Nemko Test Report:	6L0116RUS1
Applicant:	Banner Engineering 9714 10th 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

Table of Contents

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".

NVLAP LAB CODE: 100426-0

Summary of Test Data

Name of Test	Paragraph Number	Results
Radiated Emissions	15.245	Complies
Powerline Conducted Emissions	15.207	Complies

Footnotes For N/A's:

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

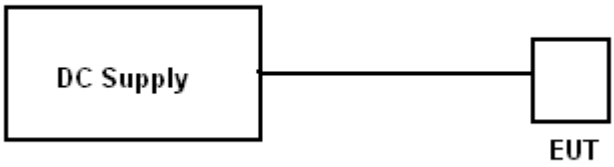
General Equipment Information

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

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



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 dBµV/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.

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

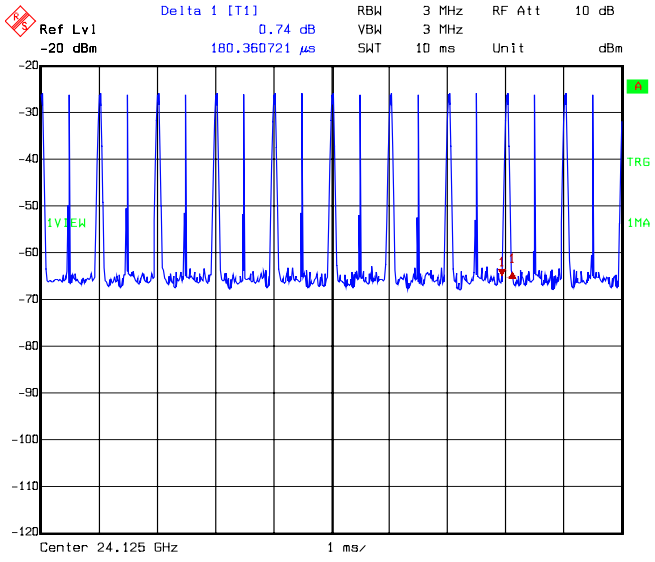
Complete	X			Job # :	6L0116	Test # :	2
Preliminary				Page	1	of	1
Client Name :	Banner Engineering						
EUT Name :	R-Gage 24 GHz radar sensor						
EUT Config. :	Tx						
Specification :	15.245			Reference :			
Bicon Ant. #:	760	Temp. (deg. C) :	21	Date :	06/07/06		
Log Ant.#:	759	Humidity (%) :	35	Time :	11:00		
Horn Ant.#:	984 990	EUT Voltage :	30	Staff :	D. Light		
	985 992	EUT Frequency :	dc	Photo ID:	NA		
Mixer#:	989-987-986	Phase:	O	Peak Bandwidth:	1 MHz		
Preamp #	791 1016	Location:	A OATS	Video Bandwidth	1 MHz		
Cable#:	1626 1627	Distance:	3 meters				
Detector#:	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

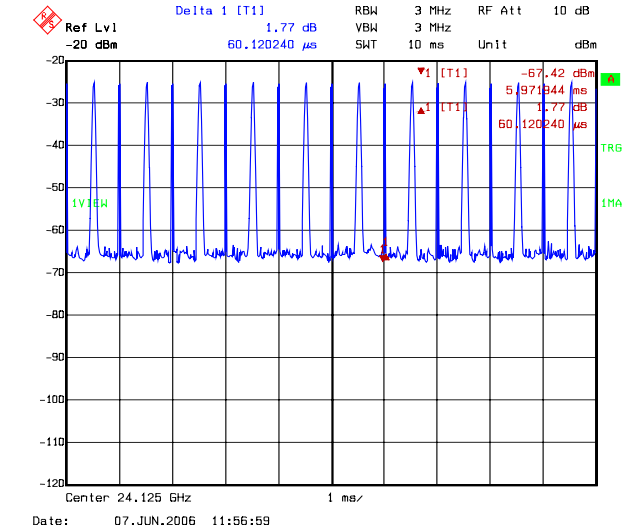
The spectrum was searched from 30 MHz to 100 GHz.

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

Duty Cycle Plots



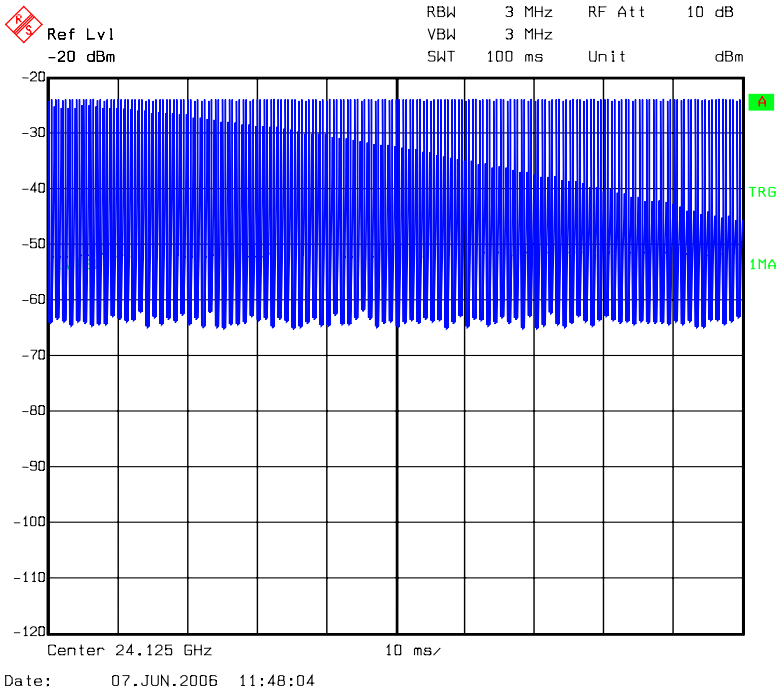
10 mS Plot



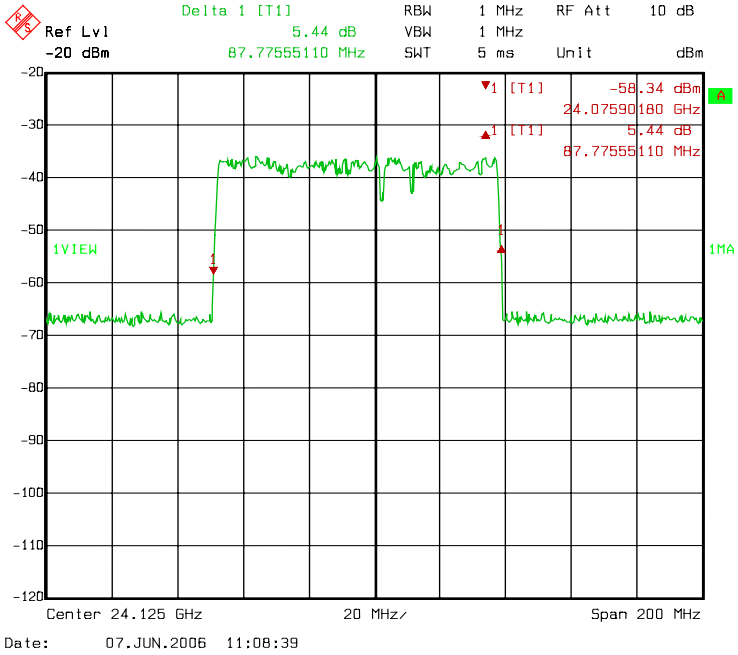
10 mS Plot

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 dB

100 mS Plot



20 dB Bandwidth



Radiated Photographs

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

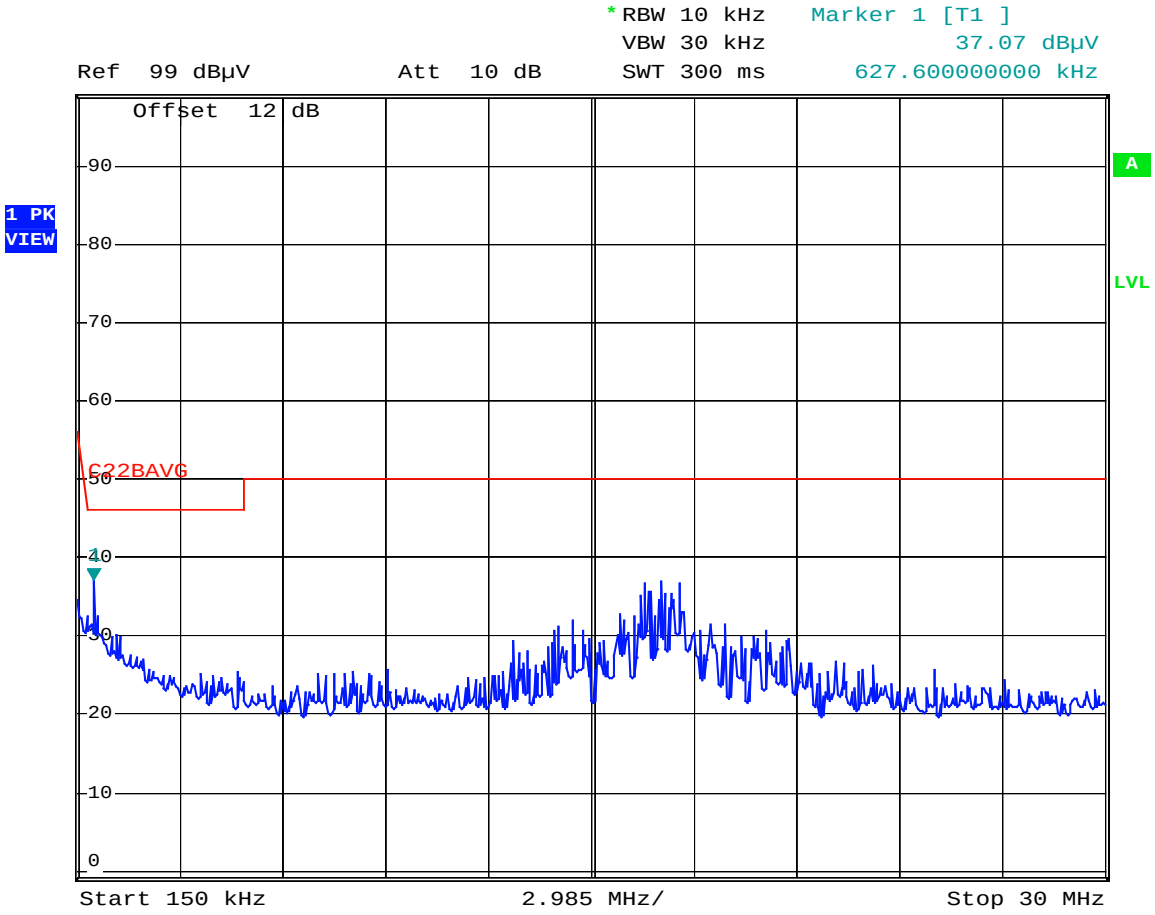
Test Results: Complies. The worst-case emission level is 37.1 dBµV on L1 at 627.6 kHz. This is 11.3 dB below the specification limit.

Test Data: See attached table.

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

Test Conditions: 22ºC 35 %RH

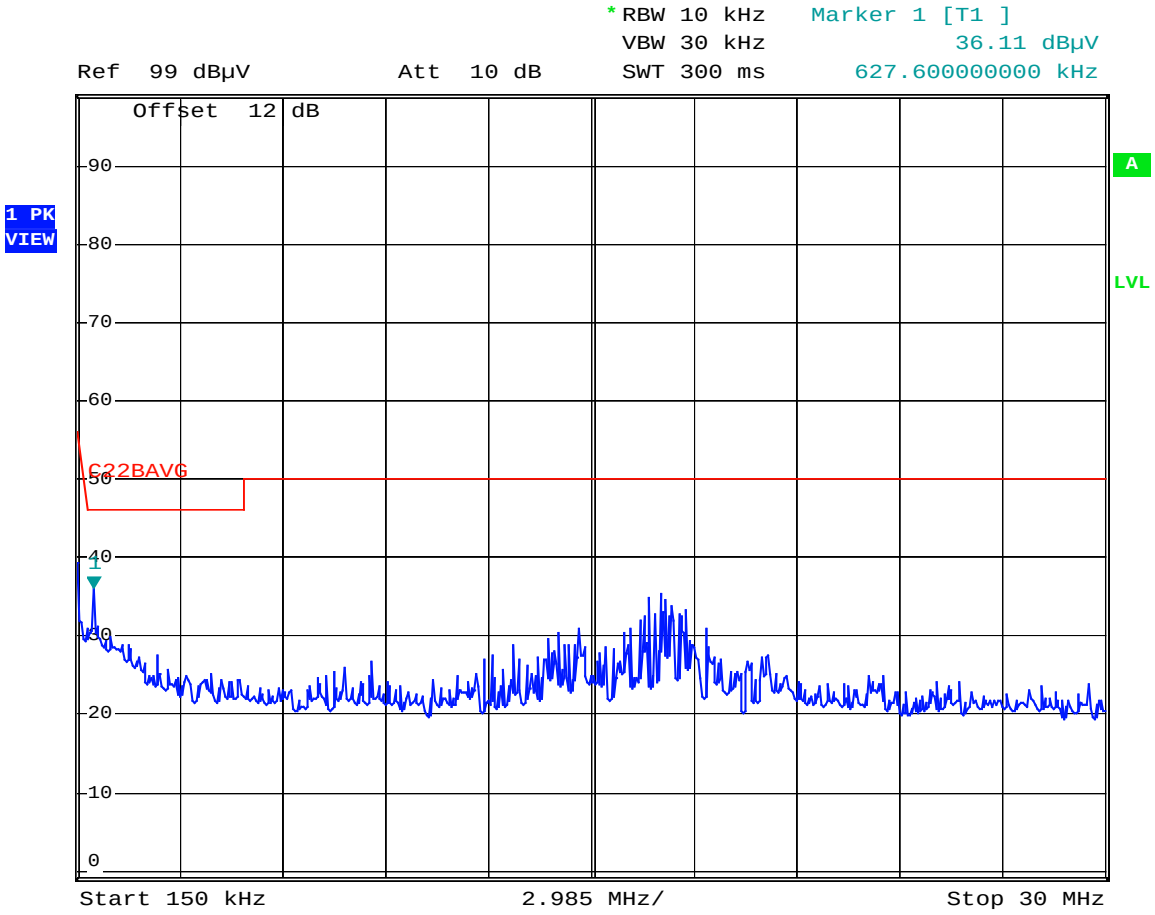
Test Data – Powerline Conducted Emissions



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

L1

Test Data – Powerline Conducted Emissions

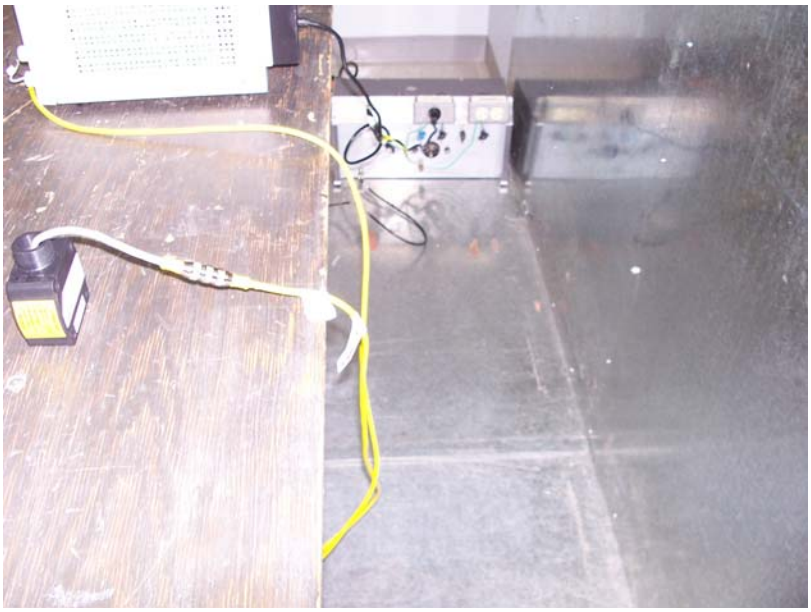


Comment: Quasi Peak
Date: 7.JUN.2006 15:54:49

Photos – Powerline Conducted Emissions

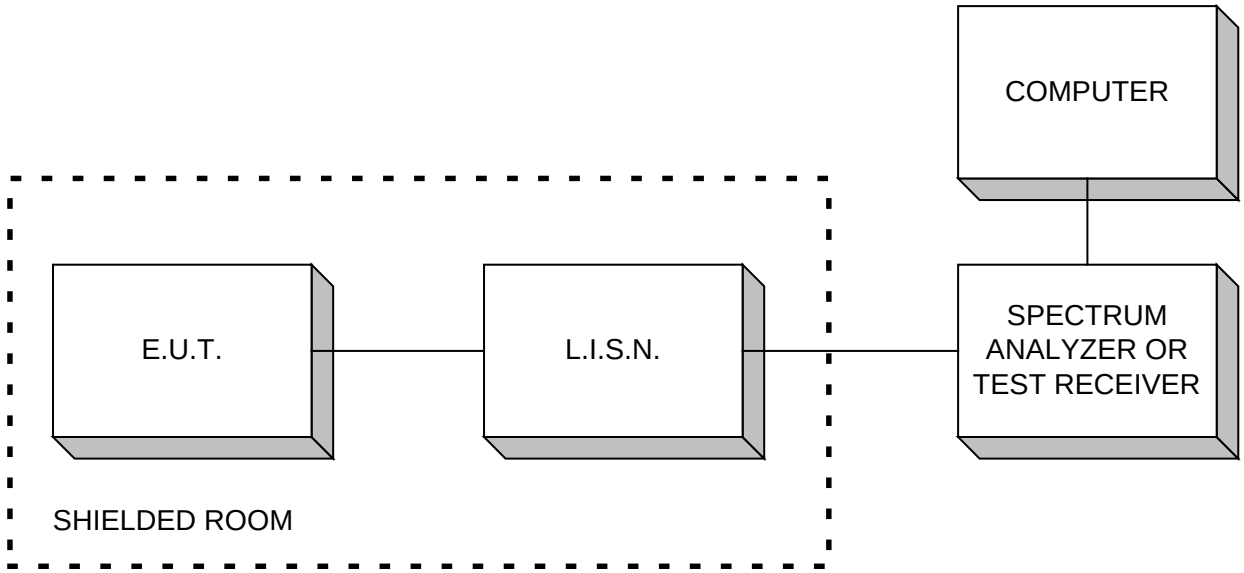
Front

Side

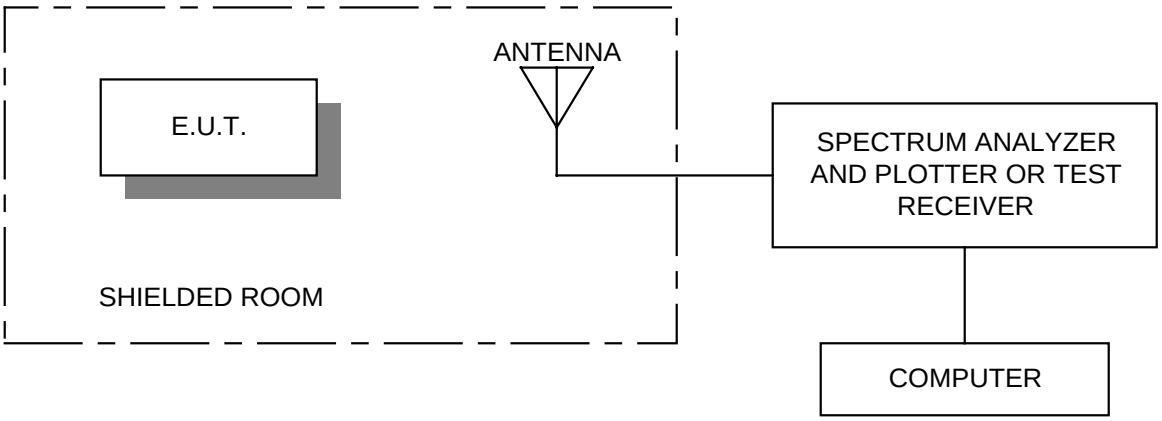


Section 5. Block Diagrams

Conducted Emissions



Radiated Prescan



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 (millitvolts/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.).

§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 (MHz)	Field Strength (millivolts/meter)	Measurement Distance (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

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 Conducted Emission (MHz)	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.