Electromagnetic Compatibility Test Report

Tests Performed on an I.D.-ology

Handheld RFID Reader, Model ISO Cane Reader

Radiometrics Document RP-5399

ACCREDITED
Certification # 1495.01

Product Detail: FCC ID: SYAICR04 Equipment type: Low power Transmitter
Test Standards: US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2004 Industry Canada RSS-210, Issue 5 as required for Category I Equipment This report concerns: Original Grant for Certification FCC Part 15.247 & 15.209

Tests Performed For:	*Test Facility:*
I.D.-ology 1324 West Clairemont Ave. Eau Claire, WI 54701	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 Phone: (815) 293-0772 e-mail: info@radiomet.com

Test Date(s): (Month-Day-Year) Jan 19 to Feb 10, 2005

Document RP-5399 Revisions:

Rev.	Issue Date	Affected Pages	Revised By	Authorized Signature for Revision
0	February 15, 2005			
1	March 1, 2005	3, 10-12, 14	Joseph Strzelecki	Joseph Strzelecki

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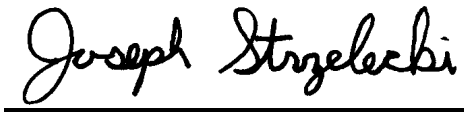
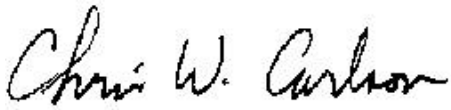
1 ADMINISTRATIVE DATA

Equipment Under Test: An I.D.-ology, Handheld RFID Reader for Animal ISO Tags Model: ISO Cane Reader; Serial Number: None This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) Jan 19, 2005	*Test Date(s): (Month-Day-Year)* Jan 19 to Feb 10, 2005
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* The tests were not witnessed by I.D.-ology
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Handheld RFID Reader for Animal ISO Tags, Model ISO Cane Reader, manufactured by I.D.-ology. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30-25 GHz	RSS-210 & FCC Part 15	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	RSS-210 & FCC Part 15	Pass
RF Radiated Emissions H-Field	0.009 – 30 MHz	RSS-210 & FCC Part 15	Pass

Frequency Hopping Spread Spectrum Transmitter Requirements

Environmental Phenomena	Frequency Range	FCC Section	RSS-210 Section	Test Result
Carrier Frequency Separation	2.4-2.483 GHz	15.247 a	6.2.2 (o) (a)	Pass
Number of Hopping Frequencies	2.4-2.483 GHz	15.247 a	6.2.2 (o) (a)	Pass
Time of Occupancy (Dwell Time)	2.4-2.483 GHz	15.247 a	6.2.2 (o) (a)	Pass
20 dB Bandwidth Test;	2.4-2.483 GHz	15.247 a	6.2.2 (o) (a)	Pass
Peak Output Power	2.4-2.483 GHz	15.247 b	6.2.2 (o) (a)	Pass
Band-edge Compliance of RF Conducted Emissions	2.4-2.483 GHz	15.247 c	6.2.2 (o) (e)	Pass
Spurious RF Conducted Emissions	30-25000 MHz	15.247 c	6.2.2 (o) (e1)	Pass
Spurious Radiated Emissions	30-25000 MHz	15.247 c	6.2.2 (o) (a)	Pass

2.1 RF Exposure Compliance Requirements

The Effective Radiated power output is 158 mW at 2.48 GHz and 1mW at 134 kHz. The EUT meets the FCC requirement for RF exposure. Since it is less than 200 mW, it is exempt from RSS-102. There are no power level adjustments and the antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Handheld RFID Reader for Animal ISO Tags, Model ISO Cane Reader, manufactured by I.D.-ology. The EUT was in good working condition during the tests, with no known defects.

3.2 Related Submittals

I.D.-ology is not submitting any other products simultaneously for equipment authorization related to the EUT.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations.

Power was supplied at 115 VAC, 60 Hz single-phase to its external power supply. Power was supplied with a fully charged battery. The EUT was tested as a stand-alone device. The only cable connected to the EUT is a 6-foot power cord.

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	Handheld RFID Reader for Animal ISO Tags	E	I.D.-ology	ISO Cane Reader	11
2	AC Adaptor	E	CUI Inc	KSAFD1200125W1US	None

* Type: E = EUT

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2004	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-2001	2001	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 5	2001	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)
IC RSS-212 Issue 1	1998	Test Methods For Radio Equipment
FCC DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

The test procedures used are in accordance with the FCC DA 00-75, Industry Canada RSS-212 and ANSI document C63.4-2001, "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 1999 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.net).

Open Area Test Site (OATS): Is located on 8625 Helmar Road in Newark, Illinois, USA and measures 56' L X 24' W X 17' H. The entire open field test site has a metal ground screen. The FCC has accepted these sites as test site number 31040/SIT 1300F2. The FCC test site Registration Number is 90897. Details of the site characteristics are on file with the Industry Canada as file number IC3124.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	12/07/04
AMP-20	Avantek	Pre-amplifier	SF8-0652	15221	8-18GHz	12 Mo	12/07/04
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	12/07/04
AMP-29	Hewlett-Packard	Amplifier	11975A	2304A00158	2-8 GHz	12 Mo.	07/21/04
AMP-29	Hewlett-Packard	Amplifier for 18-26 GHz Mixer	11975A	2304A00158	2-8 GHz	12 Mo.	07/21/04
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	10/13/04
ANT-48	RMC	Std Gain Horn	HW2020	1001	18-26 GHz	12 Mo.	10/13/04
ANT-42	EMCO	Bicon Antenna	3104C	9512-4713	25-300MHz	12 Mo.	12/02/04
ANT-44	Impossible Machine	Super Log Antenna	SL-20M2G	1002	20-2000MHz	24 Mo.	06/15/04
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	12/31/03
HPF-03	Mini-Circuits	High Pass Filter	VHP-39	HPF-03	3-10 GHz	12 Mo.	08/03/04
LSN-03	Farnell	50 uH LISN	1EXLSN30B	000314	0.01-30MHz	24 Mo.	04/08/03
MXR-01	H P	Harmonic Mixer	11970K	3003A02243	18.6-26.5GHz	12 Mo.	01/06/05
REC-01	Hewlett Packard	Spectrum Analyzer	8566A	2106A02115, 2209A01349	30Hz-22GHz	12 Mo.	08/17/04
REC-07	Anritsu	Spectrum Analyzer	MS2601A	MT53067	0.01-2200MHz	12 Mo.	01/04/05
THM-01	Extech Inst.	Temp/Humid Meter	4465CF	001106557	N/A	24 Mo.	01/28/04

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

10.1 AC Conducted Emissions; Section 15.207

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on semi-log graph paper generated by the computer and plotter. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

Broadband conducted emissions may exceed the following limits by no more than 13 dB. An emission is defined as broadband if the average detector amplitude is 6 dB or more under the quasi-peak detector amplitude.

FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

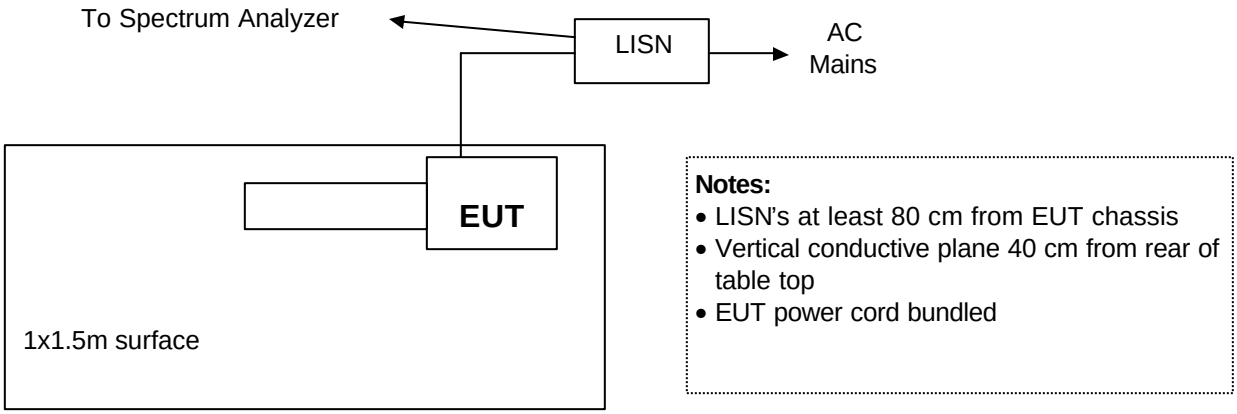
The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from power cord, after testing all modes of operation. The Amplitude is the final corrected value with cable and LISN Loss.

Test Date : Jan 19, 2005

Lead Tested	Frequency MHz	QP Amplitude	QP Limit	Average Amplitude	Average Limit
AC Neutral	0.15	53.75	65.94	29.37	55.94
AC Neutral	0.25	49.99	61.71	36.74	51.71
AC Neutral	0.38	46.72	58.18	35.95	48.18
AC Neutral	29.90	51.22	60.00	48.40	50.00
AC Hot	0.27	49.55	60.98	40.04	50.98
AC Hot	0.41	44.32	57.68	36.23	47.68
AC Hot	29.93	50.54	60.00	47.41	50.00

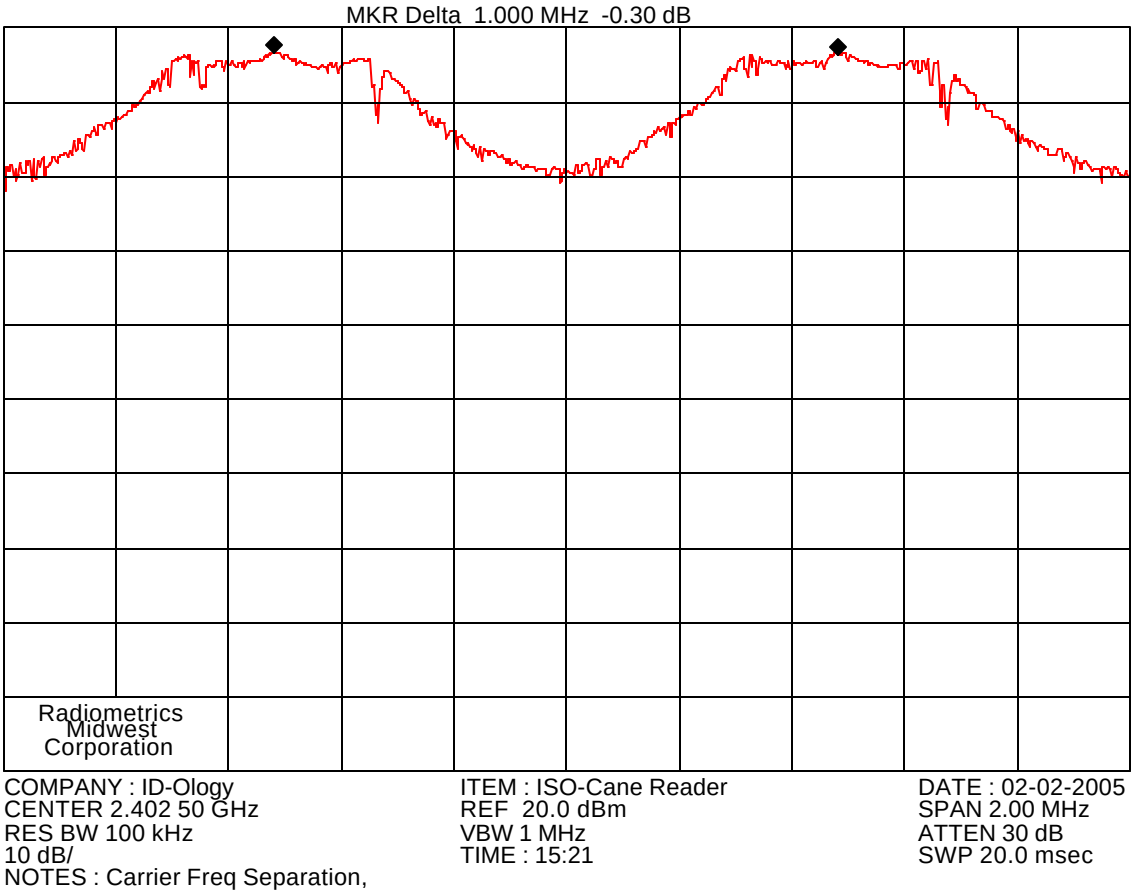
The above are the worst case results with three test frequencies.
* QP readings are quasi-peak with a 9 kHz bandwidth and no video filter.
Judgment: Passed by 1.6 dB

Figure 1. Conducted Emissions Test Setup



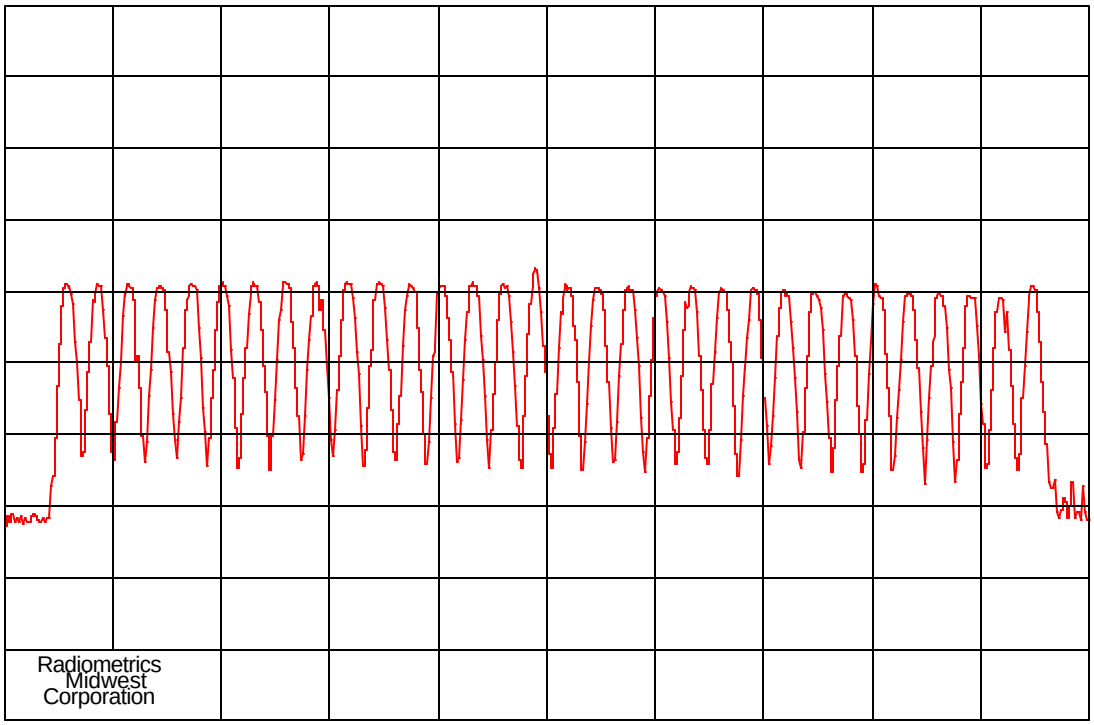
10.2 Carrier Frequency Separation

The EUT has its hopping function enabled. The spectrum analyzer was set to the MAX HOLD mode to read peak emissions. The sweep was set to AUTO. The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.



10.3 Number of Hopping Frequencies

The EUT has its hopping function enabled. The spectrum analyzer was set to the MAX HOLD mode to read peak emissions. The sweep was set to AUTO. The trace was allowed to stabilize. The plots show 32 Channels.



COMPANY : I.D.ology
START 2.401 0 GHz
RES BW 300 kHz
10 dB/
NOTES : Number of Hopping Frequencies,

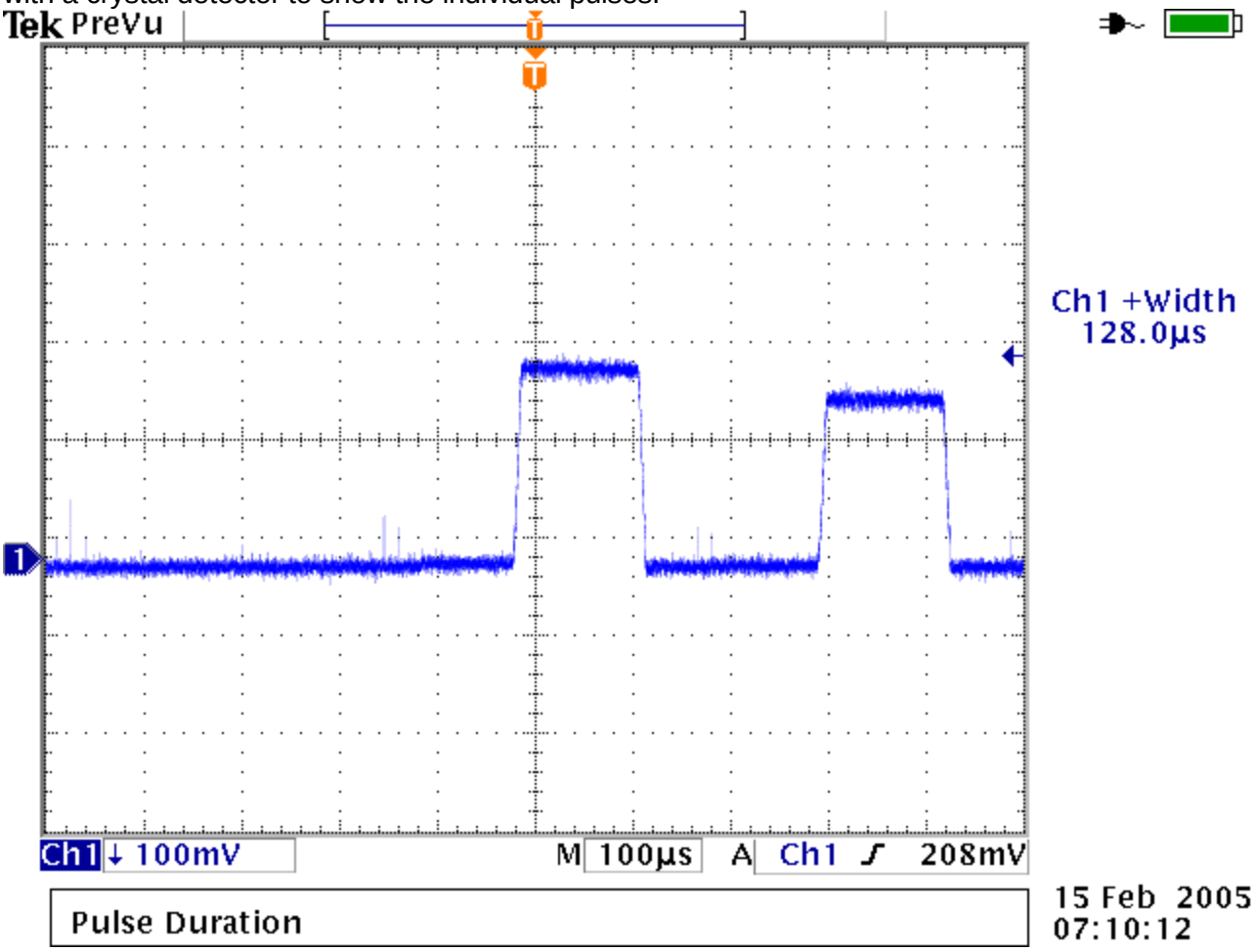
ITEM : ISO cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 13:08

DATE : 02-15-2005
STOP 2.471 0 GHz
ATTEN 30 dB
SWP 20.0 msec

The EUT has its hopping function enabled. The spectrum analyzer was set to the MAX HOLD mode to read peak emissions. The sweep was set to AUTO. The trace was allowed to stabilize. The plots show 79 Channels.

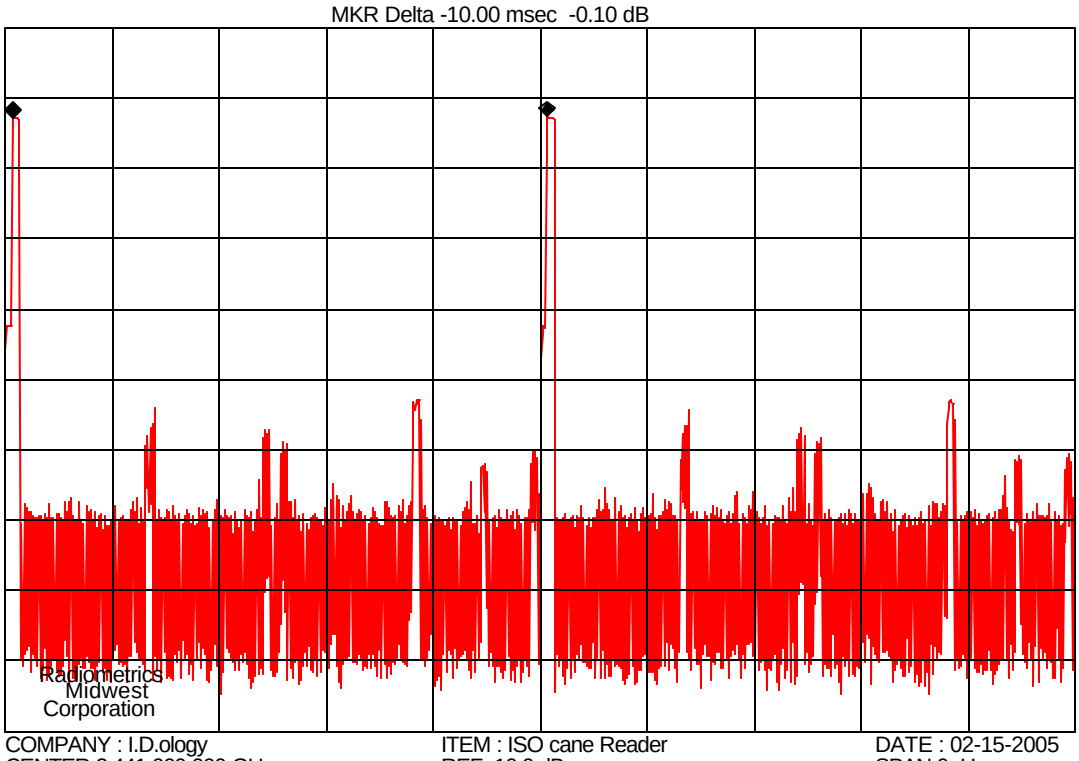
10.4 Time of Occupancy (Dwell Time)

The EUT has its hopping function enabled. This shows the the individual pulses. A scope was used with a crystal detector to show the individual pulses.

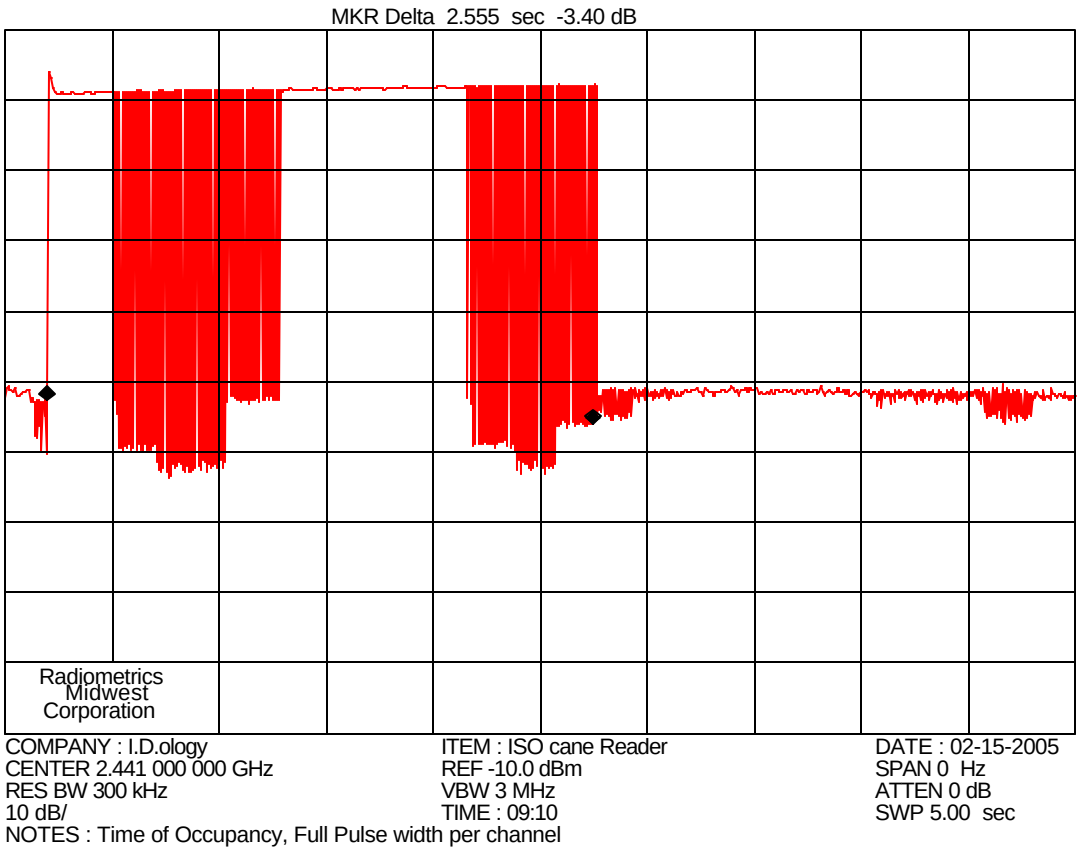


The total duration for each pulse is 128uSec x 2 or 256 uSec.

The following plots were made with a spectrum analyzer with the span was set to zero. The marker-delta function is used to determine the period between pulses. This is used to determine the number of pulses per transmission.



The following plot shows the total on time per channel for the Bluetooth.



The previous three plots were made to show the total time of occupancy.

Each pair of pulses is 256 uSec. This is from the first plot (128uSec x 2).

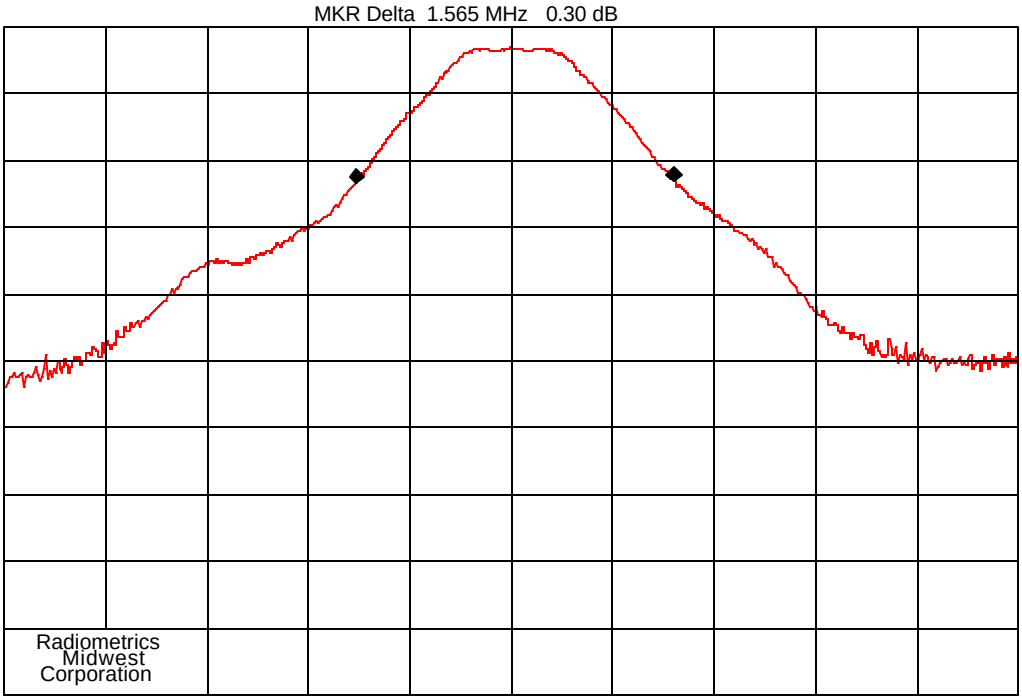
The pulse pair is repeated every 10 mSec for 2.55 seconds. There are (2.55/0.01) or 255 pulses at each channel. Therefore the total time of occupancy per channel is as follows:

255 * 256 uSec = 65280uSec = 0.06528 seconds. (This is the time of Occupancy per channel)

10.5 Occupied Bandwidth (20 dB)

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

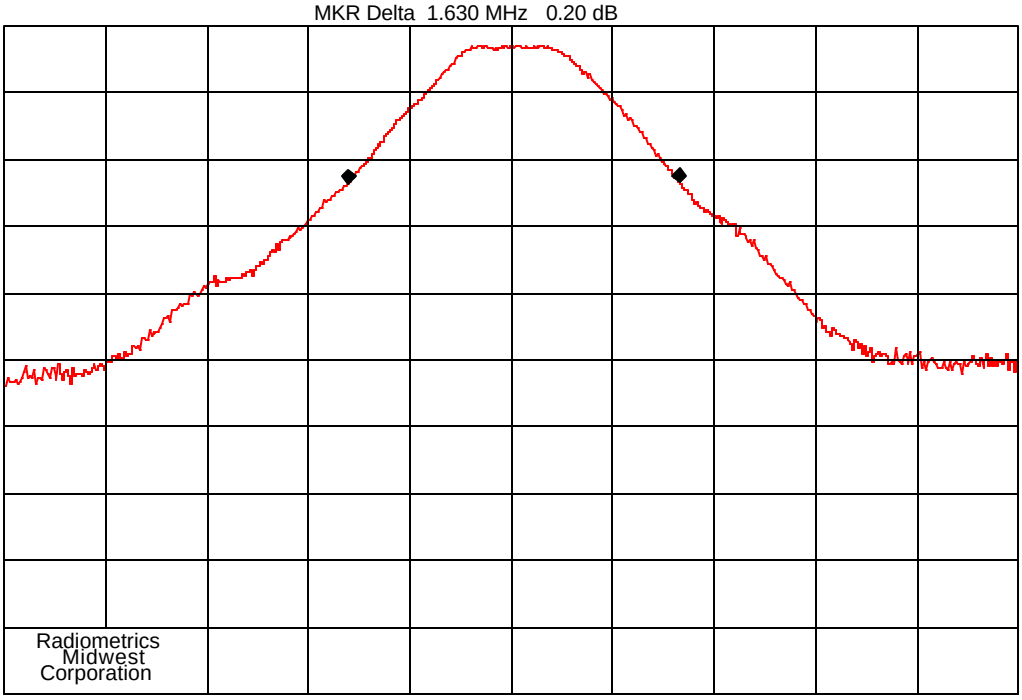
The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.



COMPANY : ID-Ology
CENTER 2.402 00 GHz
RES BW 300 kHz
10 dB/
NOTES : 20 dB Bandwidth, Low Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 16:56

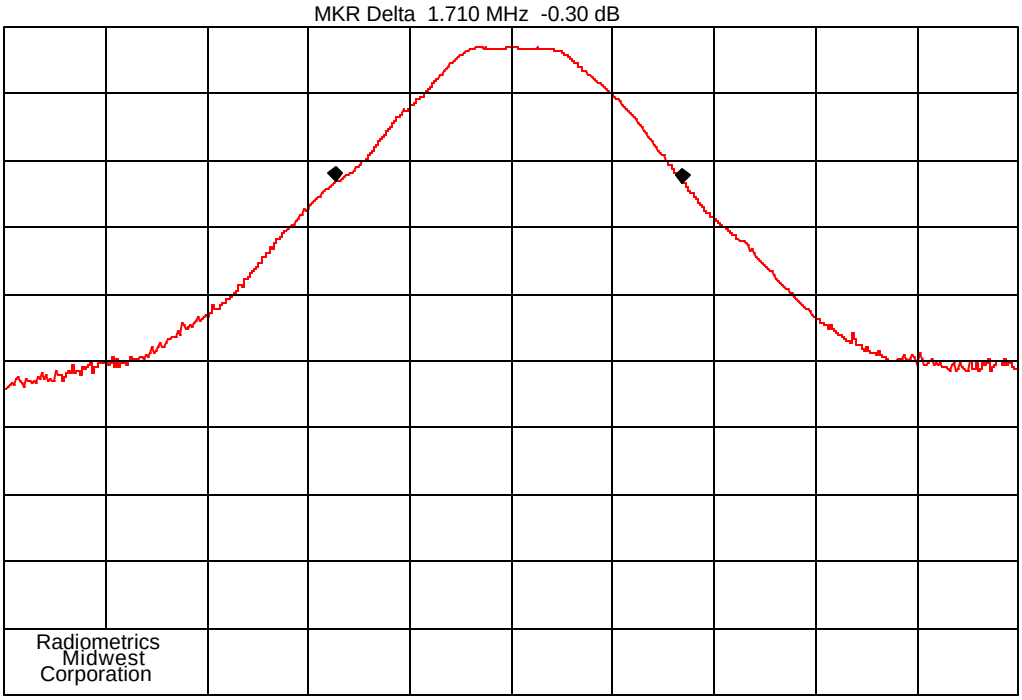
DATE : 01-31-2005
SPAN 5.00 MHz
ATTEN 30 dB
SWP 20.0 msec



COMPANY : ID-Ology
CENTER 2.441 00 GHz
RES BW 300 kHz
10 dB/
NOTES : 20 dB Bandwidth, Mid Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 16:58

DATE : 01-31-2005
SPAN 5.00 MHz
ATTEN 30 dB
SWP 20.0 msec



10.6 Peak Output Power

The spectrum analyzer was set to the following settings:

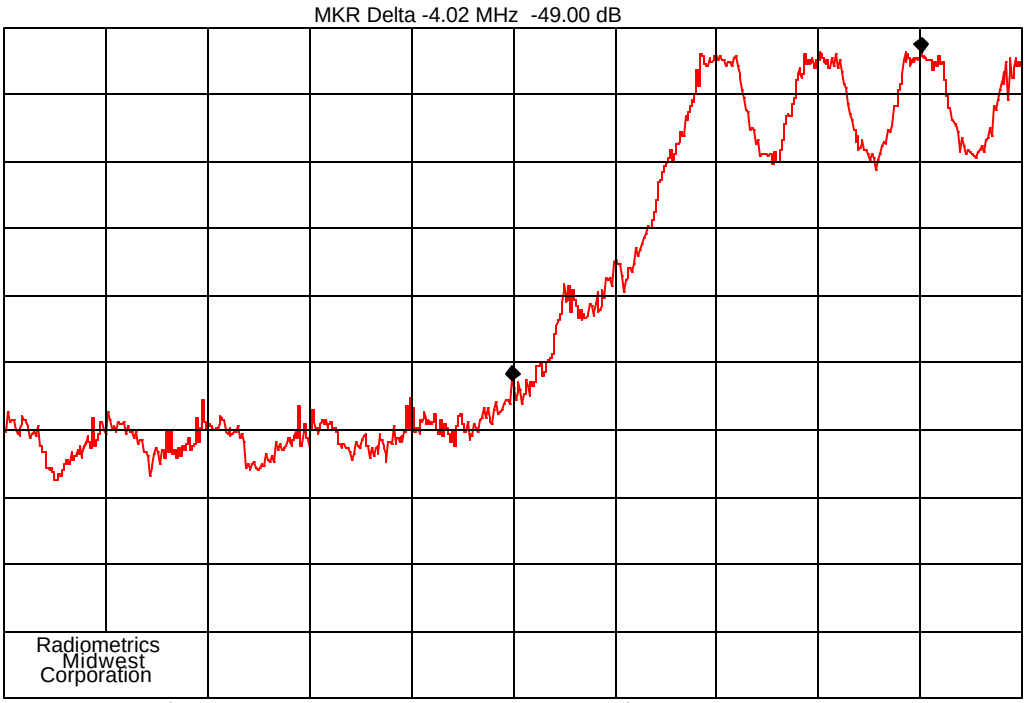
Span = 2 MHz (centered on a hopping channel)
RBW = 3 MHz (> the 20 dB bandwidth of the emission being measured)
VBW = 3 MHz
Sweep = auto
Detector function = peak
Trace = max hold

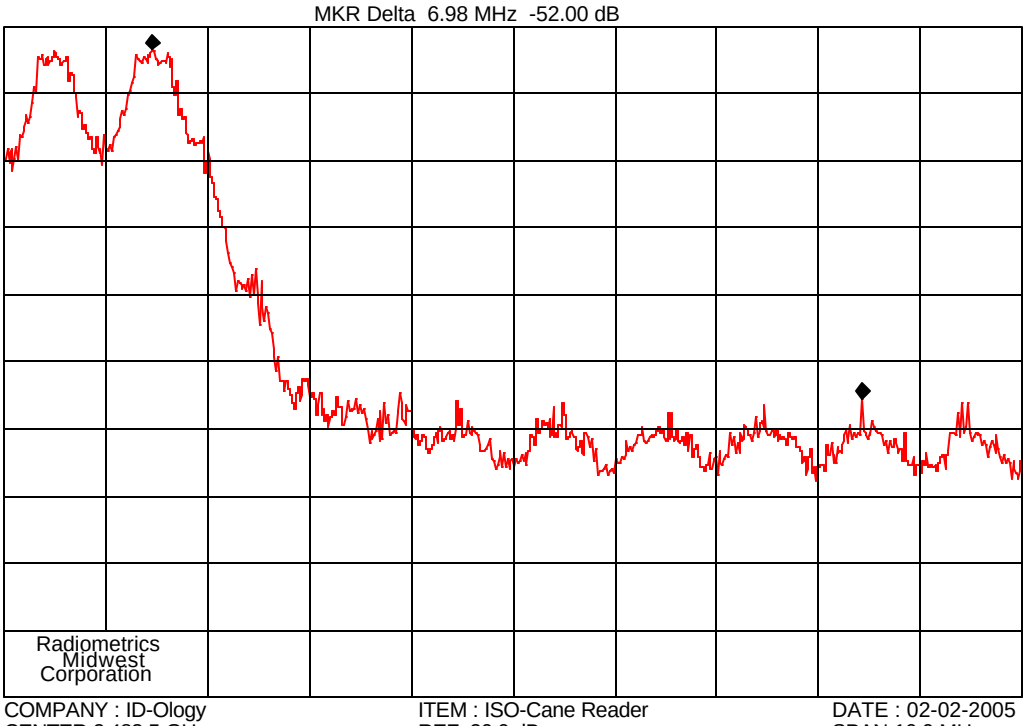
The trace was allowed to stabilize. The marker-to-peak function was used to measure the peak of the emission. The indicated level is the peak output power. Note 30 dBm = 1 watt. Since the gain of the antenna is always less than 6dB, the limit is not reduced.

Frequency (MHz)	Reading (dBm)	Cable Loss (dB)	Total Power (dBm)		Limit	
			dBm	Watts	Watts	(dBm)
2402	17.8	0.1	17.9	0.062	0.125	21.0
2441	17.5	0.1	17.5	0.058	0.125	21.0
2480	17.4	0.1	17.4	0.056	0.125	21.0

10.7 Band-edge Compliance of RF Conducted Emissions

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation at the band-edge, with the EUT set to the lowest frequency. The trace was allowed to stabilize.





COMPANY : ID-Ology
CENTER 2.483 5 GHz
RES BW 100 kHz
10 dB/
NOTES : Upper Band Edge Test,

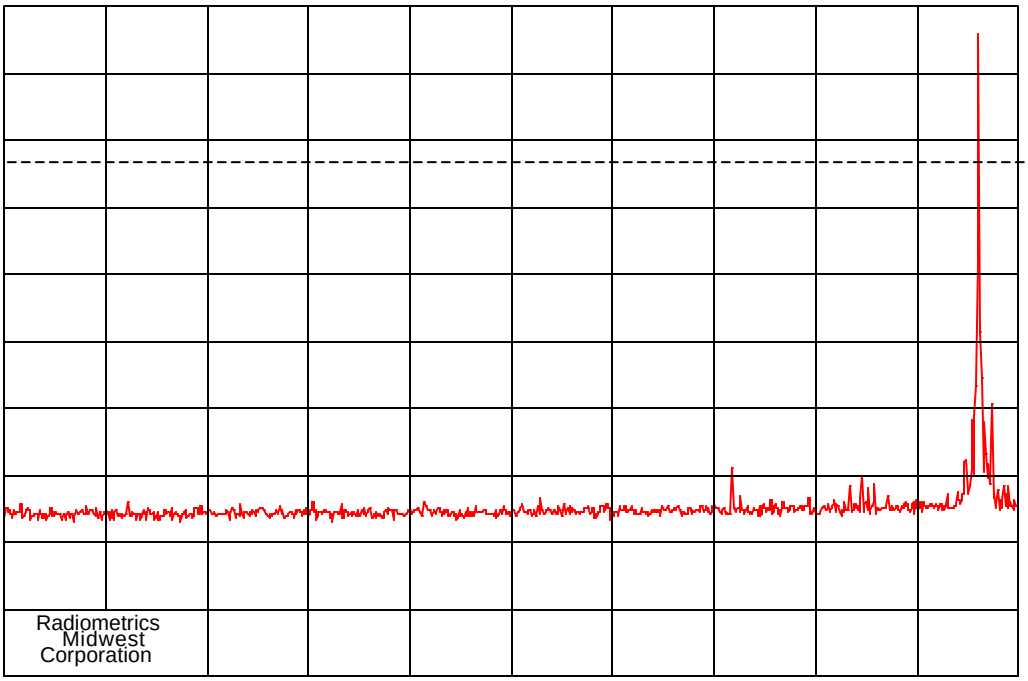
ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:32

DATE : 02-02-2005
SPAN 10.0 MHz
ATTEN 30 dB
SWP 20.0 msec

10.8 Spurious RF Conducted Emissions

The spectrum analyzer was set to the MAX HOLD mode to record all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic. The trace was allowed to stabilize. The first two plots were made while stepping through three frequencies (Low middle and high). Each frequency was on for 30 seconds. The last two plots were made with hopping enabled.

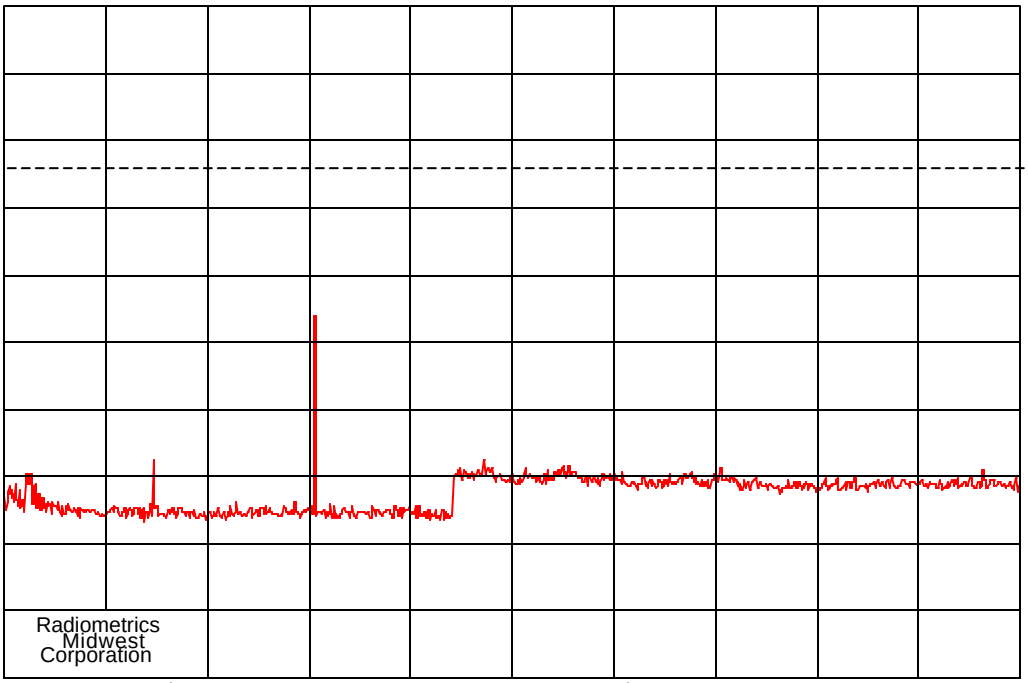
The dashed lines are 20 dB below the level of the fundamental.



COMPANY : ID-Ology
START 1 MHz
RES BW 100 kHz
10 dB/
NOTES : Spurious RF Cond Emissions, Low Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:40

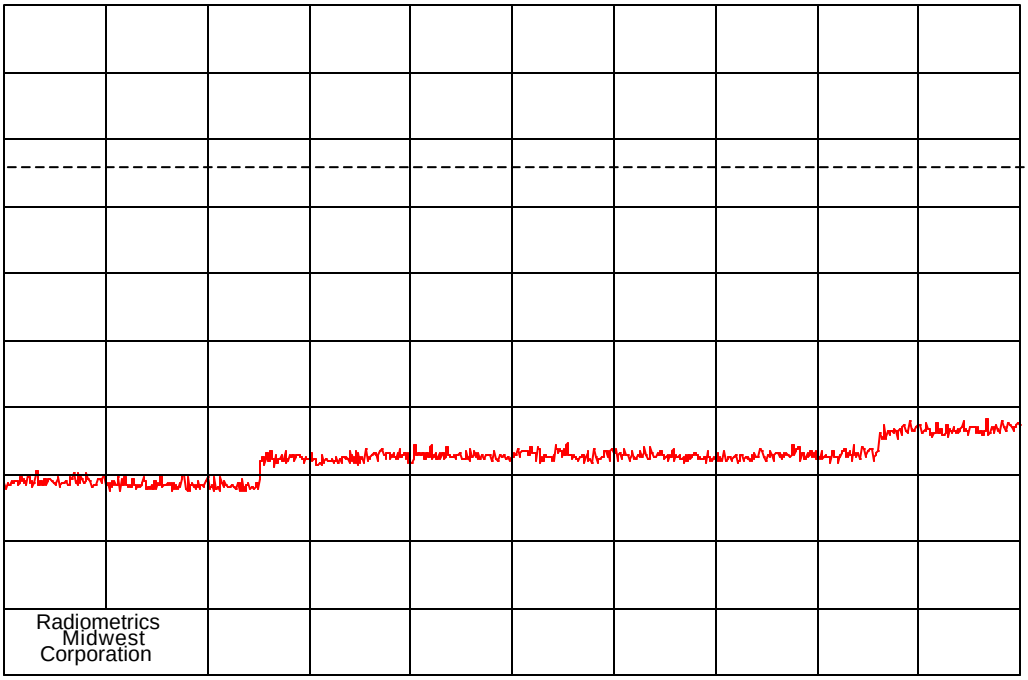
DATE : 02-02-2005
STOP 2.50 GHz
ATTEN 30 dB
SWP 749 msec



COMPANY : ID-Ology
START 2.50 GHz
RES BW 100 kHz
10 dB/
NOTES : Spurious RF Cond Emissions, Low Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:49

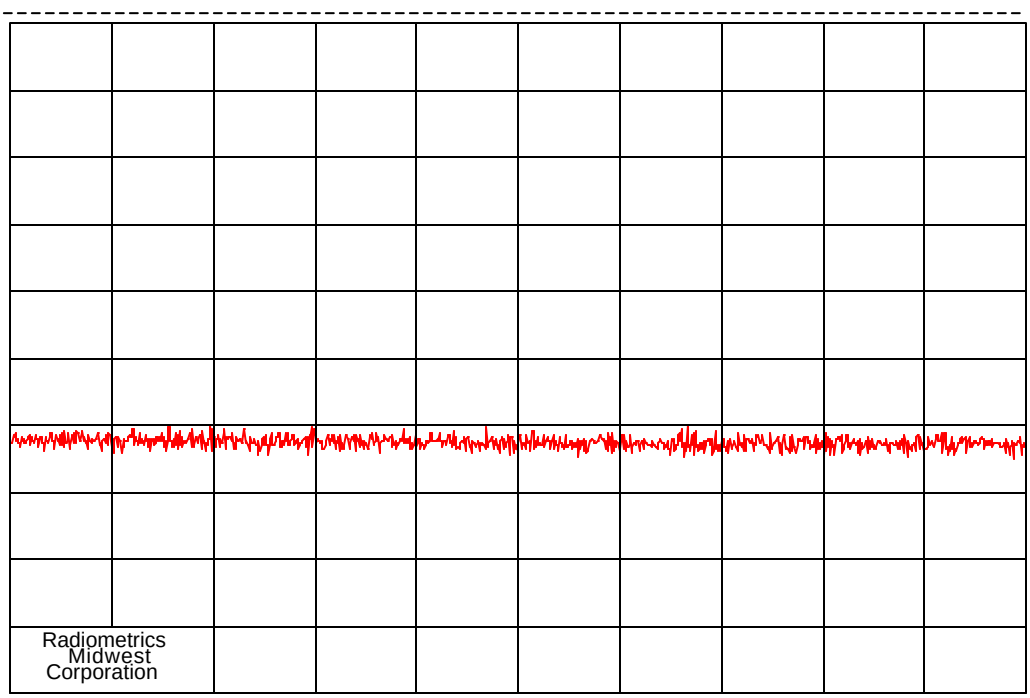
DATE : 02-02-2005
STOP 10.00 GHz
ATTEN 30 dB
SWP 2.25 sec



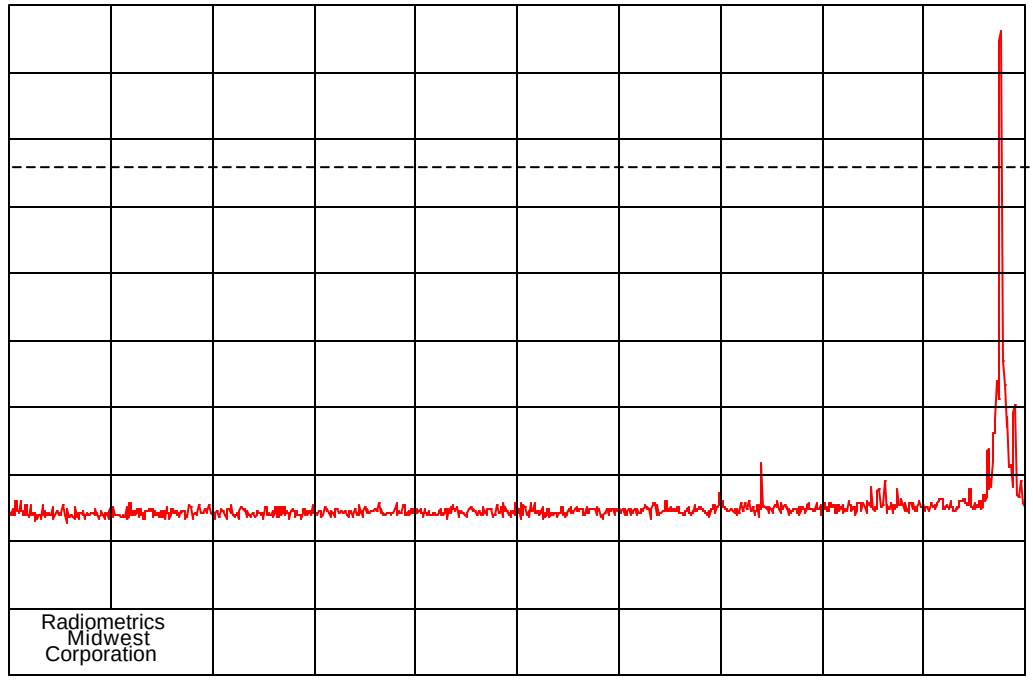
COMPANY : ID-Ology
START 10.0 GHz
RES BW 100 kHz
10 dB/
NOTES : Spurious RF Cond Emissions, Low Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:51

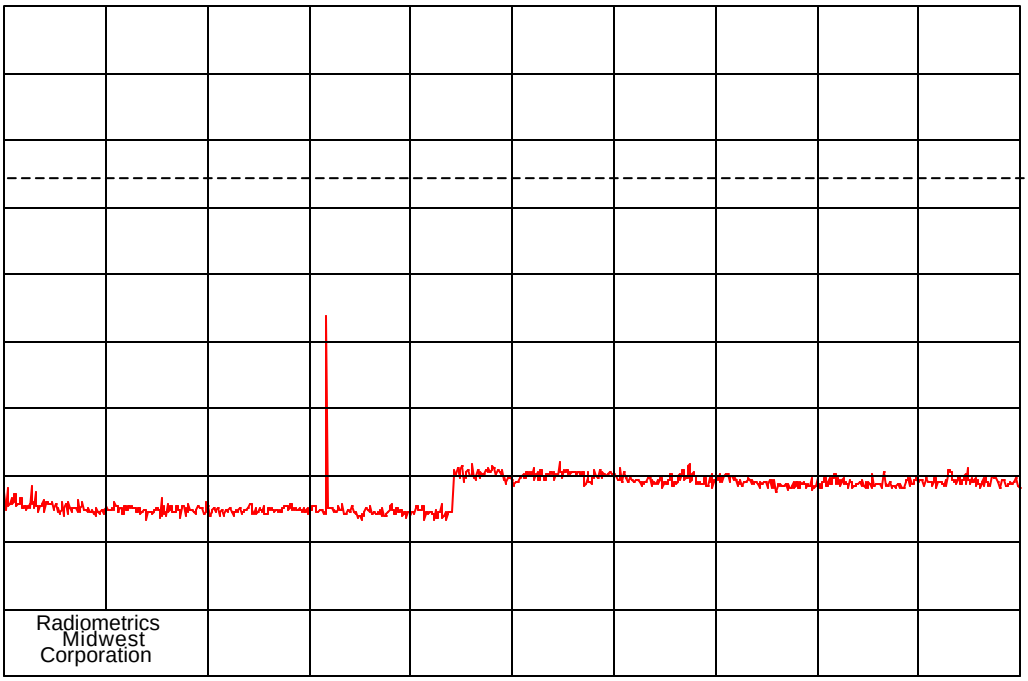
DATE : 02-02-2005
STOP 20.0 GHz
ATTEN 30 dB
SWP 3.00 sec



COMPANY : ID-Ology
START 20.00 GHz
RES BW 300 kHz
10 dB/
ITEM : ISO-Cane Reader
REF -7.0 dBm
VBW 1 MHz
TIME : 16:28
DATE : 02-02-2005
STOP 25.00 GHz
ATTEN 20 dB
SWP 150 msec
NOTES : Spurious RF Cond Emissions, Low Channel; 3 dB ext att



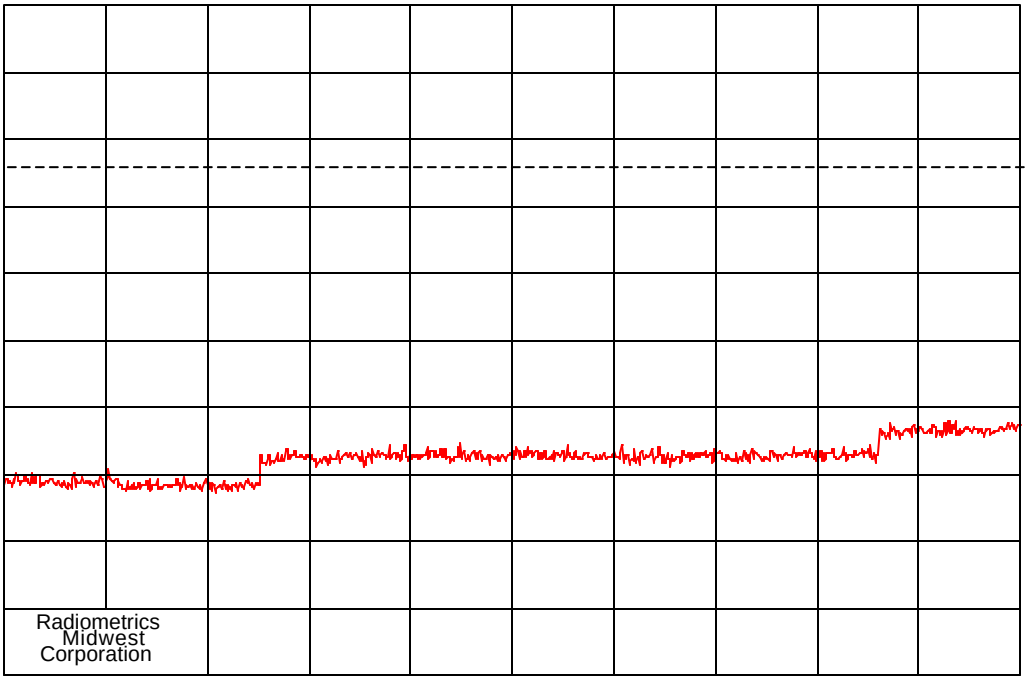
COMPANY : ID-Ology
START 1 MHz
RES BW 100 kHz
10 dB/
ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:41
DATE : 02-02-2005
STOP 2.50 GHz
ATTEN 30 dB
SWP 749 msec
NOTES : Spurious RF Cond Emissions, Mid Channel



COMPANY : ID-Ology
START 2.50 GHz
RES BW 100 kHz
10 dB/
NOTES : Spurious RF Cond Emissions, Mid Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:49

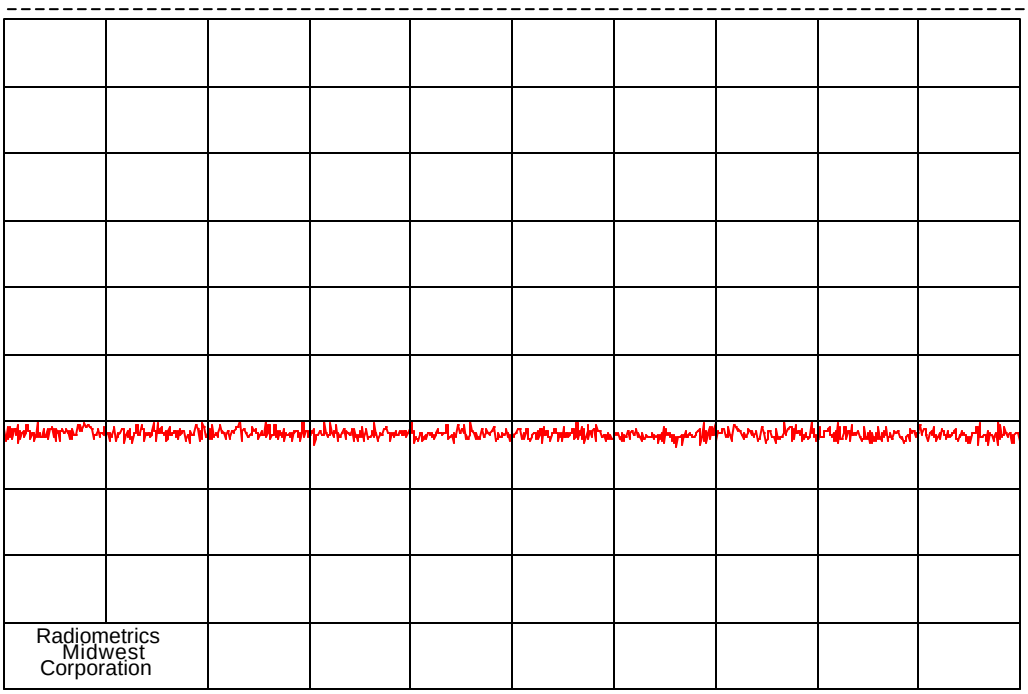
DATE : 02-02-2005
STOP 10.00 GHz
ATTEN 30 dB
SWP 2.25 sec



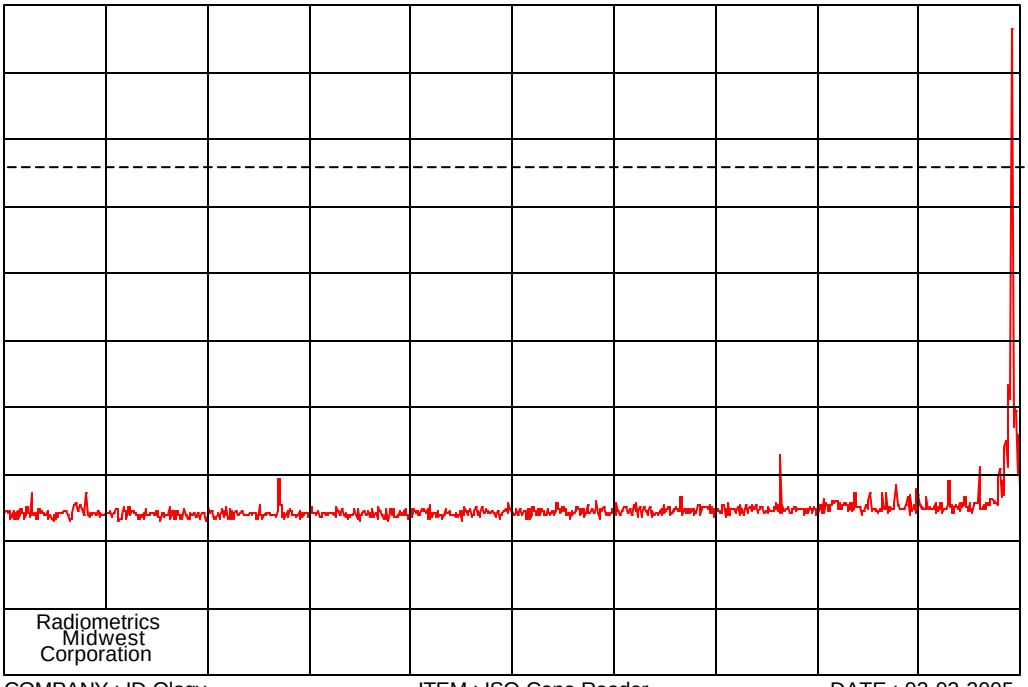
COMPANY : ID-Ology
START 10.0 GHz
RES BW 100 kHz
10 dB/
NOTES : Spurious RF Cond Emissions, Mid Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:52

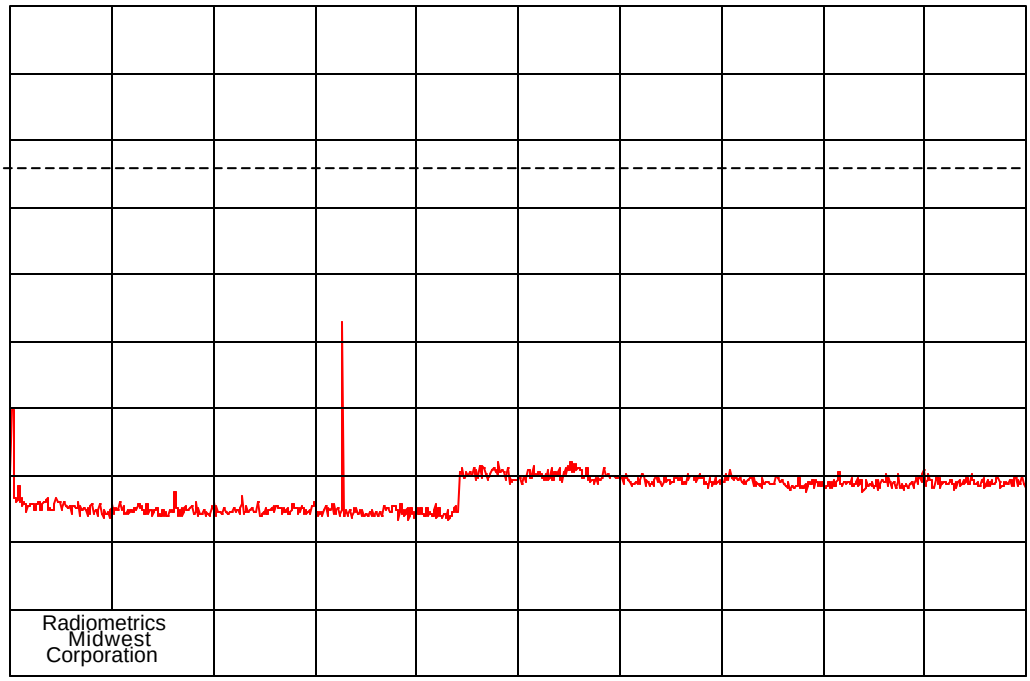
DATE : 02-02-2005
STOP 20.0 GHz
ATTEN 30 dB
SWP 3.00 sec



COMPANY : ID-Ology
START 20.00 GHz
RES BW 300 kHz
10 dB/
ITEM : ISO-Cane Reader
REF -7.0 dBm
VBW 1 MHz
TIME : 16:32
DATE : 02-02-2005
STOP 25.00 GHz
ATTEN 20 dB
SWP 150 msec
NOTES : Spurious RF Conducted Emission, Mid Channel; 3 dB att



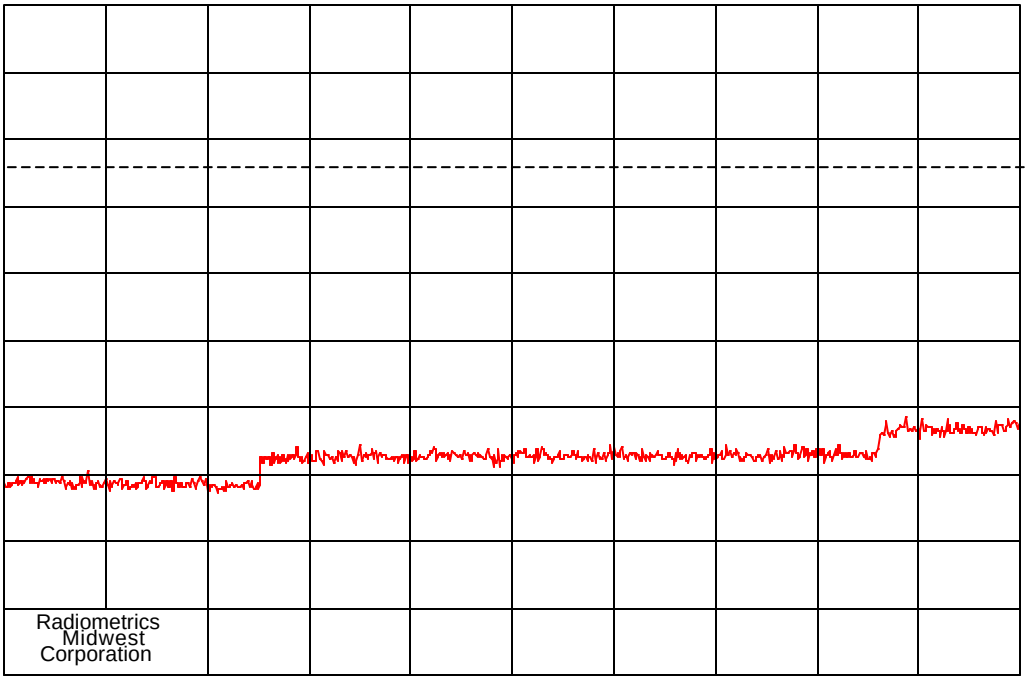
COMPANY : ID-Ology
START 1 MHz
RES BW 100 kHz
10 dB/
ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:42
DATE : 02-02-2005
STOP 2.50 GHz
ATTEN 30 dB
SWP 749 msec
NOTES : Spurious RF Cond Emissions, High Channel



COMPANY : ID-Ology
START 2.50 GHz
RES BW 100 kHz
10 dB/
NOTES : Spurious RF Cond Emissions, High Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:48

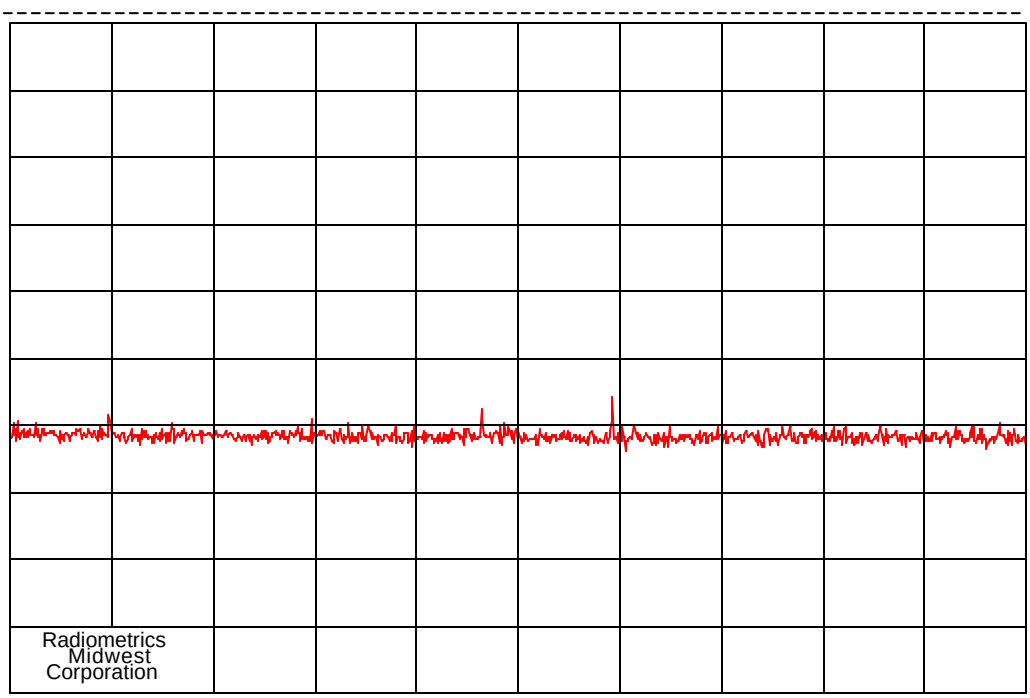
DATE : 02-02-2005
STOP 10.00 GHz
ATTEN 30 dB
SWP 2.25 sec



COMPANY : ID-Ology
START 10.0 GHz
RES BW 100 kHz
10 dB/
NOTES : Spurious RF Cond Emissions, High Channel

ITEM : ISO-Cane Reader
REF 20.0 dBm
VBW 1 MHz
TIME : 15:53

DATE : 02-02-2005
STOP 20.0 GHz
ATTEN 30 dB
SWP 3.00 sec



10.9 Spurious Radiated Emissions (Restricted Band)

Radiated emission measurements in the Restricted bands were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. Below 1 GHz, when a radiated emission is detected approaching the specification limit, the measurement of the emission is repeated using a tuned dipole antenna with a Roberts Balun. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu Spectrum analyzer and a MITEQ AM-1431 amplifier with a 10 dB attenuator connected to the input were used. The out of band emissions and the ambient emissions were below the level of input overload.

For tests from 1 to 25 GHz, an HP8566A spectrum analyzer was used with a preamplifier. A harmonic mixer was used from 20 to 25 GHz The out of band emissions and the ambient emissions were below the level of input overload (72 dBuV). In addition, a high pass filter was used to reduce the fundamental emission.

Radiated emission measurements are performed with linearly polarized broadband antennas. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded.

Final radiated emissions measurements were performed in the open area test site at a test distance of 3 meters. The entire frequency range from 30 MHz to 25 GHz was slowly scanned and the emissions in the restricted frequency bands were recorded. Measurements were performed using the peak detector function. The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground. The open area test site used to collect the radiated data is located on 8625 Helmar Road in Newark, Illinois. The open field test site has a metal ground screen. All other tests are performed at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The was device was rotated through three orthogonal axis as per 13.1.4.1 of ANSI C63.4 during the prescans and during final radiated tests.

10.9.1 Radiated Emissions Field Strength Sample Calculation

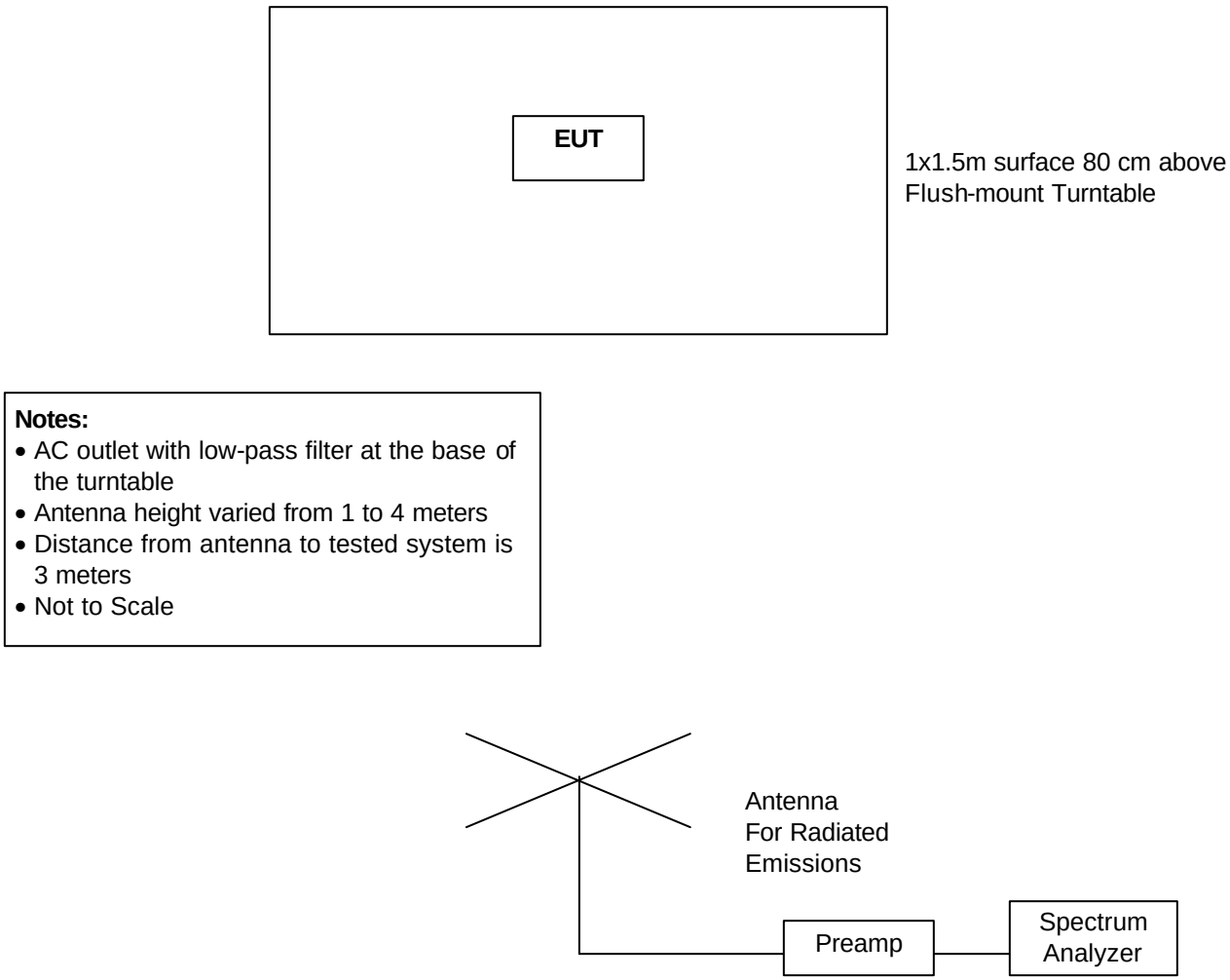
The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
HPF = High pass Filter Loss
PKA = Peak to Average Factor (This is zero for non-average measurements)

The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

Figure 2. Drawing of Radiated Emissions Setup



10.9.2 Spurious Radiated Emissions Test Results (Restricted Band)

The following spectrum analyzer settings were used.

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
A Video Bandwidth of 10 Hz was used for Average measurements above 1 GHz.

The peak emissions did not exceed the average Limit by more than 20 dB.

Manufacturer	I.D.-ology	Specification	FCC Part 15 Subpart C & RSS-210
Model	ISO Cane Reader	Test Date	Jan 24, 2005
Serial Number	None	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; BC = Biconical (ANT-3); LP = Log-Periodic (ANT-6); HN = Horn (ANT-13) P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain		

Emissions Below 1 GHz
Tested in FHSS Hopping mode with 134 kHz transmitter operating

Freq. MHz	Meter Reading dBuV	Antenna Factor dB	Antenna Pol/ Type	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
130.1	38.3 P	9.9	H/44	-16.5	31.6	43.5	11.9
138.0	43.9 P	8.8	H/44	-16.5	36.2	43.5	7.3
400.9	28.9 P	16.0	H/44	-14.8	30.1	46.0	15.9
74.7	41.9 P	7.3	V/44	-17.1	32.1	40.0	7.9
74.9	39.5 P	7.2	V/44	-17.1	29.6	40.0	10.4
75.3	39.7 P	7.2	V/44	-17.1	29.8	40.0	10.2
115.4	36.4 P	12.3	V/44	-16.7	32.0	43.5	11.5
130.5	42.8 P	10.1	V/44	-16.5	36.4	43.5	7.1
133.4	46.1 P	10.0	V/44	-16.5	39.6	43.5	3.9
134.7	46.8 P	10.0	V/44	-16.5	40.3	43.5	3.2
141.3	49.4 Q	7.7	V/44	-16.4	40.7	43.5	2.8
250.3	33.2 P	12.8	V/44	-15.6	30.3	46.0	15.7
254.2	33.1 P	12.8	V/44	-15.6	30.3	46.0	15.7
279.8	35.7 P	12.8	V/44	-15.4	33.1	46.0	12.9
280.5	33.3 P	12.8	V/44	-15.4	30.7	46.0	15.3
331.1	30.3 P	14.3	V/44	-15.1	29.5	46.0	16.5

Emissions above 1 GHz

Tx Freq	Ant Pol.	Detector Function	Emission Freq. MHz	dBuV/m	Limit	Margin under limit
2402	V	Peak	4804	72.1	74	1.9
2402	H	Peak	4804	70.5	74	3.5
2441	V	Peak	4882	72.5	74	1.5
2441	V	Peak	7323	56.4	74	17.6
2441	H	Peak	4882	70.8	74	3.2
2441	H	Peak	7323	56.0	74	18.0
2480	V	Peak	4960	73.0	74	1.0
2480	V	Peak	7440	57.5	74	16.5
2480	H	Peak	4960	71.9	74	2.1
2480	H	Peak	7440	56.4	74	17.6
2402	V	Ave	4804	45.3	54	8.7
2402	H	Ave	4804	44.0	54	10.0
2441	V	Ave	4882	46.4	54	7.6
2441	H	Ave	4882	44.4	54	9.6
2480	V	Ave	4960	46.8	54	7.2
2480	H	Ave	4960	45.2	54	8.8

Judgment: Passed by 1.0 dB
No other emissions were detected in the restricted bands.

10.10 Magnetic Field Measurements and Decay Factor Calculations

Radiated emission measurements are performed with shielded loop antennas. An Empire LG-105 and an Empire LP-105 antenna were used. The antennas were rotated in order to find the maximize readings.

The decay exponent used is 2. The distance correction factor is calculated as follows:

Distance factor (dB) = 40*Log(TD/300)

TD is the actual test distance in meters. 300 meters is the specification distance. The actual Distance correction factor at 5 meters is –71.1 dB.

10.10.1 Magnetic Field Radiated Emissions Results (0.009 to 30 MHz)

Test Date	Jan 24, 2005
Test Distance	3 Meters
Specification	FCC 15 & RSS-210
Notes	Corr. Factors = cable loss - preamp gain - distance factor. Decay Exponent = 2 Shielded Loop Antennas were used for this test.
Notes	All readings are using a peak detector

Span = wide enough to fully capture the emission being measured
RBW = 10 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Freq (kHz)	Peak meter reading dBuV	Loop Ant Factor	Dist (m)	Decay exp	Cable Loss dB	dist factor dB	Amp Gain dB	Field Strength dBuV/m	15.209 Limit dBuV/m	Margin Under Limit dB
134.2	44.1	46.0	5.0	2.0	0.0	-71.1	0.0	19.0	25.0	6.0
268.4	19.0	56.0	3.0	2.0	0.0	-80.0	19.0	-24.0	19.0	43.0
402.6	27.5	57.9	3.0	2.0	0.1	-80.0	19.0	-13.5	15.5	29.0
536.8	20.0*	56.1	3.0	2.0	0.1	-40.0	19.0	17.2	33.6	16.4
671.0	20.0*	53.5	3.0	2.0	0.1	-40.0	19.0	14.6	31.1	16.5
939.4	20.0*	52.8	3.0	2.0	0.1	-40.0	19.0	13.9	28.1	14.2
1074	20.0*	52.0	3.0	2.0	0.1	-40.0	19.0	13.1	27.0	13.9
1208	20.0*	51.0	3.0	2.0	0.1	-40.0	29.0	2.1	26.0	23.9
1342	20.0*	49.0	3.0	2.0	0.1	-40.0	29.0	0.1	25.0	24.9

*ambient emissions; No detectable emissions above 500 kHz.

Judgement: Passed by 6 dB.

10.11 Card Reader Occupied Bandwidth (20 dB)

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.