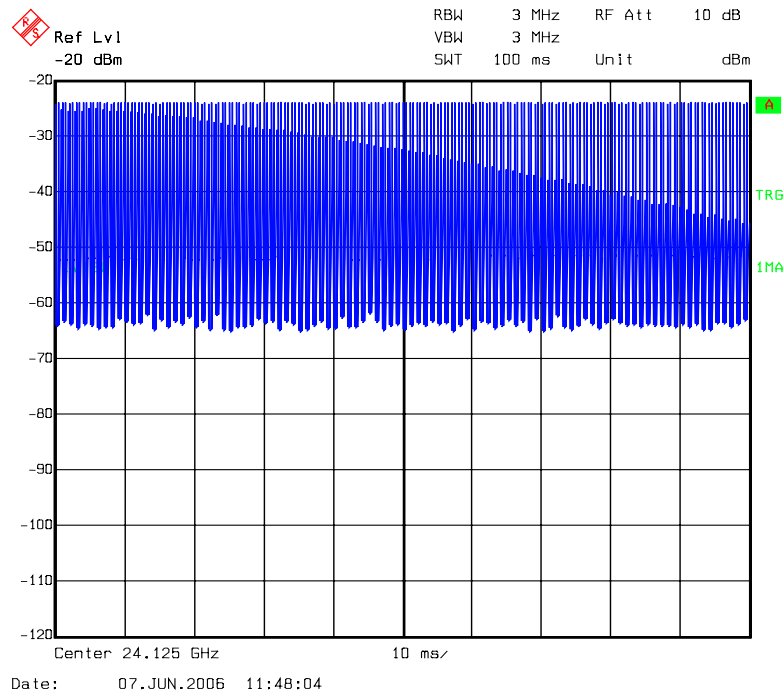


10 mS Plot

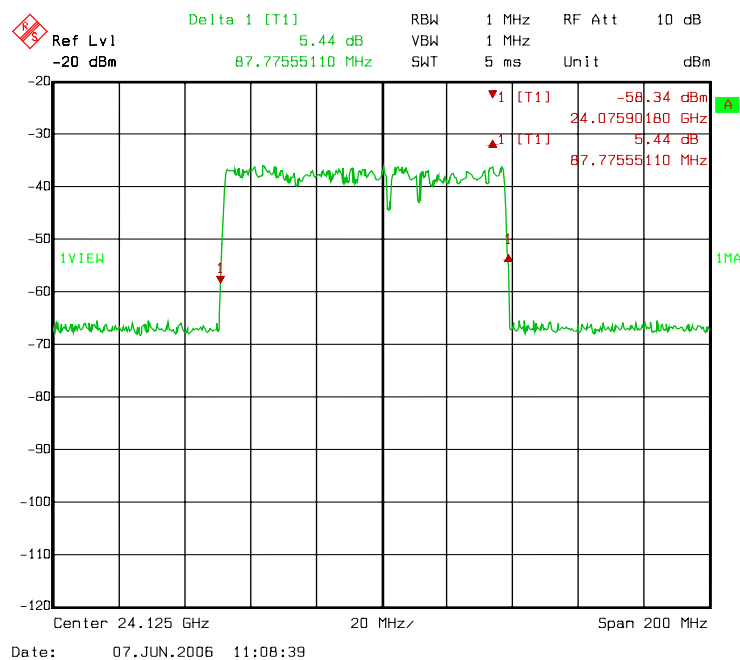
180.4 μs large pulse  
100 large pulses in 100 ms  
60.1 μs small pulse  
110 small pulses in 100 ms  
18.04 mS + 6.611 mS = 24.65 mS total ON time in 100 mS  
Duty cycle =  $20 \log (24.65/100) = -12.16 \text{ dB}$

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## 100 mS Plot



## 20 dB Bandwidth



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**Radiated Photographs**



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## **Section 4. Powerline Conducted Emissions**

|                                             |                      |
|---------------------------------------------|----------------------|
| NAME OF TEST: Powerline Conducted Emissions | PARA. NO.: 15.207(a) |
| TESTED BY: David Light                      | DATE: 07 June 2006   |

**Minimum Standard:** 15.207

**Test Results:** Complies. The worst-case emission level is 37.1 dB $\mu$ V on L1 at 627.6 kHz. This is 11.3 dB below the specification limit.

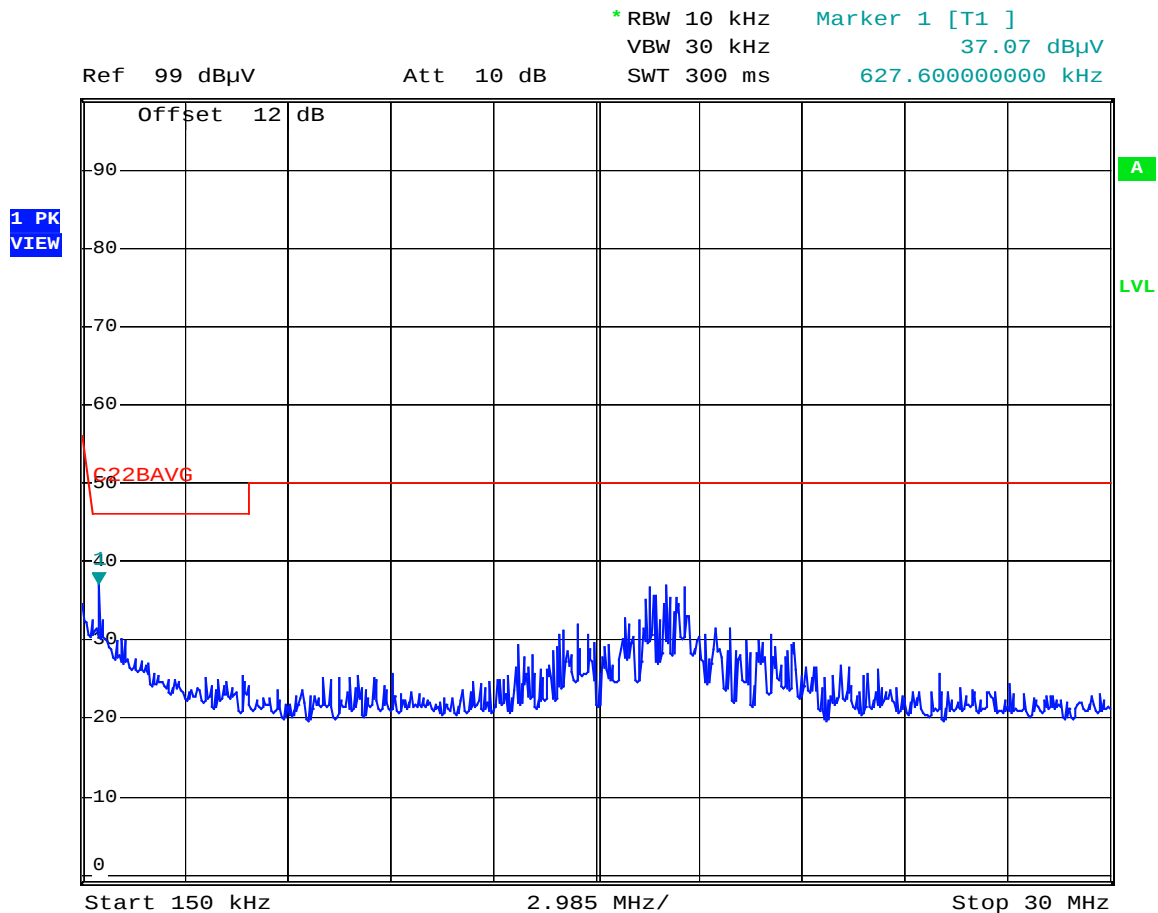
**Test Data:** See attached table.

**Test Equipment:** 1659-969-1555-1990-813-674

**Test Conditions:** 22°C 35 %RH

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# Test Data – Powerline Conducted Emissions

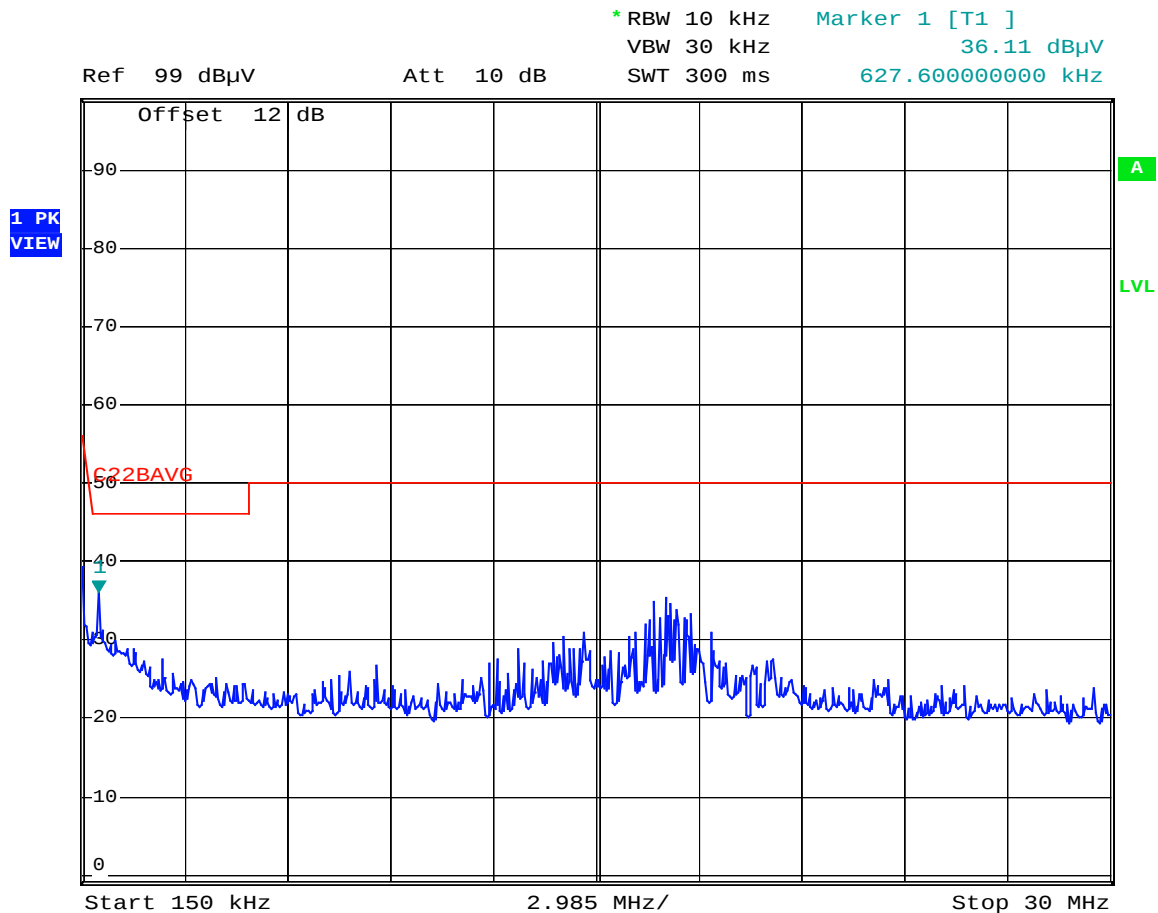


Comment: Quasi Peak  
 Date: 7.JUN.2006 15:53:58

L1

EQUIPMENT: QT50R-74914

# Test Data – Powerline Conducted Emissions



Comment: Quasi Peak  
 Date: 7.JUN.2006 15:54:49

*EQUIPMENT: QT50R-74914*

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**Photos – Powerline Conducted Emissions**

Front

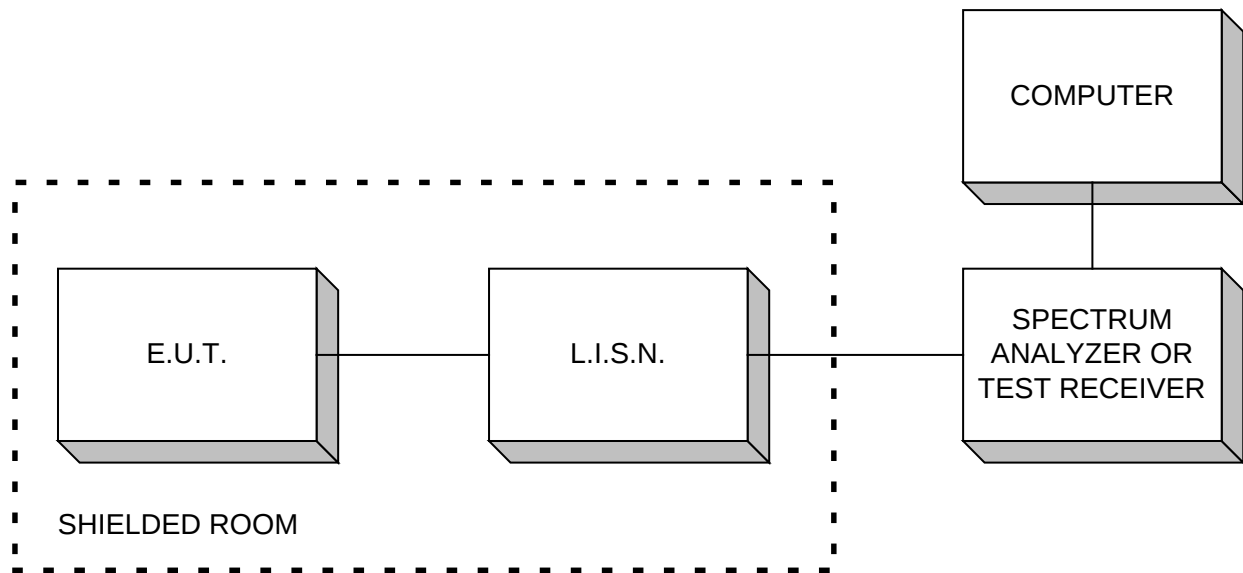


Side

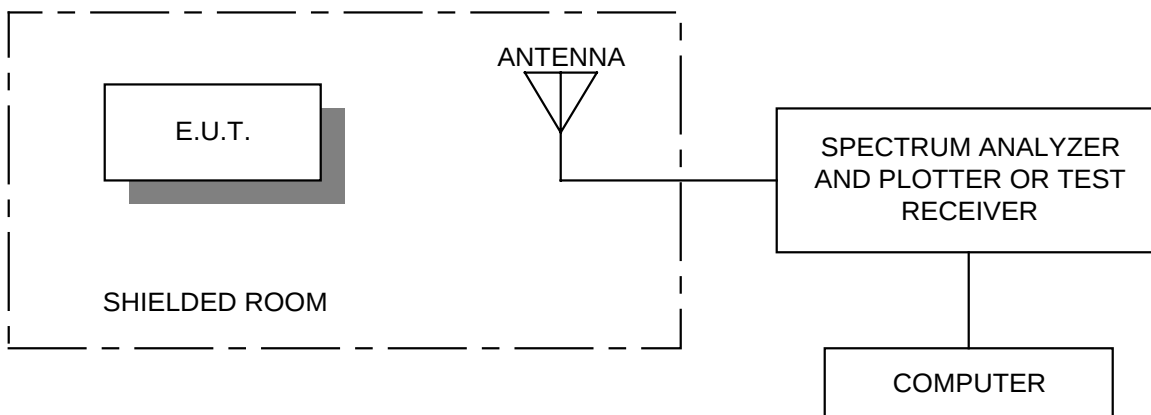


## Section 5. Block Diagrams

### Conducted Emissions



### Radiated Prescan



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**Section 6. Test Equipment List**

| Nemko | Descriptio           | Manufacture Model     | Serial    | Calibratio Dat | Calibratio Du |
|-------|----------------------|-----------------------|-----------|----------------|---------------|
| 75    | ANTENNA, LOG         | A.H. SAS-             | 55        | 02/13/0        | 02/13/0       |
| 76    | Antenna              | Electro MFC-          | 47        | 08/04/0        | 08/04/0       |
| 79    | PREAMP,              | Nemko USA, LNA2       | 39        | 04/20/0        | 04/20/0       |
| 99    | Horn antenna 1-18    | A.H. SAS-             | XX        | 08/01/0        | 08/02/0       |
| 101   | Pre-                 | HEWLETT PACKARD 8449  | 2749A0015 | 04/20/0        | 04/20/0       |
| 98    | HORN ANTENNA 40-60   | MILLITEC NON          | NON       | CBU            | N/            |
| 99    | HORN ANTENNA 50-75   | MILLITEC NON          | NON       | CBU            | N/            |
| 98    | HORN ANTENNA 75-110  | MILLITEC NON          | NON       | CBU            | N/            |
| 99    | Horn antenna 18-26.5 | EMC 3160-             | 9705-     | CBU            | N/            |
| 98    | HARMONIC             | Hewlett 11970         | 2332A0011 | CNR            | N/            |
| 98    | HARMONIC             | Hewlett 5356          | 2521A0058 | CNR            | N/            |
| 98    | HARMONIC             | Hewlett 11970         | 2521A0122 | CNR            | N/            |
| 162   | CABLE, 5             | MEGAPHAS 10311        | N/        | 11/11/0        | 11/11/0       |
| 162   | CABLE, 5             | MEGAPHAS 10312        | N/        | 11/11/0        | 11/11/0       |
| 103   | SPECTRUM             | ROHDE & SCHWARZ FSEK3 | 830844/00 | 05/26/0        | 05/26/0       |

|      |                       |                            |            |          |          |
|------|-----------------------|----------------------------|------------|----------|----------|
| 1659 | Spectrum Analyzer     | Rhode & Schwarz FSP        | 973353     | 01/10/06 | 01/10/07 |
| 969  | lisn                  | Schwarzbeck NNLA 8120      | 8120281    | 02/02/06 | 02/02/07 |
| 1555 | Filter high pass 5KHz | Solar Electronics 7930-5.0 | 933125     | 04/20/06 | 04/20/07 |
| 1990 | CABLE, 4.8m           | Nemko USA, Inc. RG214      | N/A        | 03/09/06 | 03/09/07 |
| 813  | CABLE, 5.7m           | Nemko USA, Inc. RG223      | N/A        | 03/09/06 | 03/09/07 |
| 674  | LIMITER               | HP 11947A                  | 3107A02200 | 04/19/06 | 04/19/07 |

## Section 7 Limits

### Radiated Emissions

#### §15.245 Operation within the bands 902-928 MHz, 2435-2465 MHz, 5785-5815 MHz, 10500-10550 MHz and 24075-24175 MHz.

- (a) Operation under the provision of this section is limited to intentional radiators used as field disturbance sensors, excluding perimeter protection systems.
- (b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental Frequency (MHz) | Field Strength Of Fundamental (millivolts/meter) | Field Strength of Harmonics (millivolts/meter) |
|-----------------------------|--------------------------------------------------|------------------------------------------------|
| 902-928                     | 500                                              | 1.6                                            |
| 2435-2465                   | 500                                              | 1.6                                            |
| 5785-5815                   | 500                                              | 1.6                                            |
| 10500-10550                 | 2500                                             | 25.0                                           |
| 24075-24175                 | 2500                                             | 25.0                                           |

- (1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:
  - (i) For field disturbance sensors designed for use only within a building or to open building doors, 25 mV/m.
  - (ii) For all other field disturbance sensors, 7.5 mV/m.
  - (iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands fully comply with the limits given in §15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment; vehicles such as fork-lifts that are intended primarily for use indoors or for very specialized operations. Or railroad locomotives, railroad cars and other equipment which travel on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g. putting a vehicle in reverse gear, activating a turn signal, etc.).

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**§15.245, continued**

- (2) Field strength limits are specified at a distance of 3 meters.
- (3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
- (4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

**§15.209 Radiated Emission Limits, General Requirements**

- (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency<br>(MHz) | Field Strength<br>(millivolts/meter) | Measurement Distance<br>(meters) |
|--------------------|--------------------------------------|----------------------------------|
| 0.009-0.490        | 2400/F (kHz)                         | 300                              |
| 0.490-1.705        | 2400/F (kHz)                         | 30                               |
| 1.705-30.0         | 30                                   | 30                               |
| 30-88              | 100                                  | 3                                |
| 88-216             | 150                                  | 3                                |
| 216-960            | 200                                  | 3                                |
| Above 960          | 500                                  | 3                                |

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**Powerline Conducted Emissions****Minimum Standard:** §15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 mH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of<br>Emission (MHz) | Conducted | Limit (dBmV) |           |
|--------------------------------|-----------|--------------|-----------|
|                                |           | Quasi-peak   | Average   |
| 0.15-0.5                       |           | 66 to 56*    | 56 to 46* |
| 0.5-5                          |           | 56           | 46        |
| 5-30                           |           | 60           | 50        |

\* Decreases with the logarithm of the frequency.