

**PCTC**

**Product Compliance Test Center**

**2476 Swedesford Road, Malvern, PA 19355**

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**ELECTROMAGNETIC INTERFERENCE TEST REPORT**

**Doc. 20050903R01/Project No. 1202**

**TEST STANDARDS: 47 CFR PART 15 C**

**RFR-02**


**FCC ID: UL4RFR-02**

**ACCUSORT SYSTEMS, INC.**

**TELFORD, PA 18969**

**TEST DATES: April 12<sup>th</sup> through September 26<sup>th</sup>, 2005**

**ISSUE: September 21<sup>st</sup>, 2006**

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**AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION**

Certificate No: 1028.01

**ERRATA SHEET**

This document is revision 1 to document 20050903R and is marked as “PCTC Doc. No. 20050903R01”, dated 21 September 2006. This revision is issued to make the following corrections and clarifications:

<b>Page(s)</b>	<b>Change</b>
All	Changed FCC ID from TCARFR-02 to UL4RFR-02

## PREFACE

This report documents product testing conducted to verify compliance of the specified EUT with applicable standards and requirements as identified herein. EUT, test instrument configurations, test procedures and recorded data are generally described in this report. The reader is referred to the applicable test standards for detailed procedures. The following table summarizes the test results obtained during this evaluation.

## SUMMARY

The RFR-02 was tested to the standards listed below, and found to have the following characteristics:

### Emission Tests

	47 CFR Part	Test Range	RESULT
Radiated Emissions Intentional Radiator, Fundamental	15.225(a)-(d)	1.705 to 10 MHz	Below Max. Permissible Limit
Radiated Emissions Intentional Radiator, Harmonics	15.209	10 MHz to 1 GHz	
Conducted Emissions Intentional Radiators	15.209	450 kHz to 30 MHz	
Frequency Tolerance	15.225(e)	-20°C to 50°C	
		85% & 115 % of nominal AC voltage	

### EUT Modifications:

Two clamp-on ferrites (Fair-Rite part number is 0443164251) were added to the Network Interface Cable of the RFR-02 to meet radiated emission requirements.

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**1.0 Description of the Equipment under Test (EUT)**

Equipment Identification	RFR-02
Serial Number	05013806
Manufacturer	AccuSort Systems, Inc.
Technical Contact	Glen Weisel
Condition Received	Acceptable for Test
Date Received	4/12/05
Sample Type	Pre-production
Equipment Classification	Non-residential, Information Technology Equipment (ITE)
Unisys Test Personnel	Paul Banker, Charles Cunningham

**1.1 General Description**

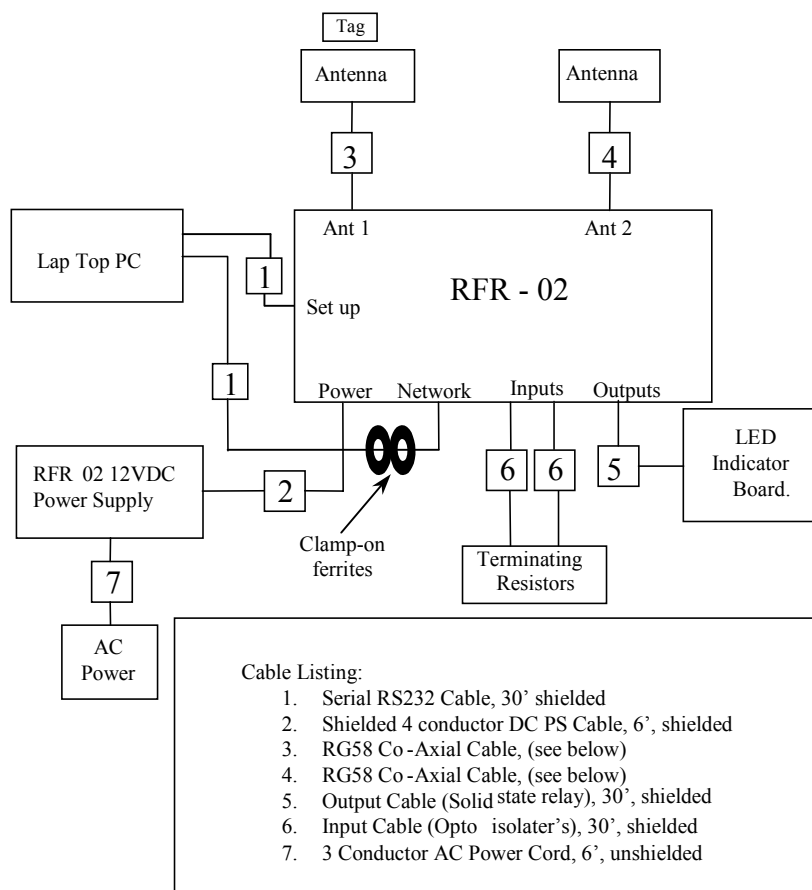
The RFR-02 is a RFID reader operating in the 13.56 MHz frequency range, the unit operates between 10 to 30 VDC. It is also available in a 12VDC only version.

**1.2 Test Configurations**

The RFR-02 will be tested using its 10 to 30 VDC power input option. Three different style antennae will be tested they are RFA-02 (5" x 7") RFA-02-2 (12" x 16") RFA-02-3 (5" x 16"). The unit will be tested using a laptop PC for monitoring and control purposes. Power for the unit will be provided by the RFR-02 Power Supply 12VDC@2.1a. Indicator lights will be attached to the outputs of the unit, which indicate good and bad reads of tag data. Connection between the RFR-02 and the PC will use an RS232 connection. The RFR02 will be put into continuous read mode of tags.

The antennae were tested using standard cable lengths and an extension cable.

A block diagram of the EUT with I/O and power cable connections is presented on the following page.



**EMI Test Setup Block Diagram of RFR-02**

### Antenna cable description

Antenna	RG 58 Coaxial Cable Length	Manufacturer/Part #
RFA-02	6'	Wan Lung RG / 58C/U
RFA-02-2, RFA-02-3	10', 10'8"	Alpha Wire / 9058AC
Extension	14'10"	Belden / 7806A

### Equipment description

Description	Manufacturer	Model#	Serial#
RFI ISO 15693 READER 13.56 MHz	ACCU-SORT SYSTEMS, INC.	RFR-02, 10-30 VDC POWER	05013806
Power Supply	ACCU-SORT SYSTEMS, INC.	RFR-02 PS	04027879
Antenna	ACCU-SORT SYSTEMS, INC.	RFA-02 (5" X 7")	05015114
Antenna	ACCU-SORT SYSTEMS, INC.	RFA-02-2 (12" X 16")	05015115
Antenna	ACCU-SORT SYSTEMS, INC.	RFA-02-3 (5" x 16")	05013807

### **1.3 Rationale for the Chosen Configuration**

The configuration will allow the RFR-02 to be controlled via a serial RS232 connection for control and monitoring of the unit. The use of the 10 to 30 VDC input option provides the highest possible generation of EMI. Putting the RFR-02 into continuous read mode creates promotes the continuous generation of side bands that are created by the communication between the reader and tag

### **1.4 EUT Modifications**

Two clamp-on ferrites (Fair-Rite part number is 0443164251) were added to the Network Interface Cable of the RFR-02 to meet radiated emission requirements.

## **2.0 Operation of the EUT during Testing**

### **2.1 General**

#### **Climatic Environment**

The following were the ambient conditions in the laboratory during testing:

Temperature:  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$       Relative Humidity  $50\% \pm 10\% \text{ RH}$

#### **Selection of AC Power Voltage/Frequencies**

The radiated and conducted emissions tests were performed with the EUT operating at 120 Vac / 60Hz. The Frequency Tolerance Test was performed at 120 Vac / 60 Hz. and 240 Vac / 60 Hz.

### **2.2 Operating Mode**

The laptop will send the serial command R050004 to the RFR-02, which will put the unit into continuous read mode. An RFID transponder (tag) with know data contents will be placed approx 3 to 4 inches above antenna 1. The RFR-02 will constantly send tag data back to the laptop via the serial port while the tag is being read by antenna 1. The RFR-02 also operates in dual antenna mode. Two antenna are alternately energized to read tags with 1 second dwell time.

### **2.3 Rationale for the Chosen Mode of Operation**

Continuous read mode will show any disruptions in reading of tags and will also cause the continuous creation of side bands caused by tag and reader. Tag data will be continuously sent to the laptop PC for monitoring purposes

### **3.0 Applicable Requirements, Methods and Procedures**

The results of the measurement of the radio disturbance characteristics of the EUT described herein may be applied, and where appropriate provide a presumption of compliance to one or more of the following requirements or to other requirement at the discretion of the client, regulatory agencies, or other entities.

47 CFR, Part 15, Subpart C, "Intentional Radiators"

#### **Basic Test Methods and Procedures**

The applicable regulatory product family or generic standards require that radio disturbance/interference and immunity tests be performed in accordance with the following:

ANSI C63.4, 2003 "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz".

CISPR 22: 1993, A1/1995, A2/1996 "Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment."

#### **Deviations or Exclusions from the Requirements and Standards**

There were no deviations or exclusions from the specified requirements and standards.

### **4.0 Test Results**

#### **4.1 Radiated Emissions (FCC 15.209, 15.225(a)-(d))**

<b>Test Standard:</b>	USA: 47 CFR Part 15 C
<b>Frequency Range:</b>	9 kHz to 1000 MHz
<b>Test Distances:</b>	3 and 30 Meters
<b>Antenna Polarity and Height:</b>	1.705 MHz – 30 MHz: Three orthogonal axes @ 1 meter 30MHz-1 GHz: Vertical and Horizontal @ 1 to 4 Meters
<b>AC Power:</b>	120 Vac, 60 Hz
<b>EUT Type:</b>	Table Top
<b>Highest Oscillator Frequency:</b>	20 MHz
<b>Measurement Uncertainty:</b>	5.0 dB (CISPR 16-4: 2002)
<b>Field Strength Calculations:</b>	Field Strength (dBμV/m) = meter reading (dBμV) + antenna factor (dB/m)+ Cable Loss (dB)



#### 4.1.1 Radiated Emissions Test Results (5/2/05)

##### Radiated Emissions 9 kHz – 30 MHz (FCC 15.225(a)(d))

The RFR-02 was measured with each of the three types of antennae configurations. The antennae were placed in three positions for measurement: standing vertically, standing horizontally and lying horizontally on the table. The following tables show the emissions obtained for each of the antennae in the two positions producing the highest emissions. The RFR-02 did not show higher emissions while operating in dual mode with any combination of antennae.

##### **RFR-02 with RFA-02 (Antenna standing vertically)**

Frequency (MHz)	Signal Type	Antenna Polarity	Turn-table Azimuth	Measured Level QP (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	$\Delta$
13.56	Fundamental	Vert O	269	49.8	17.60	0.50	67.90	84.00	-16.10
		Vert	272	30.4			48.50		-35.50
		Horiz -	283	31.5			49.60		-34.40
27.12	2nd Harmonic	Vert O	138	9.56	17.55	0.80	27.91	29.54	-1.63
		Vert	0	3.85			22.20		-7.34
		Horiz -	0	3.85			22.20		-7.34

##### **RFR-02 with RFA-02 (Antenna laying horizontally)**

13.56	Fundamental	Vert O	348	46.4	17.60	0.50	64.50	84.00	-19.50
		Vert	350	31.65			49.75		-34.25
		Horiz -	344	29.88			47.98		-36.02
27.12	2nd Harmonic	Vert O	96	9.65	17.55	0.80	28.00	29.54	-1.54
		Vert	0	3.85			22.20		-7.34
		Horiz -	0	3.85			22.20		-7.34

##### **RFR-02 with RFA-02-2 (Antenna standing vertically)**

13.56	Fundamental	Vert O	279	50.73	17.60	0.50	68.83	84.00	-15.17
		Vert	169	42			60.10		-23.90
		Horiz -	89.5	38.54			56.64		-27.36
27.12	2nd Harmonic	Vert O	166	5.25	17.55	0.80	23.60	29.54	-5.94
		Vert	0	3.85			22.20		-7.34
		Horiz -	0	3.85			22.20		-7.34

**RFR-02 with RFA-02-2 (Antenna laying horizontally)**

Frequency (MHz)	Signal Type	Antenna Polarity	Turn-table Azimuth	Measured Level QP (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	$\Delta$
13.56	Fundamental	Vert O	328	31.3	17.60	0.50	49.40	84.00	-34.60
		Vert	309	23.85			41.95		-42.05
		Horiz -	310	20.9			39.00		-45.00
27.12	2nd Harmonic	Vert O	290	4.7	17.55	0.80	23.05	29.54	-6.49
		Vert	0	3.85			22.20		-7.34
		Horiz -	0	3.85			22.20		-7.34

**RFR-02 with RFA-02-3 (Antenna standing vertically)**

13.56	Fundamental	Vert O	278	47.5	17.60	0.50	65.60	84.00	-18.40
		Vert	336	31.7			49.80		-34.20
		Horiz -	280	26.88			44.98		-39.02
27.12	2nd Harmonic	Vert O	0	3.05	17.55	0.80	21.40	29.54	-8.14
		Vert	0	2.65			21.00		-8.54
		Horiz -	0	3.05			21.40		-8.14

**RFR-02 with RFA-02-3 (Antenna standing horizontally)**

13.56	Fundamental	Vert O	86	47.5	17.60	0.50	65.60	84.00	-18.40
		Vert	178	34.13			52.23		-31.77
		Horiz -	83	28.4			46.50		-37.50
27.12	2nd Harmonic	Vert O	0	3.05	17.55	0.80	21.40	29.54	-8.14
		Vert	0	3.05			21.40		-8.14
		Horiz -	0	3.05			21.40		-8.14

Measurement Distance is 30 meters. “Vert O” is antenna loop parallel to measurement line, “Vert |” is loop perpendicular to measurement line,

**Overall Results:** The RFR-02, with the three antenna types, complies with the specified limits. There were no other emissions between 9 kHz and 30 MHz, from the EUT, measurable at 30 meters. Adding antenna cable extension did not change emission levels.

**Spurious Emissions: 30 MHz - 1000 MHz (FCC 15.209)**

The tables below show the highest amplitude quasi-peak detected field strengths of spurious emissions measured from the EUT over the frequency range from 30 MHz to 1000 MHz, at a distance of 3 meters compared to the maximum permissible 47 CFR Part 15C limit at 3 meters. Measurements were made with the RFR-02 antenna standing vertically, horizontally and laying horizontally; the EUT position, resulting in the highest emissions, is reported below. The last table shows the only emission that increased with two antennae operating in dual mode.

**RFR-02 with RFA-02**

Freq [MHz]	Pk [dBmV/m]	Q-Pk [dBmV/m]	Pol	Angle [deg]	Ht [cm]	CF [dB]	Limit [dBmV/m]	Delta [dB]
40.671	34.3	28.21	V	201	100	16.94	40	-11.79
67.808	33.53	26.43	V	191	104	9.23	40	-13.57
94.918	38.58	28.06	V	14	400	10.28	43.5	-15.44
122.031	24.8	22.95	V	312	100	12.41	43.5	-20.55
149.154	28.17	19.97	V	4	101	10.19	43.5	-23.53
162.719	22.7	19.46	H	203	176	10.46	43.5	-24.04

**RFR-02 with RFA-02-2**

40.671	42.75	34.21	V	356	122	16.94	40	-5.79
67.808	36.02	27.1	V	191	103	9.23	40	-12.9
94.918	39.58	28.12	V	164	400	10.28	43.5	-15.38
149.154	27.87	13.79	H	184	207	10.19	43.5	-29.71
162.723	29.87	26.23	H	346	177	10.46	43.5	-17.27
176.283	26.94	22.98	H	343	154	11.23	43.5	-20.52

**RFR-02 with RFA-02-3**

40.671	35.5	29.47	V	87	100	16.94	40	-10.53
67.808	37.8	29.55	V	101	100	9.23	40	-10.45
122.035	38.18	20.06	V	207	105	12.41	43.5	-23.44
162.719	30.08	27.07	V	203	100	10.46	43.5	-16.43
189.843	37.09	28.09	V	17	396	11.91	43.5	-15.41
216.962	22.34	15.45	V	172	164	13.19	46	-30.55

The following table shows the third harmonic emission with two antennae connected to the RFR-02 operating in dual mode. The fundamental and other harmonic emissions were unchanged with RFR-02 operating in dual mode.

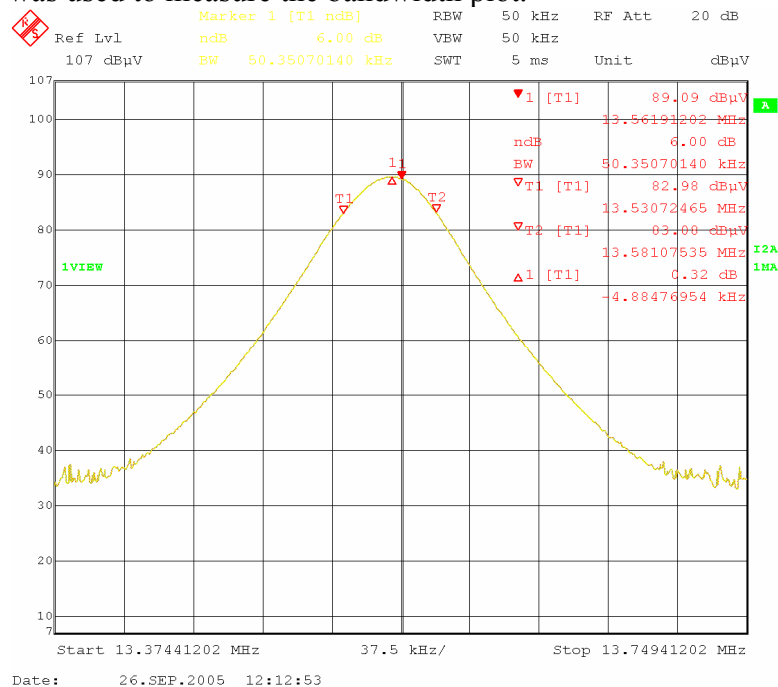
**RFR-02 with RFA-02-2 and RFA-02-3**

40.671	39.25	35.57	V	321	100	16.94	40	-4.43
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**Overall Results:** All radiated emissions are recorded at a various distances from the RFR-02 are below the specified limits. There were no other emissions above 30 MHz detected from the EUT. Adding antenna cable extension did not change emission levels.

#### 4.1.2 Occupied Bandwidth (9/26/05)

The 6-dB bandwidth plot for the RFR-02 is shown below to demonstrate compliance to the requirements of 47 CFR Part 15.225 (b) and (c). A close field probe, placed in close proximity to the EUT antenna, was used to measure the bandwidth plot.



**Overall Results:** The bandwidth plot of the RFR-02 shows that the carrier signal is more than 50 dB down from the peak below 13.410 MHz and above 13.710. Applying this drop to the maximum fundamental signal strength of 68.83 dBμV/m (2764 μV/m), at 30 meters, results in a level of less than 20 dBμV/m (10 μV/m). This level is below the requirement of 50.47 dBμV/m (334 μV/m) within the bands of 13.410 – 13.553 MHz and 13.567 – 13.710 MHz. Also this level is below the requirement of 29.54 dBμV/m (30 μV/m) within the bands of 13.110 - 13.410 MHz and 13.710 – 14.010 MHz.

**Test Setup Photos**



RFR-02 w/RFA-02 Radiated Emissions Test Setup



RFR-02 w/RFA-02-2 Radiated Emissions Test Setup



RFR-02 w/RFA-02-3 Radiated Emissions Test Setup



**4.2 Conducted Emissions (FCC 15.207)**

<b>Test Standard:</b>	USA: 47 CFR Part 15 C
<b>Frequency Range:</b>	150kHz to 30 MHz
<b>AC Power:</b>	120 Vac, 60 Hz
<b>EUT Type:</b>	Table Top
<b>Highest Oscillator Frequency:</b>	20 MHz
<b>Measurement Uncertainty:</b>	3.6 dB (CISPR 16-4: 2002)
<b>Conducted Emission Calculation:</b>	Peak Emission (dBuV Peak) = Meter reading (dBuV) + cable loss (dB) + Limiter loss (dB)

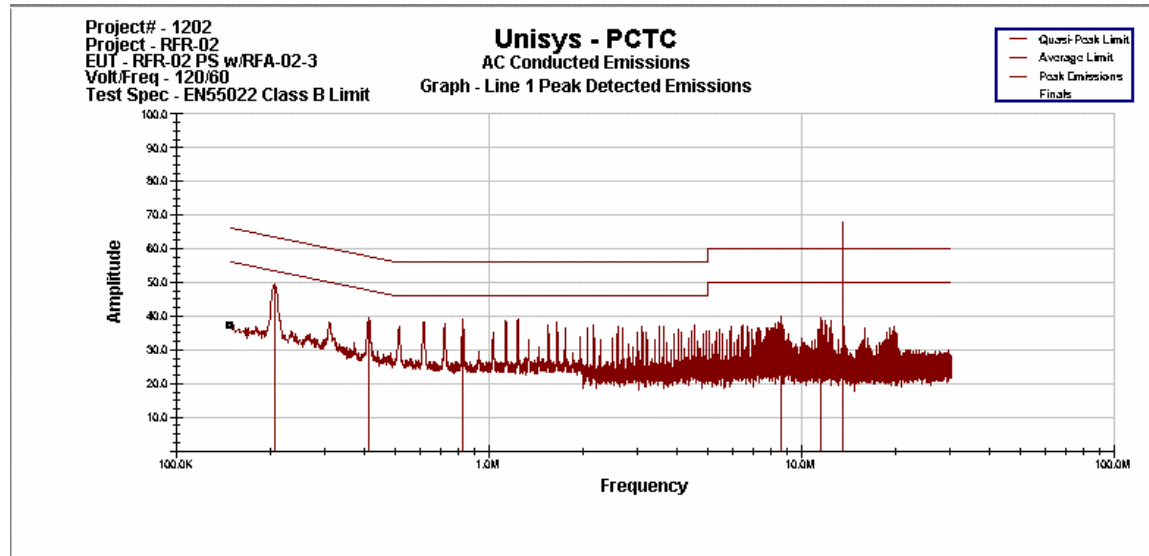
**4.2.1 Conducted Emission Test Results (5/20, 8/31 & 9/13/05)**

The conducted emissions recorded on the EUT AC power cord (s), displayed against the limits for CISPR 22 Class B devices are presented on the following pages. Conducted emission amplitudes (dBuV PK), measured with a peak detector, are compared with CISPR 22 Class B average limit and displayed on the graph. Where the measured peak detector emission exceeded the average limit, or found to be within 1 dB of average limit, re-measurement using quasi-peak and average detector functions was made. The re-measured emissions are presented in a table below the appropriate table of peak detector emissions, which displays quasi-peak measurements vs. the quasi-peak limit and the average measurements vs. the average limit.

The graphs and tables on the following pages, show the conducted emissions of the RFR-02 with an antenna attached to the EUT. The emission at 13.56 MHz, the carrier frequency, exceeds the limit. The antenna port was then connected to a 50-ohm terminator. The conducted emissions were re-measured and show compliance. The test was repeated with the RFR-02 operating in dual-antenna mode.

## Conducted Emission Test Results

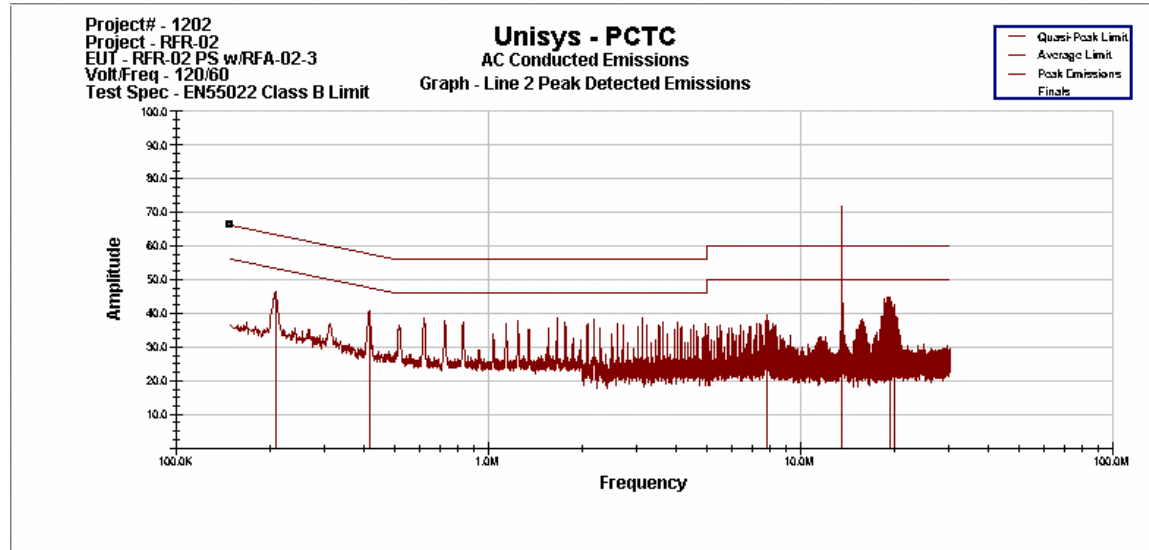
**RFR-02 with RFR-02-3 antenna attached to Antenna Port 1, 120Vac/60 Hz, Neutral Line**



**Unisys - PCTC**  
**Line 1 Conducted Emissions**  
 03:03:39 PM, Friday, May 20, 2005

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
206.000 KHz	36.46	54.40	-17.94	47.90	64.40	-16.50	11.494
413.000 KHz	37.80	48.49	-10.68	38.64	58.49	-19.85	10.507
825.000 KHz	34.54	46.00	-11.46	36.75	56.00	-19.25	10.240
8.564 MHz	16.67	50.00	-33.33	24.77	60.00	-35.23	10.234
11.574 MHz	18.10	50.00	-31.90	24.55	60.00	-35.45	10.291
13.559 MHz	67.52	50.00	17.52	67.82	60.00	7.82	10.331
Project# - 1202							
Project - RFR-02							
EUT - RFR-02 PS w/RFA-02-3							
Volt/Freq - 120/60							
Test Spec - EN55022 Class B Limit							

**RFR-02 with RFR-02-3 antenna attached to Antenna Port 1, 120Vac/60 Hz, Phase Line**

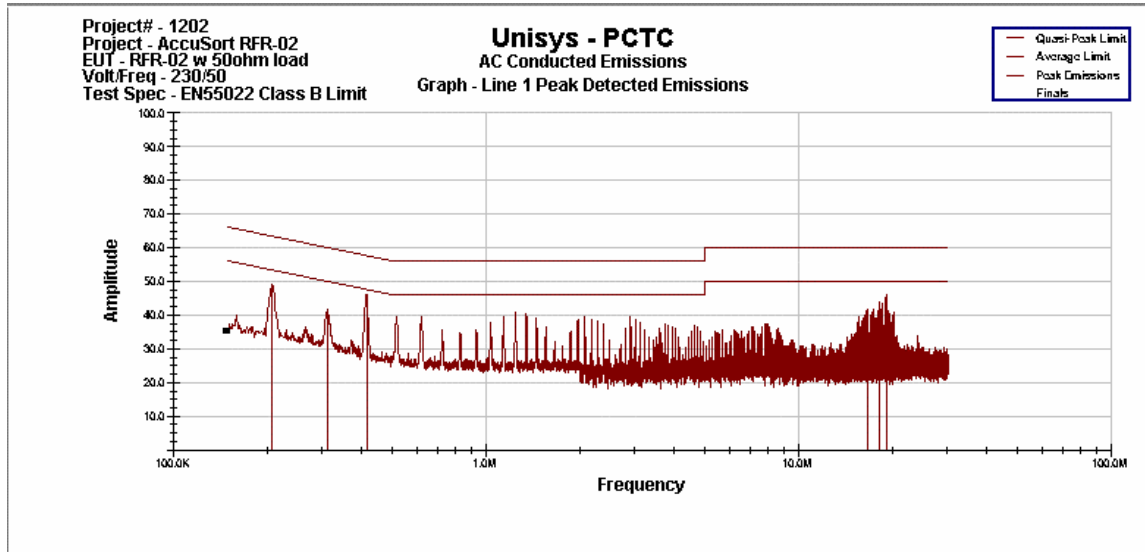


Unisys - PCTC  
 Line 2 Conducted Emissions  
 03:26:01 PM, Friday, May 20, 2005

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
208.000 KHz	38.167	54.343	-16.176	43.570	64.343	-20.773	11.459
415.000 KHz	38.922	48.429	-9.507	39.948	58.429	-18.481	10.505
7.786 MHz	32.851	50.000	-17.149	36.092	60.000	-23.908	10.220
13.559 MHz	71.543	50.000	21.543	71.854	60.000	11.854	10.331
19.414 MHz	24.140	50.000	-25.860	40.500	60.000	-19.500	10.537
19.931 MHz	21.798	50.000	-28.202	38.038	60.000	-21.962	10.557
Project# - 1202							
Project - RFR-02							
EUT - RFR-02 PS w/RFA-02-3							
Volt/Freq - 120/60							
Test Spec - EN55022 Class B Limit							



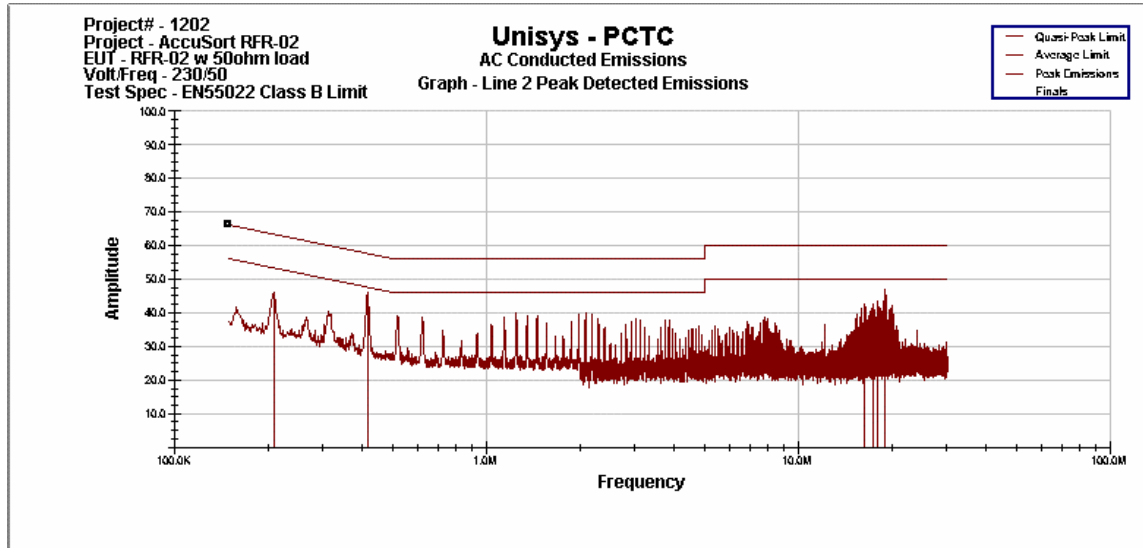
**RFA-02, Single Antenna Mode (50-ohm load), 120Vac/60 Hz, Neutral Line**



**Unisys - PCTC**  
**Line 1 Conducted Emissions**  
 12:56:32 PM, Wednesday, August 31, 2005

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
207.000 KHz	37.58	54.37	-16.79	46.72	64.37	-17.65	11.477
311.000 KHz	35.62	51.40	-15.78	39.02	61.40	-22.38	10.556
415.000 KHz	44.70	48.43	-3.73	45.26	58.43	-13.17	10.505
16.590 MHz	16.50	50.00	-33.50	21.30	60.00	-38.70	10.424
18.140 MHz	16.62	50.00	-33.38	21.36	60.00	-38.64	10.486
19.073 MHz	16.89	50.00	-33.11	21.81	60.00	-38.19	10.523
Project# - 1202							
Project - AccuSort RFR-02							
EUT - RFR-02 w 50ohm load							
Volt/Freq - 230/50							
Test Spec - EN55022 Class B Limit							

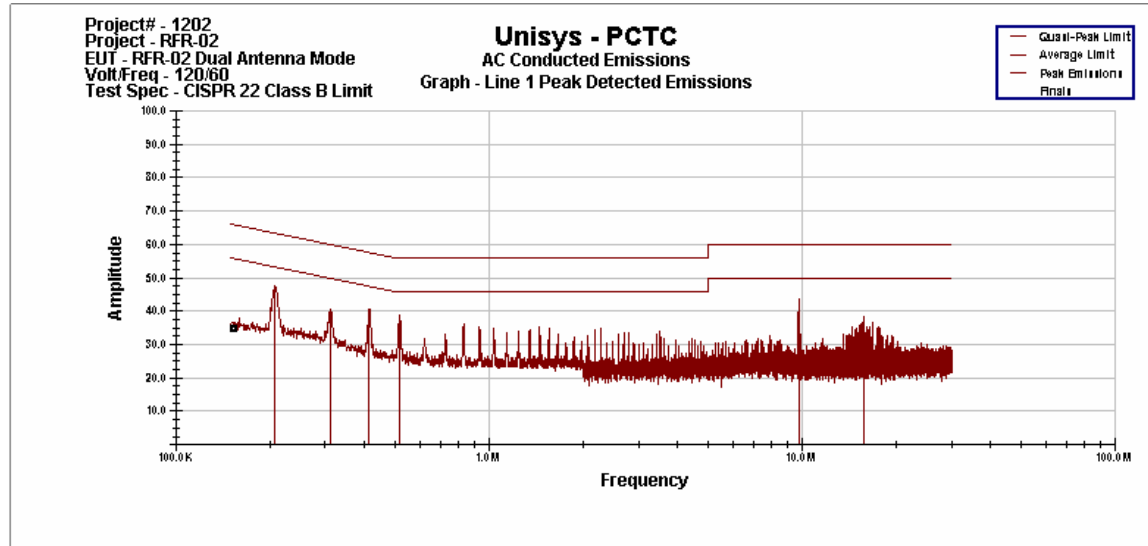
**RFA-02, Single Antenna Mode (50-ohm load), 120Vac/60 Hz, Phase Line**



Unisys - PCTC  
 Line 2 Conducted Emissions  
 01:01:58 PM, Wednesday, August 31, 2005

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
208.000 KHz	39.045	54.343	-15.297	42.663	64.343	-21.680	11.459
416.000 KHz	45.062	48.400	-3.338	45.670	58.400	-12.730	10.504
16.319 MHz	19.312	50.000	-30.688	34.402	60.000	-25.598	10.413
17.357 MHz	17.415	50.000	-32.585	24.992	60.000	-35.008	10.454
17.981 MHz	17.904	50.000	-32.096	25.284	60.000	-34.716	10.479
19.020 MHz	17.508	50.000	-32.492	24.783	60.000	-35.217	10.521
Project# - 1202							
Project - AccuSort RFR-02							
EUT - RFR-02 w 50ohm load							
Volt/Freq - 230/50							
Test Spec - EN55022 Class B Limit							

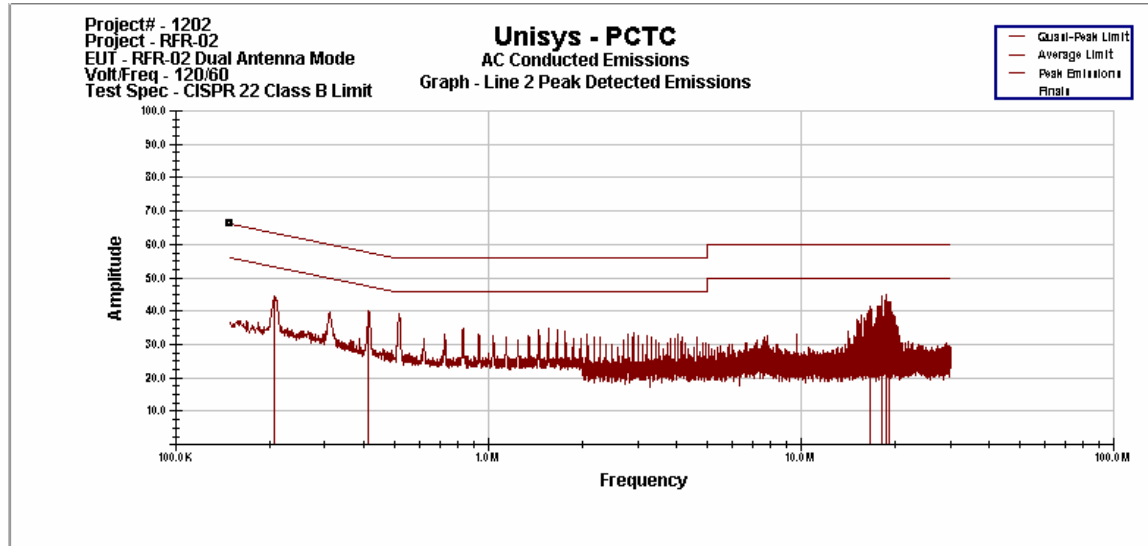
**RFA-02, Dual Antenna Mode (50-ohm loads), 120Vac/60 Hz, Neutral Line**



Unisys - PCTC  
 Line 1 Conducted Emissions  
 09:42:25 AM, Tuesday, September 13, 2005

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
207.000 KHz	36.07	54.37	-18.30	45.74	64.37	-18.63	11.477
310.000 KHz	34.51	51.43	-16.92	38.04	61.43	-23.39	10.556
414.000 KHz	37.84	48.46	-10.62	39.75	58.46	-18.71	10.506
518.000 KHz	37.15	46.00	-8.85	38.21	56.00	-17.79	10.426
9.839 MHz	25.12	50.00	-24.88	28.32	60.00	-31.68	10.257
15.743 MHz	21.53	50.00	-28.47	34.38	60.00	-25.62	10.390
Project# - 1202							
Project - RFR-02							
EUT - RFR-02 Dual Antenna Mode							
Volt/Freq - 120/60							
Test Spec - CISPR 22 Class B Limit							

**RFA-02, Dual Antenna Mode (50-ohm loads), 120Vac/60 Hz, Phase Line**



Unisys - PCTC  
 Line 2 Conducted Emissions  
 09:47:57 AM, Tuesday, September 13, 2005

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
207.000 KHz	37.196	54.371	-17.175	42.061	64.371	-22.310	11.477
414.000 KHz	37.974	48.457	-10.483	39.184	58.457	-19.273	10.506
16.700 MHz	16.837	50.000	-33.163	30.131	60.000	-29.869	10.428
18.034 MHz	22.856	50.000	-27.144	40.259	60.000	-19.741	10.481
18.667 MHz	18.811	50.000	-31.189	29.905	60.000	-30.095	10.507
19.176 MHz	22.462	50.000	-27.538	41.112	60.000	-18.888	10.527
Project# - 1202							
Project - RFR-02							
EUT - RFR-02 Dual Antenna Mode							
Volt/Freq - 120/60							
Test Spec - CISPR 22 Class B Limit							

**Overall Results:** The conducted emissions of the RFR-02, with the antenna output(s) terminated into 50-ohms, are compliant to the specified limit.

**Conducted Emissions Test Setup**

RFR-02 with 50-ohm termination on antennae output

### 4.3 Frequency Tolerance (FCC 15.225(e))

#### 4.3.1 Frequency Tolerance Test Results (5/6/05)

The RFR-02 was tested for frequency tolerance of the carrier signal. A single configuration, with the RFA-02-3 antenna, was tested. The following tables show the carrier signal frequency at nominal temperature and then at temperature extremes of  $-20^{\circ}\text{C}$  and  $50^{\circ}\text{C}$ . Also, tables show the carrier at low (120 Vac) and high (240 Vac) nominal voltages and then 85% and 115 % of low and high nominal voltages.

#### Frequency Variation

23°C

Elapsed Time (minutes)	Frequency (Hz)	Deviation (Hz)	Deviation %
0	13,559,958.0	0.0	
2	13,559,955.0	-3.0	0.00002
5	13,559,964.4	6.4	0.00005
10	13,559,966.5	8.5	0.00006

50°C

0	13,559,970.5	0.0	
2	13,559,944.1	-26.4	0.00019
5	13,559,952.3	-18.2	0.00013
10	13,559,958.5	-12.0	0.00009

-20°C

0	13,559,906.6	0.0	
2	13,559,912.8	6.2	0.00005
5	13,559,914.2	7.6	0.00006
10	13,559,916.1	9.5	0.00007

### Voltage Variation

120 Vac / 60 Hz

Elapsed Time (minutes)	Frequency (Hz)	Deviation (Hz)	Deviation %
0	13,559,967.4	0.0	
2	13,559,965.8	-1.6	0.00001
5	13,559,965.4	-2.0	0.00001
10	13,559,961.6	-5.8	0.00004

240 Vac / 60 Hz

Elapsed Time (minutes)	Frequency (Hz)	Deviation (Hz)	Deviation %
0	13,559,960.8	0.0	
2	13,559,959.0	-1.8	0.00001
5	13,559,959.2	-1.6	0.00001
10	13,559,958.8	-2.0	0.00001

102 Vac / 60 Hz

0	13,559,970.8	0.0	
2	13,559,965.8	-5.0	0.00004
5	13,559,965.8	-5.0	0.00004
10	13,559,966.6	-4.2	0.00003

276 Vac / 60 Hz

0	13,559,962.4	0.0	
2	13,559,959.6	-2.8	0.00002
5	13,559,957.8	-4.6	0.00003
10	13,559,956.6	-5.8	0.00004

138 Vac / 60 Hz

0	13,559,969.6	0.0	
2	13,559,965.4	-4.2	0.00003
5	13,559,965.8	-3.8	0.00003
10	13,559,965.4	-4.2	0.00003

204 Vac / 60 Hz

0	13,559,956.0	0.0	
2	13,559,955.4	-0.6	0.00000
5	13,559,954.8	-1.2	0.00001
10	13,559,953.8	-2.2	0.00002

**Overall Results:** The EUT exhibited slight frequency change (up to 5.8 Hz), at ambient conditions as shown in the above tables. The RFR-02 operated with less than 0.01% variation in operating frequency during temperature and voltage variations. This complies with the requirements of 47 CFR Part 15.225.

**Appendix A – Test Equipment List****Emission Test Equipment**

<b>Description</b>	<b>Freq Range (Hz)</b>	<b>Model Number</b>	<b>Manufacturer</b>	<b>ID / SN</b>	<b>Last Cal Date</b>
EMI Test Receiver	20 – 40 G	ESIB40	Rohde & Schwarz	C-062	12/7/04
Antenna	25 M – 2 G	LPB-2520/A	ARA	B965	9/27/04
Antenna, Active Loop	1 k – 30 M	6507	EMCO	D-244	4/20/05
Controller, Tower and Turntable	NA	2090	EMCO	B812	NA
EMI Test Receiver	20 – 26.5 G	ESIB26	Rohde & Schwarz	C-232	3/18/05
Filter, Bandpass	0.15 M – 30 M	NA	Unisys	NA	NA
Limiter, Pulse	DC – 30 M	ESH3-Z2	Polarad	NA	NA
LISN	9 k – 30 M	8012-50-R-24-BNC	Chase	U775	9/21/04
Spectrum Analyzer	20 – 22 G	8566B	Hewlett Packard	Y0313	4/11/05
SA Display	NA	Option 462	Hewlett Packard	Y0314	4/11/05
Multi-voltmeter, True RMS	0 – 30 k	8060A	Fluke	X740	7/13/04
Variable Autotransformer	50 – 60	PowerStat 246	Superior Electric Company	V278	NA
Temperature/Humidity Chamber	Temp. Range	SM32C	Thermotron	V733	12/1/04
	-67.8 – 177°C				