

Nemko Test Report: 1L0553RUS1

Applicant: Q-Free Access
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**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

EQUIPMENT: MD5850 Multireader

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EQUIPMENT: MD5850 Multireader

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



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 LAB CODE: 100351-0**

TESTED BY: _____ DATE: _____

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EQUIPMENT: MD5850 Multireader

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

EQUIPMENT: MD5850 Multireader

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

EQUIPMENT: MD5850 Multireader

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.

EQUIPMENT: MD5850 Multireader

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

EQUIPMENT: MD5850 Multireader

Section 3. Equipment Configuration

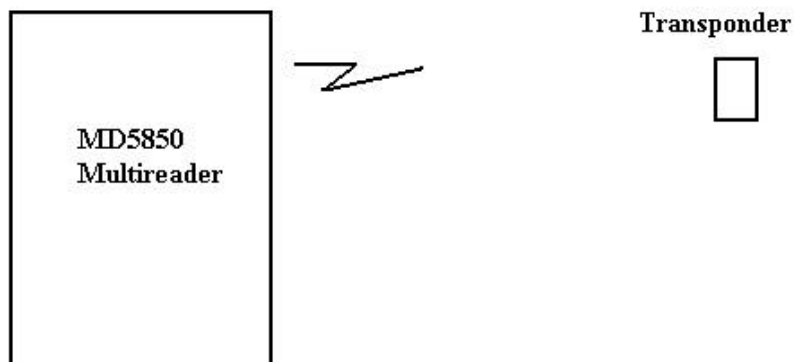
Equipment Configuration List:

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)



EQUIPMENT: MD5850 Multireader

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

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EQUIPMENT: MD5850 Multireader

Radiated Emissions								
Page <u>1</u> of <u>1</u>								
Job No.:		1L0553R			Date: 10/11/01			
Specification:		CFR 47, Part 15.245			Temperature(°C): <u>22</u>			
Tested By:		David Light			Relative Humidity(%) <u>45</u>			
E.U.T.:		MD5850 Multireader						
Configuration:		TYPICAL - TRANSMIT AT 5.8025 GHz						
Sample Number:		<u>1</u>						
Location:		<u>AC 3</u>			RBW:		<u>1 MHz</u>	
Detector Type:		<u>Peak</u>			VBW:		<u>300 kHz</u>	
Test Equipment Used								
Antenna:		<u>1033</u>			Directional Coupler:		<u>#N/A</u>	
Pre-Amp:		<u>983</u>			Cable #1:		<u>1484</u>	
Filter:		<u>#N/A</u>			Cable #2:		<u>1485</u>	
Receiver:		<u>1036</u>			Cable #3:		<u>1046</u>	
Attenuator #1		<u>#N/A</u>			Cable #4:		<u>1043</u>	
Attenuator #2:		<u>#N/A</u>			Mixer:		<u>#N/A</u>	
Additional equipment used:		<u>992</u>	<u>991</u>	<u>984</u>	<u>1464</u>	<u>988</u>	<u>989</u>	
Measurement Uncertainty:		<u>+/- 1.7 dB</u>						
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:								

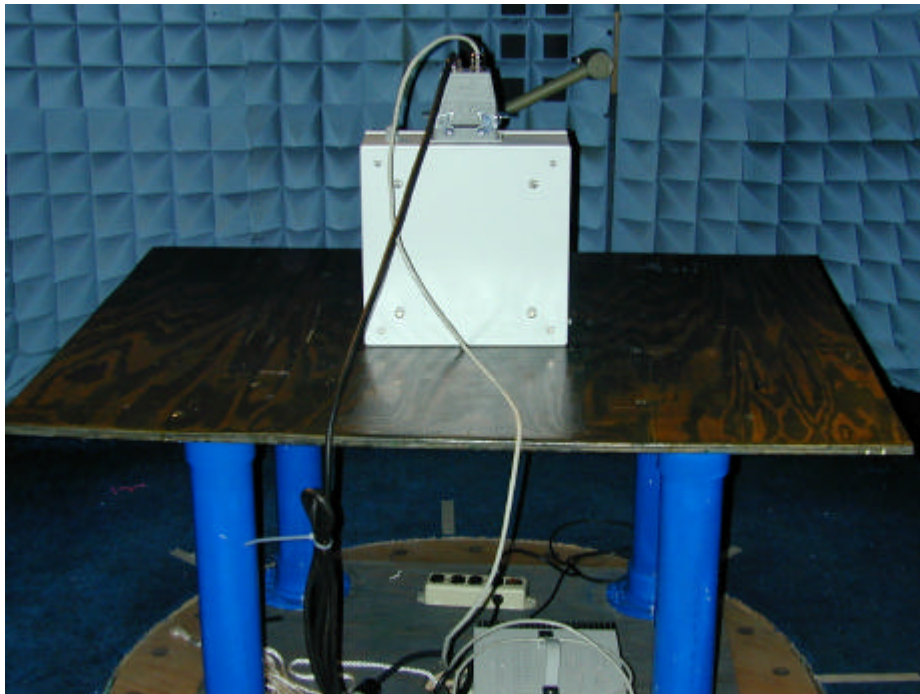
EQUIPMENT: MD5850 Multireader

Radiated Photographs (Worst Case Configuration)

FRONT VIEW



REAR VIEW



EQUIPMENT: MD5850 Multireader

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 Voltage
	mV
0.45 - 30.0	250

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.

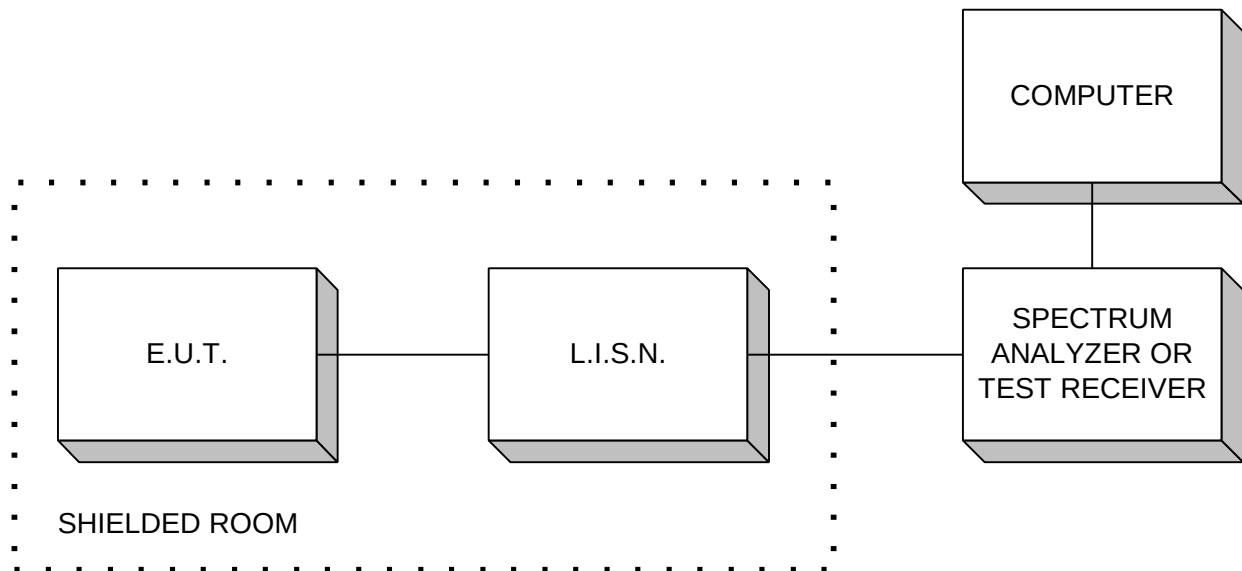
Broadband emissions are identified by switching the receiver detector function from Quasi-Peak to Average. If the amplitude of the emission drops by 6 dB or more then the emission is classified as broadband and the Quasi-Peak level is reduced by a factor of 13 dB.

All emissions within 10 dB of limit have been recorded.

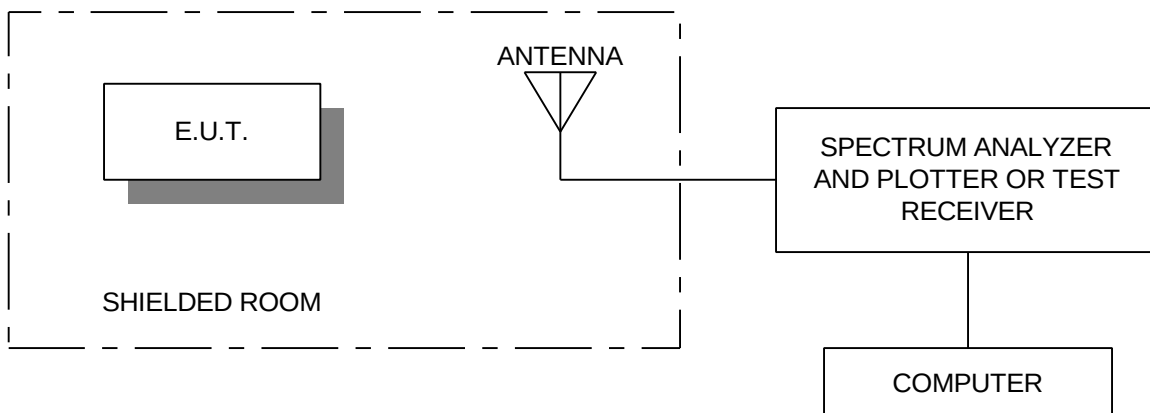
EQUIPMENT: MD5850 Multireader

Section 6. Block Diagrams

Conducted Emissions

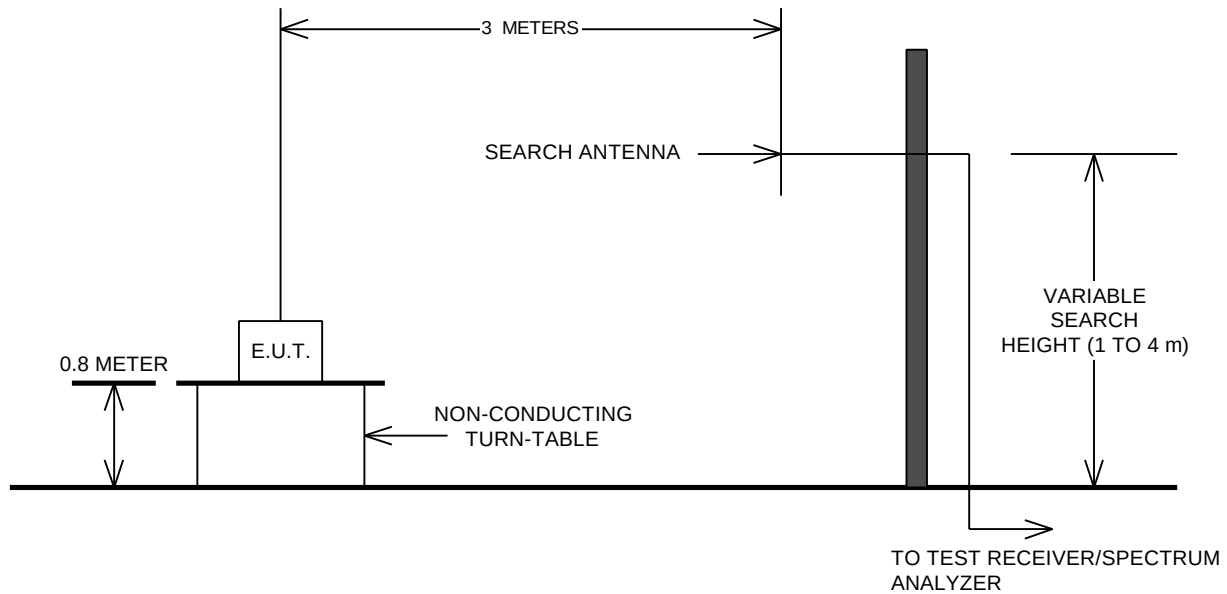


Radiated Prescan

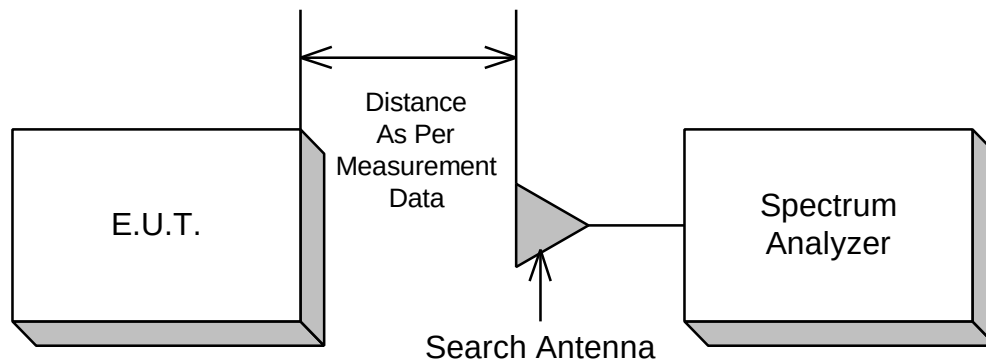


EQUIPMENT: MD5850 Multireader

Outdoor Test Site For Radiated Emissions



Indoor Measurement Setup for Emissions Above 10 GHz



EQUIPMENT: MD5850 Multireader

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	Flexible 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

Nemko Dallas

FCC PART 15, SUBPART C
INTENTIONAL RADIATORS USED AS
FIELD DISTURBANCE SENSORS
PROJECT NO.:1L0553RUS1

EQUIPMENT: MD5850 Multireader

ANNEX A - RESTRICTED BANDS

EQUIPMENT: MD5850 Multireader

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

EQUIPMENT: MD5850 Multireader

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 (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.).

EQUIPMENT: MD5850 Multireader

§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