Nemko Test Report:	1L0553RUS1
Applicant:	Q-Free Access Thonning Owesens at 35c P. O. Box 3974 LEANGEN 7443 Tronheim, Norway
Equipment Under Test: (E.U.T.)	MD5850 Multireader
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 Dallas Inc. 802 N. Kealy Lewisville, Texas 75057
Authorized By:	 Tom Tidwell: Lab Manager
Date:	10/12/01
Total Number of Pages:	22

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Section 1. Summary of Test Results

Manufacturer: Q-free Access

Model No.: MD5850 Multireader

Serial No.: 287

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 C63.4-1992. 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

F	D	S

Equipment Code

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.
See " Summary of Test Data".

NVLAP®

NVLAP LAB CODE: 100351-0

TESTED BY: _____ DATE: _____

Summary Of Test Data

Name of Test	Paragraph Number	Results
Radiated Emissions	15.231(b)	Complies
Powerline Conducted Emissions	15.207	N/A

Footnotes For N/A's: The device is DC powered

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

General Equipment Information

Frequency Range:	5.7975 to 5.8125 GHz
Operating Frequency(ies) of Sample:	5.7975 to 5.8125 GHz
Supply Power Requirement:	24 Vdc, external supply
Duty Cycle Calculation:	None

Description of E.U.T.

The Q-Free® MultiReader MD 5850 is a stand alone 5.8 GHz DSRC Transceiver designed for Automatic registration, identification and debiting of vehicles carrying the MD read / write microwave communication transponder. MD 5850 is designed to meet all standards related to Road Transportation Telematics (RTT)

Modifications Incorporated in E.U.T.

To achieve compliance the following change(s) were made by customer during compliance testing:

Customer added 16 dB attenuation at antenna input to reduce harmonic levels.

Justification

The E.U.T. was configured for testing as per typical installation.

The following combinations were investigated to establish worst case configuration:

(1) Standing upright at maximum antenna output.

Exercise Program

The E.U.T. exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to typical use.

Exercise mode:

(1) Continuous transmit at 3 channels

Section 3. Equipment Configuration

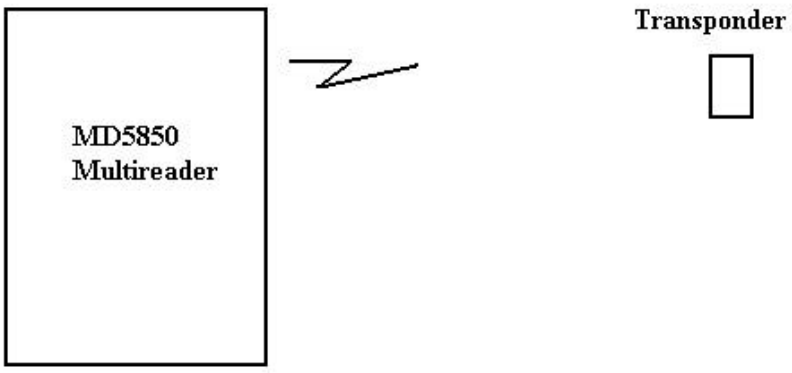
Equipment Configuration List:

Item	Description	Model No.	Serial.	Rev.
(A)	Reader	MD5850	287	
(B)				
(C)				
(D)				
(E)				
(F)				
(G)				

Inter-connection Cables:

Item	Description	Length (m)
(1)	Power cable	5
(2)		
(3)		
(4)		
(5)		
(6)		
(7)		
(8)		

Configuration of the Equipment Under Test (E.U.T)



Section 4. Radiated Emissions

NAME OF TEST: Radiated Emissions	PARA. NO.: 15.245
TESTED BY: David Light	DATE: 10/11/2001

Minimum Standard: See Annex B

Test Results: Complies.

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 3 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

Radiated Emissions

Page 1 of 1

Job No.:	1L0553R	Date:	10/11/01
Specification:	CFR 47, Part 15.245	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	45
E.U.T.:	MD5850 Multireader		
Configuration:	TYPICAL - TRANSMIT AT 5.7975 GHz (Lowest channel)		
Sample Number:	1		
Location:	AC 3	RBW:	1 MHz
Detector Type:	Peak	VBW:	300 kHz

Test Equipment Used

Antenna:	1033	Directional Coupler:	#N/A
Pre-Amp:	983	Cable #1:	1484
Filter:	#N/A	Cable #2:	1485
Receiver:	1036	Cable #3:	1046
Attenuator #1	#N/A	Cable #4:	1043
Attenuator #2:	#N/A	Mixer:	#N/A

Additional equipment used: 992, 991, 984, 1464, 988, 989

Measurement Uncertainty: +/- 1.7 dB

Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
5.7975	69.4	34.4	4.8	0	108.6	114	-5.4	Horizontal@3 meters
5.7975	69.6	34.4	4.8	0	108.8	114	-5.2	Vertical@3 meters
11.595	30	38.7	7.3	0	76.0	77	-1.0	Horizontal@20cm
11.595	30	38.7	7.3	0	76.0	77	-1.0	Vertical@20cm
17.3925	24.3	43	8.3	0	75.6	88	-12.0	Horizontal@20cm
17.3925	24.3	43	8.3	0	75.6	88	-12.0	Vertical@20cm
23.19	84.6	40.4	7	48.25	83.8	101	-17.3	Horizontal@20cm
23.19	84.6	40.4	7	48.25	83.8	101	-17.3	Vertical@20cm
28.9875	74.1	43.5	9	43.9	82.7	101	-18.3	Horizontal@20cm
28.9875	74.1	43.5	9	43.9	82.7	101	-18.3	Vertical@20cm
34.785	73.3	43.6	10	50.9	76.0	101	-25.0	Horizontal@20cm
34.785	73.3	43.6	10	50.9	76.0	101	-25.0	Vertical@20cm
40.5825	40	39.7	0	0	79.7	101	-21.3	Horizontal@20cm
40.5825	40	39.7	0	0	79.7	101	-21.3	Vertical@20cm
46.38	40	40.2	0	0	80.2	101	-20.8	Horizontal@20cm
46.38	40	40.2	0	0	80.2	101	-20.8	Vertical@20cm
52.1775	38	41	0	0	79.0	101	-22.0	Horizontal@20cm
52.1775	38	41	0	0	79.0	101	-22.0	Vertical@20cm
57.975	38	41.8	0	0	79.8	101	-21.2	Horizontal@20cm
57.975	38	41.8	0	0	79.8	101	-21.2	Vertical@20cm

Notes:

EQUIPMENT: MD5850 Multireader

Radiated Emissions

Page 1 of 1

Job No.:	1L0553R	Date:	10/11/01
Specification:	CFR 47, Part 15.245	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	45
E.U.T.:	MD5850 Multireader		
Configuration:	TYPICAL - TRANSMIT AT 5.8025 GHz		
Sample Number:	1		
Location:	AC 3	RBW:	1 MHz
Detector Type:	Peak	VBW:	300 kHz

Test Equipment Used

Antenna:	1033	Directional Coupler:	#N/A
Pre-Amp:	983	Cable #1:	1484
Filter:	#N/A	Cable #2:	1485
Receiver:	1036	Cable #3:	1046
Attenuator #1	#N/A	Cable #4:	1043
Attenuator #2:	#N/A	Mixer:	#N/A
Additional equipment used:	992, 991, 984, 1464, 988, 989		
Measurement Uncertainty:	+/- 1.7 dB		

Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
5.8025	69.8	34.4	4.8	0	109.0	114	-5.0	Horizontal@3 meters
5.8025	70	34.4	4.8	0	109.2	114	-4.8	Vertical@3 meters
11.605	29.5	38.7	7.3	0	75.5	77	-1.5	Horizontal@20cm
11.605	27.2	38.7	7.3	0	73.2	77	-3.8	Vertical@20cm
17.4075	17	43	8.3	0	68.3	88	-19.3	Horizontal@20cm
17.4075	17	43	8.3	0	68.3	88	-19.3	Vertical@20cm
23.21	67.9	40.4	7	48.25	67.1	101	-34.0	Horizontal@20cm
23.21	67.9	40.4	7	48.25	67.1	101	-34.0	Vertical@20cm
29.0125	67.9	43.5	9	43.9	76.5	101	-24.5	Horizontal@20cm
29.0125	67.9	43.5	9	43.9	76.5	101	-24.5	Vertical@20cm
34.815	71.7	43.6	10	50.9	74.4	101	-26.6	Horizontal@20cm
34.815	71.7	43.6	10	50.9	74.4	101	-26.6	Vertical@20cm
40.6175	39.6	39.7	0	0	79.3	101	-21.7	Horizontal@20cm
40.6175	39.6	39.7	0	0	79.3	101	-21.7	Vertical@20cm
46.42	39	40.2	0	0	79.2	101	-21.8	Horizontal@20cm
46.42	39	40.2	0	0	79.2	101	-21.8	Vertical@20cm
52.2225	38	41	0	0	79.0	101	-22.0	Horizontal@20cm
52.2225	38	41	0	0	79.0	101	-22.0	Vertical@20cm
58.025	38	41.8	0	0	79.8	101	-21.2	Horizontal@20cm
58.025	38	41.8	0	0	79.8	101	-21.2	Vertical@20cm

Notes:

EQUIPMENT: MD5850 Multireader

Radiated Emissions

Page 1 of 1

Job No.:	1L0553R	Date:	10/11/01
Specification:	CFR 47, Part 15.245	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	45
E.U.T.:			
Configuration:	TYPICAL		
Sample Number:	1		
Location:	AC 3	RBW:	1 MHz
Detector Type:	Peak	VBW:	300 kHz

Test Equipment Used

Antenna:	1033	Directional Coupler:	#N/A
Pre-Amp:	983	Cable #1:	1484
Filter:	#N/A	Cable #2:	1485
Receiver:	1036	Cable #3:	1046
Attenuator #1	#N/A	Cable #4:	1043
Attenuator #2:	#N/A	Mixer:	#N/A

Additional equipment used: 992, 991, 984, 1464, 988, 989

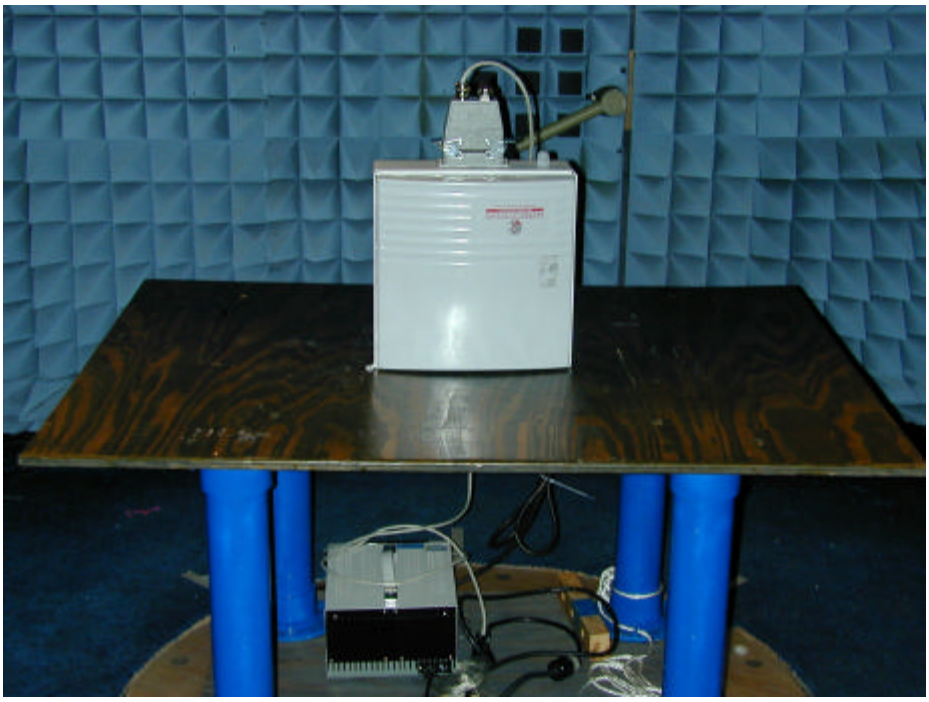
Measurement Uncertainty: +/- 1.7 dB

Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
5.812	86.2	34.4	4.8	0	125.4	114	11.4	Vertical
5.812	86.3	34.4	4.8	0	125.5	114	11.5	Horizontal
								Added 16 dB Attenuation
5.812	69.4	34.4	4.8	0	108.6	114	-5.4	Horizontal@3 meters
5.812	69.6	34.4	4.8	0	108.8	114	-5.2	Vertical@3 meters
11.625	28.5	38.7	7.3	0	74.5	77	-2.5	Horizontal@20cm
11.625	23.9	38.7	7.3	0	69.9	77	-7.1	Vertical@20cm
17.437	21	43	8.3	0	72.3	88	-15.7	Horizontal@20cm
17.437	18.6	43	8.3	0	69.9	88	-18.1	Vertical@20cm
23.25	75.6	40.4	7	48.25	74.8	101	-26.3	Horizontal@20cm
23.25	78	40.4	7	48.25	77.2	101	-23.9	Vertical@20cm
29.063	70	43.5	9	43.9	78.6	101	-22.4	Horizontal@20cm
29.063	72	43.5	9	43.9	80.6	101	-20.4	Vertical@20cm
34.875	66.7	43.6	10	50.9	69.4	101	-31.6	Horizontal@20cm
34.875	68.7	43.6	10	50.9	71.4	101	-29.6	Vertical@20cm
40.688	40	39.7	0	0	79.7	101	-21.3	Horizontal@20cm
40.688	40	39.7	0	0	79.7	101	-21.3	Vertical@20cm
46.5	40	40.2	0	0	80.2	101	-20.8	Horizontal@20cm
46.5	40	40.2	0	0	80.2	101	-20.8	Vertical@20cm
52.313	38	41	0	0	79.0	101	-22.0	Horizontal@20cm
52.313	38	41	0	0	79.0	101	-22.0	Vertical@20cm
58.125	38	41.8	0	0	79.8	101	-21.2	Horizontal@20cm
58.125	38	41.8	0	0	79.8	101	-21.2	Vertical@20cm

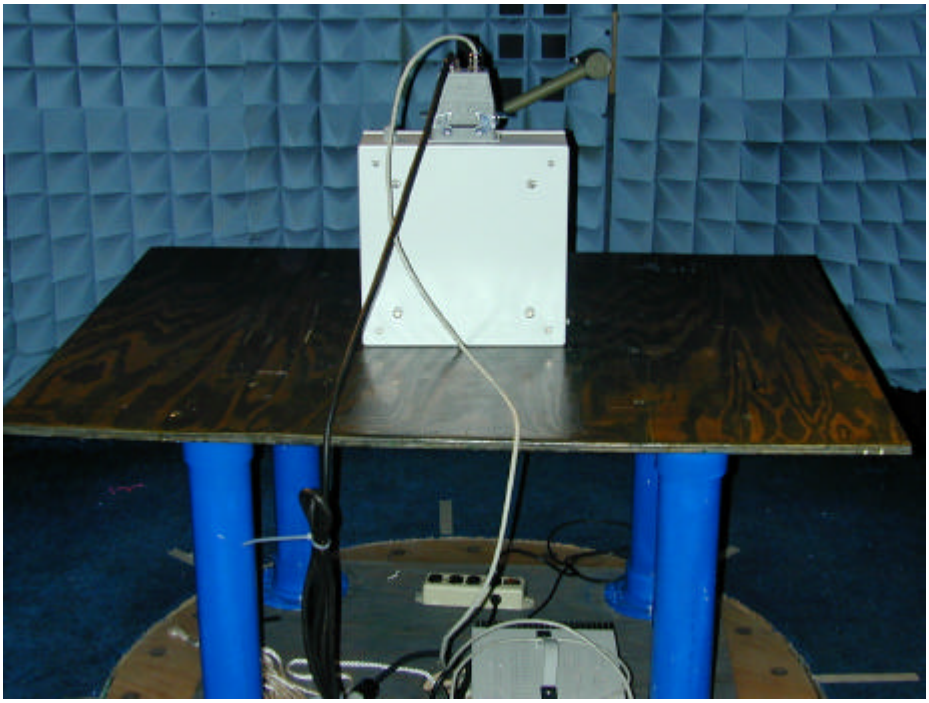
Notes:

Radiated Photographs (Worst Case Configuration)

FRONT VIEW



REAR VIEW



Section 5. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207
TESTED BY: Tom Tidwell & Debbie Jensen	DATE:

Minimum Standard:

Frequency(MHz)	Maximum Powerline Conducted RF Voltage	
	mV	dBmV
0.45 - 30.0	250	48

Test Results: Complies/Does Not Comply. See attached graphs and table.

Test Data: See attached table and graphs.

Method Of Measurement: (Procedure ANSI C63.4-1992)

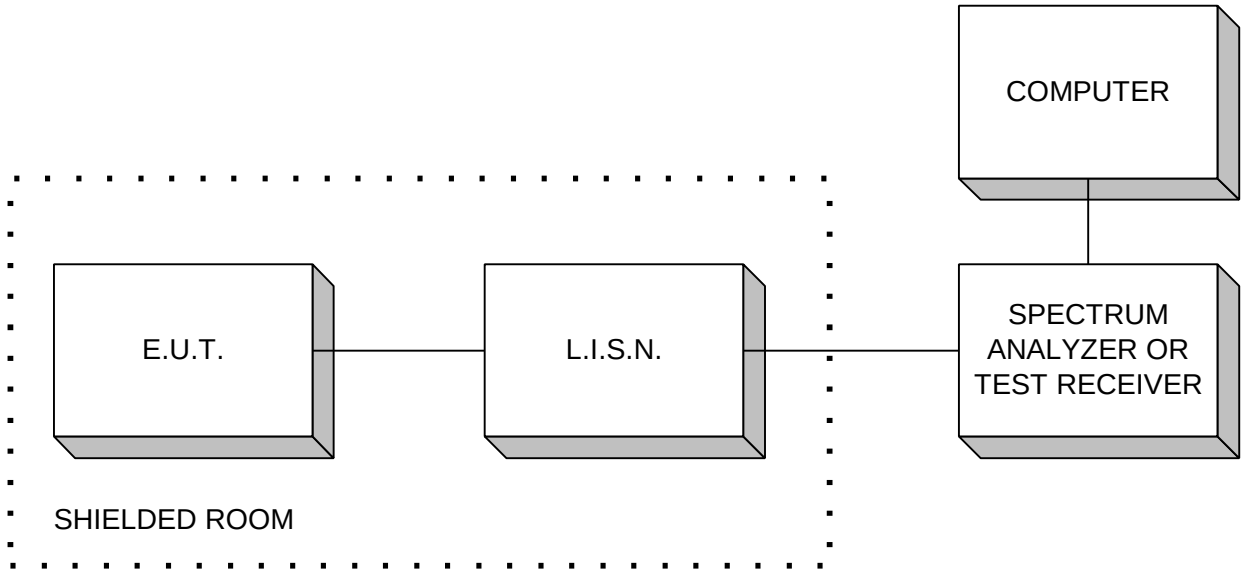
Measurements were made using a spectrum analyzer with 10 kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 10 kHz bandwidth, CISPR Quasi-Peak detector.

Broadband emissions are identified by switching the receiver detector function from Quasi-Peak to Average. If the amplitude of the emission drops by 6 dB or more then the emission is classified as broadband and the Quasi-Peak level is reduced by a factor of 13 dB.

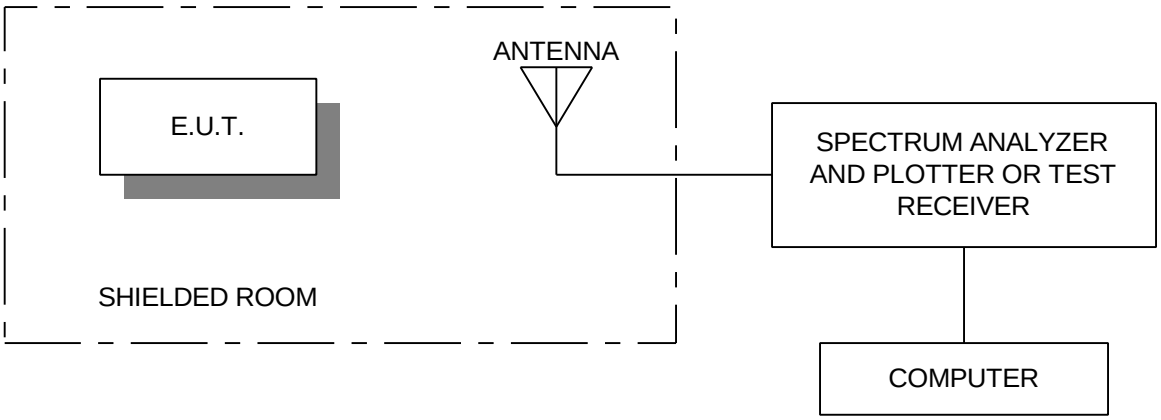
All emissions within 10 dB of limit have been recorded.

Section 6. Block Diagrams

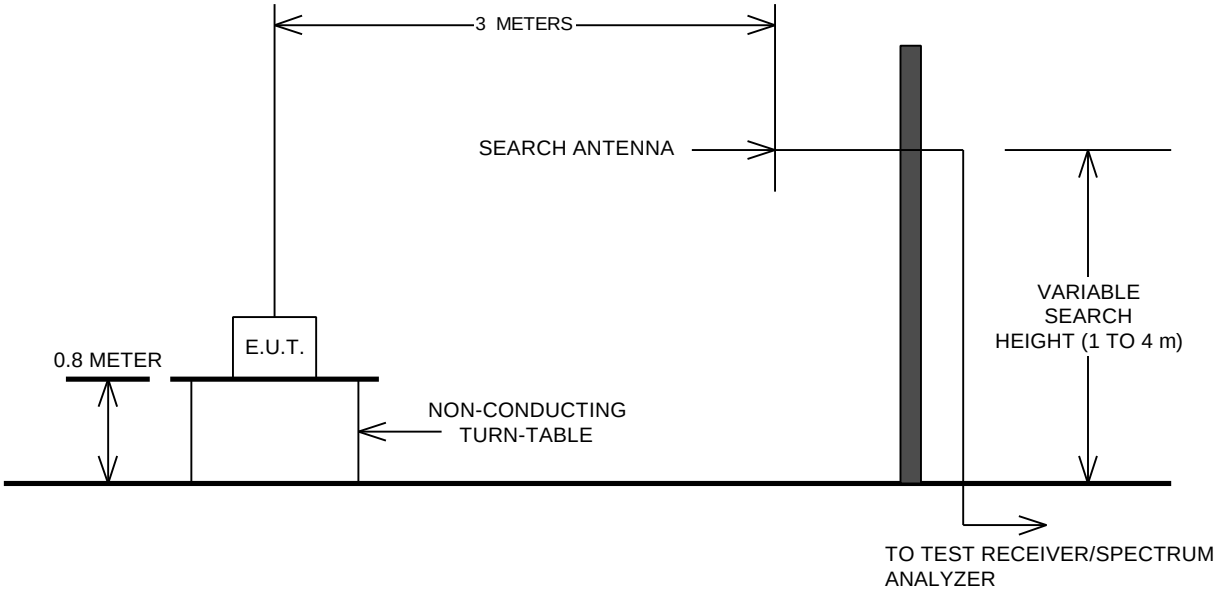
Conducted Emissions



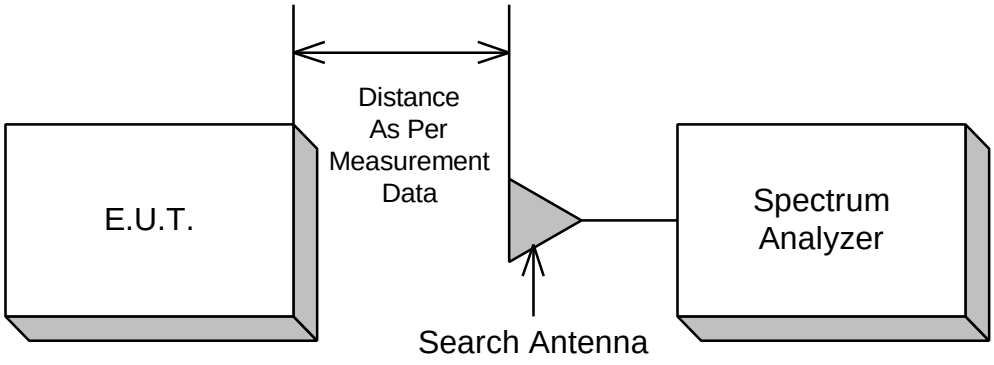
Radiated Prescan



Outdoor Test Site For Radiated Emissions



Indoor Measurement Setup for Emissions Above 10 GHz



Section 7. Test Equipment List

ASSET	Description	Manufacturer Model Number	Serial Number	Cal. Date	Cal. Due
1033	Horn antenna	EMCO 3115	8812-3035	08/29/01	08/30/03
983	PRE-AMP, 18-40 GHz	KTL BB1	1	01/25/01	01/25/02
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	09/17/01	09/18/03
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	06/01/01	06/01/02
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	06/01/01	06/01/02
1046	Flex cable 1m	Astrolab Inc. 32022-2-29094K-1M	N/A	01/29/01	01/29/02
1043	Flexable cable 1m	Astrolab Inc. 32027-2-29094K-1M	0	01/29/01	01/29/02
992	Horn antenna	EMCO 3160-09	9705-1079	CNR	N/A
991	Horn antenna	EMCO 3160-10	9704-1049	CNR	N/A
984	HORN ANTENNA	MILLITECH NONE	NONE	CNR	N/A
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01	01/02/02
988	HARMONIC MIXER	Hewlett Packard 11970A	2332A01929	01/00/00	N/A
989	HARMONIC MIXER	Hewlett Packard 11970U	2332A00116	01/00/00	N/A

ANNEX A - RESTRICTED BANDS

Section A Restricted Bands of Operation

(a) Except as shown in paragraph (d) of this section , only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.15
0.49 - 0.51	16.69475-16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425-16.80475	960-1240	7.25-7.75
3.020 - 3.026	25.5-25.67	1300-1427	8.025-8.5
4.125 - 4.128	37.5-38.25	1435-1626.6	9.0-9.2
4.17725 - 4.17775	73-74.6	1645.5-1646.5	9.3-9.5
4.20725 - 4.20775	74.8-75.2	1660-1710	10.6-12.7
6.215 - 6.218	108-121.94	1718.8-1722.2	13.25-13.4
6.31175 - 6.31225	123-138	2220-2300	14.47-14.5
8.291 - 8.294	149.9-150.05	2310-2390	15.35-16.2
8.362 - 8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625 - 8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425 - 8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29 - 12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975 - 12.52025	240-285	3345.8-3358	36.43-36.5
12.57675 - 12.57725	322-335.4	3600-4400	Above 38.6
13.36 - 13.41			

ANNEX B - RADIATED EMISSION LIMITS

Radiated Emission Limits

§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