HP Roseville Hardware Test Center
8000 Foothills Blvd.
Roseville, CA 95747-5603
916-785-5509

WORK ORDER NUMBER(S) 20669

TEST NAME ..... RADIO INTERFERENCE
REGULATION/STANDARD ..... **FCC Class B, 47 CFR 15.107, 109, 207, & 209**
HP TEST SECTION ..... N/A

DATE(S) TEST PERFORMED ... Aug 25, 1999

PROJECT NAME(S) ..... RF 350
MODEL NUMBER(S) P088-200-01
SERIAL NUMBER(S) ..... 021-821-752 & 748

CLIENT NAME ..... JEFF BROWER
CLIENT DIVISION ..... VASD
CLIENT ADDRESS ..... 3755 Atherton Road, Rocklin, Ca. 95765-3701

TECHNICIAN(S) ..... Doug Frederick/Ken Hall

RECORD AUTHOR ..... Doug Frederick

TESTED BY:

TESTED BY: _____
Name Date

ACCREDITED

COMPANY CONFIDENTIAL

TEST OBJECTIVE/PURPOSE:

1. To determine if the EUT meets the radio disturbance levels (emissions) established by FCC Class & Band emission limits for intentional radiators,15.207 and 15.209.

2. To determine if the EUT meets the frequency stability requirements of part 15.225 “Operation within the band 13.553-13.567 MHz”.

RESULTS :

The EUT(s) **met** the FCC Class B emission requirements and FCC part 15 Intentional Radiator Requirements.

Conducted disturbance passed by 5.2 dB 120V/60Hz.
Radiated disturbance passed by 2.2 dB.
Radiated disturbance within the 13.553-13.567 MHz band passed by 34.1 dB.

OPERATIONAL CONDITIONS:

During the product development evaluation phases worst case emission conditions using different card configurations, module location and cable placement are evaluated. Once determined the defined configuration and cable placement is used throughout the testing process.

TEST DESCRIPTION/PROCEDURE:

Conducted disturbance at the mains ports

OVERVIEW: This test uses the spectrum analyzer to measure the interference voltage over the frequency range specified by the regulatory agency on the EUTs supply mains leads. For this test the spectrum analyzer is connected to the Line Impedance Stabilization Network (LISN), which is inserted in the EUTs supply mains leads. The LISN is connected to line voltage for 120/208V 60 Hz testing and an AC Power Source for 240V 50 HZ testing. This test is outlined in detail in the RHTCs Supplemental Test Procedure 765.008TC1.

TEST Outline:

Scanned LINE and NEUTRAL, performed QP and AVG on highest signals. For table-top products a portable vertical wall is used for measuring emission for CISPR 22 and CNS 13438.

Radiated disturbance

OVERVIEW: This test measures the radiated emissions of products from 30MHz to 1000MHz, as required, using the spectrum analyzer with a broadband receiving antenna and a Double Ridged Waveguide Horn antenna as required.. This test was performed entirely in a 10 M Semi-Anechoic Chamber that meets the Normalized Site Attenuation specifications of ANSI C63.4. The emission levels were measured on 8 sides in vertical and horizontal antenna polarities.

As a minimum, all peak frequency emissions within 6 dB of the limit were maximized using the turntable/antenna positioners then measured using the required detector (QP or AVG).

This test is outlined in detail in the RHTCs SUPPLEMENTAL TEST MANUAL 765.009TC3.

TEST Outline:
Placed the EUT on the turntable, then performed the prescan and final tests using the Radiated Emissions (RE) software.

Stability tests 15.225(c) & 15.31(e)

Overview: This test measures either the change in fundamental frequency or transmitted power while varying either the temperature or line voltage.

TEST Outline:
For frequency stability over temperature the EUT is placed in a temperature controlled chamber, the fundamental frequency is monitored with a near-field antenna. The frequency is reported for the temperature changes.

For frequency stability over line voltage variations the EUT is connected to a variable line source, the fundamental frequency is monitored with a near-field antenna. The frequency is reported for nominal, 85% and 115% of the rated line voltage.

For amplitude variation over line voltage variations the EUT is connected to a variable line source, the fundamental amplitude is monitored with a near-field antenna. The amplitude is reported for nominal, 85% and 115% of the rated line voltage.

CONDUCTED EMISSIONS DATA – FCC Class B, 47 CFR 15.107 & 15.207

Test Procedure

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Any peaks within 10 dB of the lowest limit are quasi-peaked and averaged.

The peak, quasi-peak, or average information along with the phase being measured for the significant emissions are presented below:

Measured Data

Judgment: Passed

Conducted Emissions summary. Tested at 120VAC/60Hz

Line

Frequency [MHz]	Cable loss	dBuV (corrected)	Detector	Limit	Margin
.4672	10.3	42.5	QP - M	48	-5.5
13.53	11.6	42.5	QP - M	48	-5.5
1.459	10.4	35	QP	48	-13
.911	10.3	33.3	QP	48	-14.7
.900	10.3	32.7	QP	48	-15.3
.873	10.3	32.6	QP	48	-15.4
1.517	10.4	36.1	QP	48	-11.9
1.214	10.3	34.2	QP	48	-13.8
1.143	10.3	29.5	QP	48	-18.5
1.119	10.3	30.8	QP	48	-17.2

Corrected reading equals Spectrum Analyzer Reading + cable loss

Neutral

Frequency [MHz]	Cable loss	dBuV (corrected)	Detector	Limit	Margin
13.589	11.6	42.8	PK	48	-5.2
.4672	10.3	42.5	QP - M	48	-5.5
13.531	11.6	42.5	QP	48	-5.5
1.027	10.3	41.4	PK	48	-6.6
1.041	10.3	41	PK	48	-7
1.091	10.3	40.8	PK	48	-7.2
1.214	10.3	40.7	PK	48	-7.3
1.077	10.3	40	PK	48	-8
13.53	10.3	39.9	AV - M	48	-8.1
2.871	10.6	27.5	QP	48	-20.5

Corrected reading equals Spectrum Analyzer Reading + cable loss

RADIATED EMISSIONS DATA – FCC Class B, 47 CFR 15.109 & 15.209

Test Procedure

The following data lists the significant emission frequencies, measured levels, correction factors (includes cable correction and antenna factors), the corrected reading, plus the limit. Explanation of the Correction Factor is given below. The frequency range investigated was (30MHz to 1000MHz).

Measured Data

Judgment: Passed by 2.2 dB

Frequency [MHz]	Polarity [V/H]	Receiver Reading* [dB(uV)]	Correction Factor** [dB/m]	Corrected Reading [dB(uV/m)]	Margin	*** 10 Meter Limit [dB(uV/m)]
630.02	H	57.0	-23.7	33.3	2.2	35.5
660.03	H	56.7	-24.1	32.6	2.9	35.5
660.02	H	56.1	-24.0	32.1	3.4	35.5
577.52	V	56.3	-24.2	32.1	3.4	35.5
600.02	H	56.2	-24.6	31.6	3.9	35.5
558.77	V	55.1	-24.0	31.1	4.4	35.5
618.77	H	54.8	-24.0	30.8	4.7	35.5
566.28	V	54.7	-24.0	30.7	4.8	35.5
607.53	H	54.7	-24.5	30.2	5.3	35.5
588.76	H	51.8	-24.5	27.3	8.2	35.5

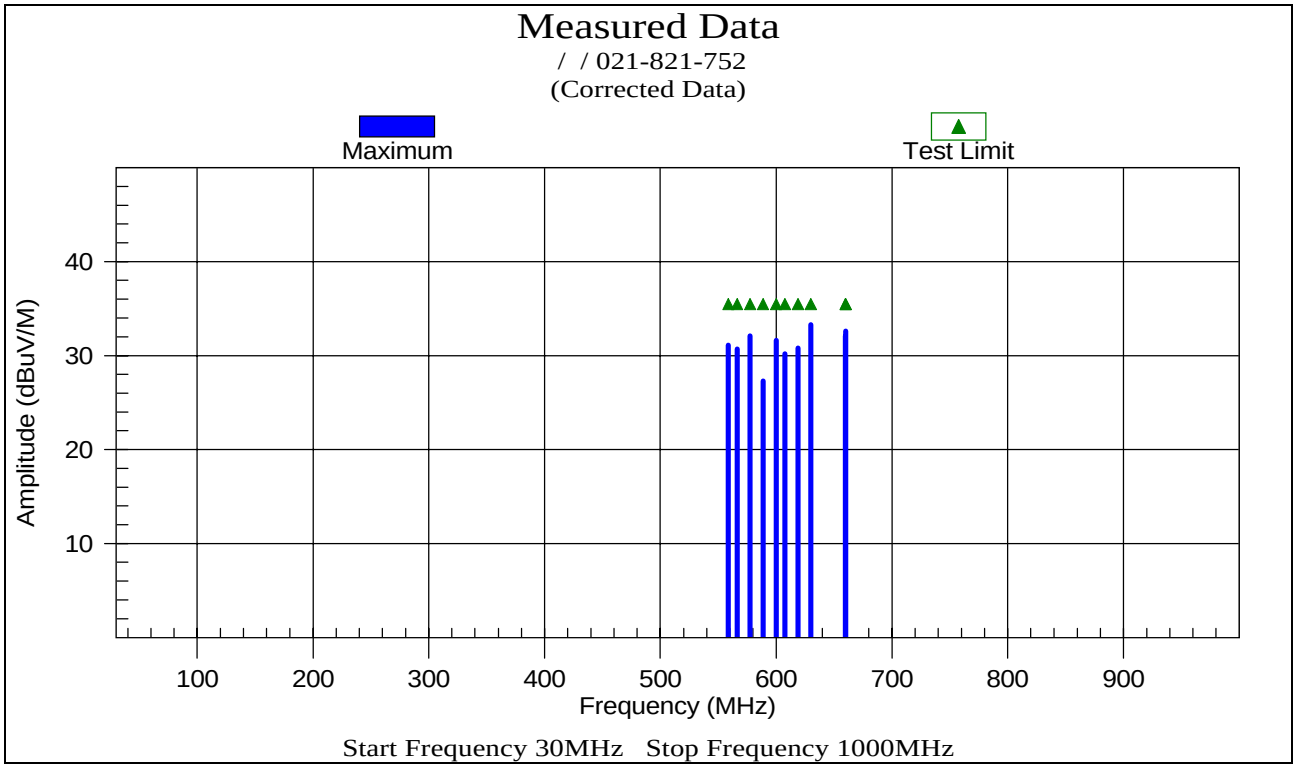
* All readings less than 1000 MHz are quasi-peaked unless stated otherwise, using a QPA bandwidth of 120 kHz, with a 20 mS sweep time. All readings greater than 1000 MHz are averaged unless stated otherwise, using a bandwidth of 1 MHz, with a 20 mS sweep time.

** Correction factor = Antenna factor + cable loss - amplifier gain.

*** 3 Meter limit extrapolated to 10 meters using 20 x Log (3/10)

Data from Column: D:\TEST DATA NEW\20669\RE_RF 350_021-821-752_1_FULL\FINALTEST_FINAL.DAT

Job # File Name (RE_20669_RF 350.DOC)



RADIATED EMISSIONS DATA – FCC, 47 CFR 15.209

Test Procedure

The following data lists the significant emission frequencies, measured levels, correction factors (includes cable correction and antenna factors), the corrected reading, plus the limit. Explanation of the Correction Factor is given below. The frequency range investigated was (0.009 to 30 MHz).

Measured Data

Judgment: Passed by

Frequency [MHz]	Polarity [V/H]	Receiver Reading* [dB(uV)]	Correction Factor** [dB/m]	Corrected Reading [dB(uV/m)]	Margin	*** 10 Meter Limit [dB(uV/m)]
13.53	N/A	29	6	35	13.6	48.6
13.56	N/A	59	6	65	34.1	99.1
27.12	N/A	22	7.5	29.5	19.1	48.6

* All readings were made using a peak detector in a 9 kHz bandwidth.

** Correction factor = Antenna factor + cable loss - amplifier gain.

*** 30 Meter limit extrapolated to 10 meters using 40 x Log (30/10), (CFR 15.31(f))

Additional provisions – FCC 47 CFR 15.225(c)

Frequency Stability over temperature

The following data lists the frequency deviation when temperature was varied.

Measured Data

Judgment: Passed by 701 Hz

Supply voltage 119.9V 60 Hz Date 23 Sept 1999

Time	Delta Time Min	Temperature Degrees C	Frequency MHz	Frequency deviation Hz	Limit Hz (0.01%)
10:12	0	24	13.560330	330	1356
10:50	38	0	13.560605	605	1356
11:18	28	10	13.560535	535	1356
11:55	37	20	13.560455	455	1356
13:09	74	30	13.560365	365	1356
13:35	26	40	13.560290	290	1356
13:59	24	50	13.560225	225	1356
14:30	31	-20	13.560695	695	1356
14:50	20	-20	13.560695	695	1356
15:10	20	-10	13.560680	680	1356
15:36	26	-10	13.560665	665	1356
15:50	14	24	13.560500	500	1356

Frequency Stability over line voltage

The following data lists the frequency deviation when varying the supply voltage.

Measured Data

Judgment: Passed by 942 Hz

Temp: 20 Deg C Humidity : 40% Date 23 Sept 1999

Time	Delta Time Min	Voltage @ 60Hz	Frequency MHz	Frequency deviation Hz	Limit Hz (0.01%)
7:16	0	120	13.560414	414	1356
8:00	44	120	13.560332	332	1356
9:00	60	102 (85%)	13.560329	329	1356
9:42	42	138 (115 %)	13.560303	303	1356
10:00	18	120	13.560308	308	1356

FCC 47 CFR 15.31 (e) Amplitude Stability over line voltage

The following data lists the amplitude variation when varying the supply voltage.

Measured Data

Judgment: No requirement

Temp: 20 C Humidity : 40% Date 1 October 1999

Time	Delta Time Min	Voltage @ 60Hz	Amplitude dBuv	Amplitude variation dB	Limit Hz
5:45	0	120	63.7	0	None
7:05	80	120	63.5	-0.2	None
8:00	55	102 (85%)	63.5	-0.2	None
9:42	102	138 (115 %)	63.6	-0.1	None
10:40	58	120	63.6	-0.1	None

COMMENTS: None.

EQUIPMENT UNDER TEST DESCRIPTION/SYSTEM CONFIGURATION Emissions:

Project Name	RF 350
Model Number	P088-200-01
Serial Number	021-821-752 & 021-821-748
EUT Description	Contactless smart card with Everest
System Configuration	EUT on turn-table connected to Everest. Connected to lap top in basement by Everest cable. Sending serial data up and down between EUT and lap-top. EUT powered by LISN 1.
Software/Firmware	BUSYSCI.OUT
Verification Method	DISPLAY
Test Parameters	120 Volts AC @ 60 Hz,1-Phase Power, 21.7 Deg C,44.0 % RH,100.5 kPa

EQUIPMENT UNDER TEST DESCRIPTION/SYSTEM CONFIGURATION Stability:

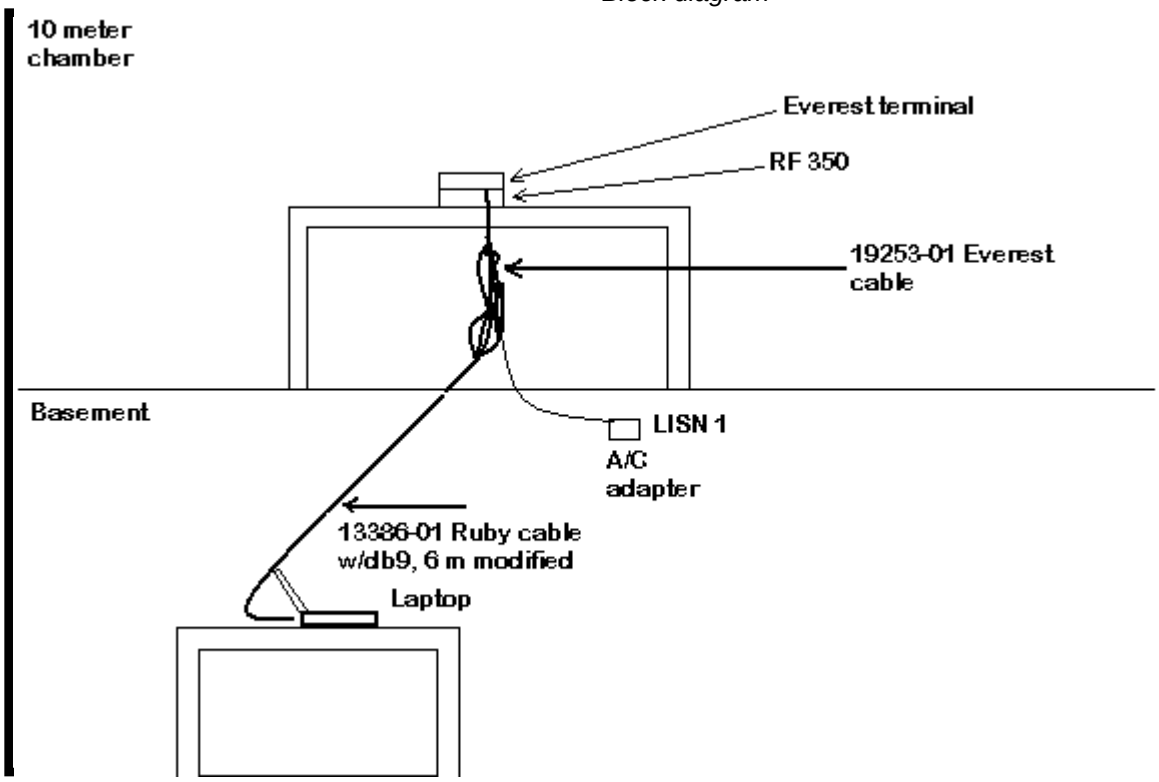
Project Name	RF 350
Model Number	P088-200-01
Serial Number	021-821-748
EUT Description	Contactless smart card with Everest
System Configuration	EUT on connected to Everest. Continous transmit cycle
Software/Firmware	None
Verification Method	DISPLAY

EUT Support Equipment:

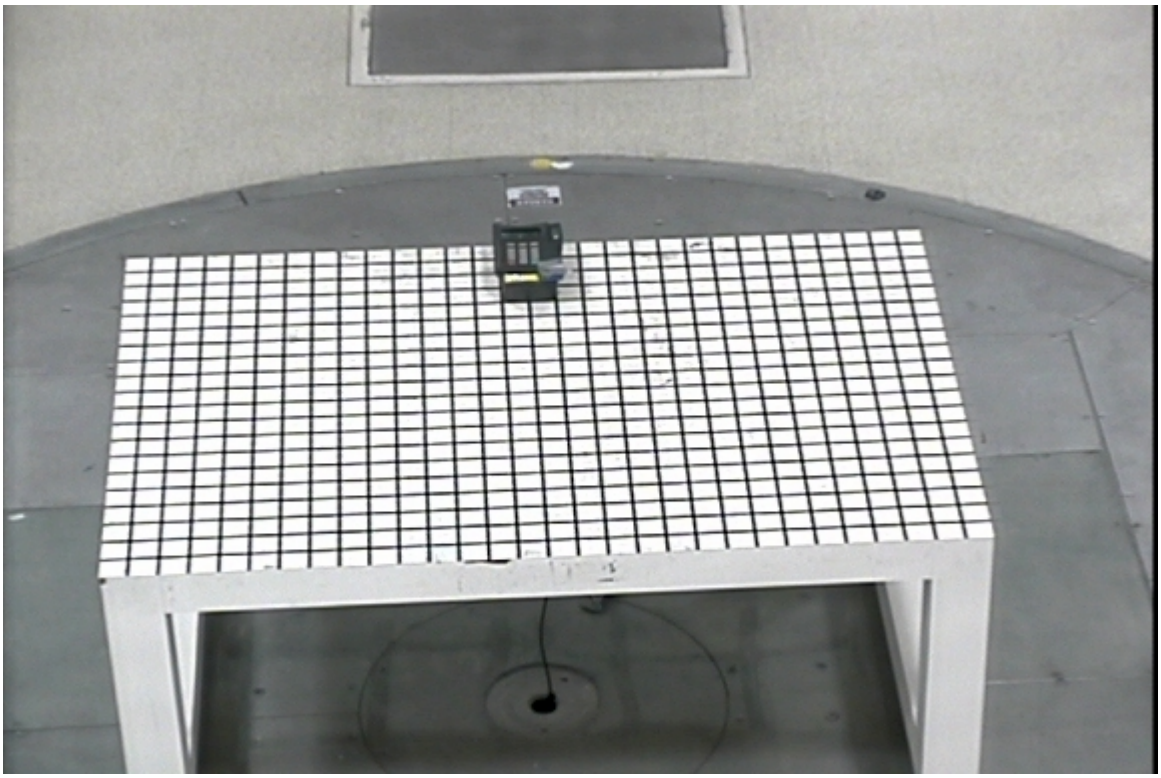
Product	Model	Ser. No.	Description
Data cable	13836-01	na	Ruby cable w/db9, 6 meter modified.
Data	19253-01	na	Everest cable
Power brick	04250-05	na	A/C adapter
Power cable	14781-02	na	Multi-port cable
Toshiba 300CT	PA1263U	Z7456925	Laptop
Verifone	P003-341-04	201-99-036	Everest terminal

EUT/System Diagram Emissions: See block diagram and photos below.

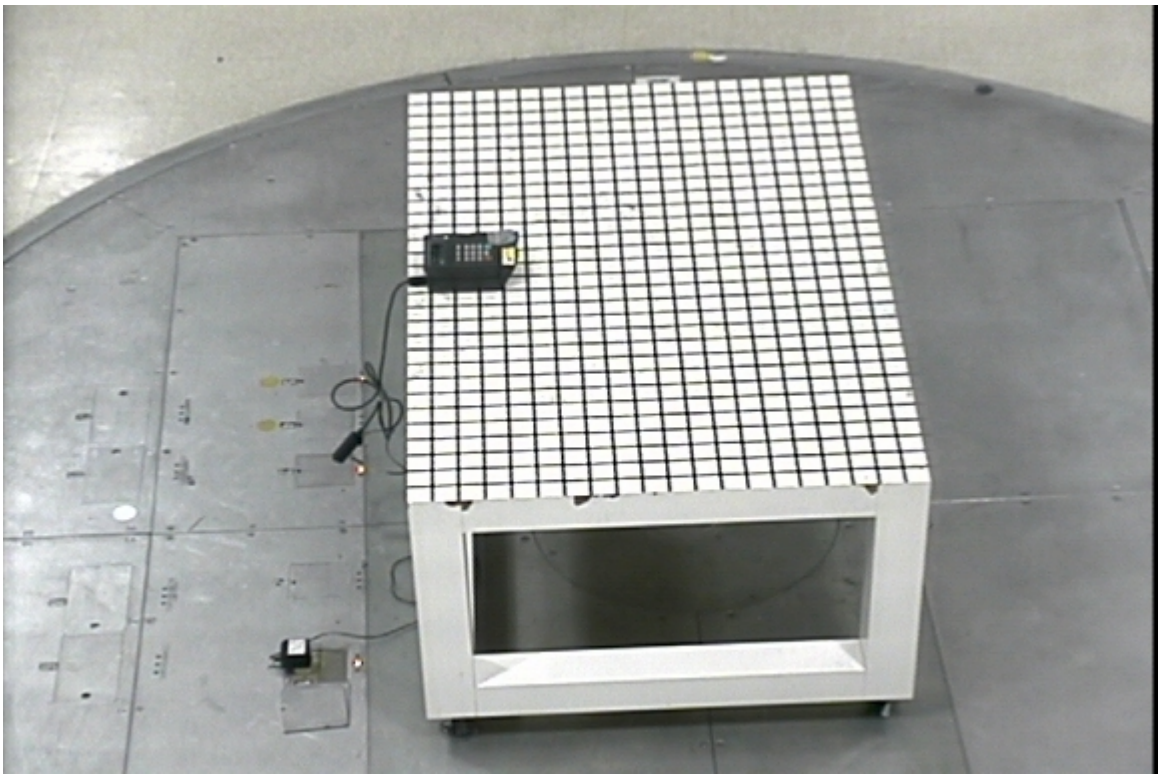
Block diagram



Front view

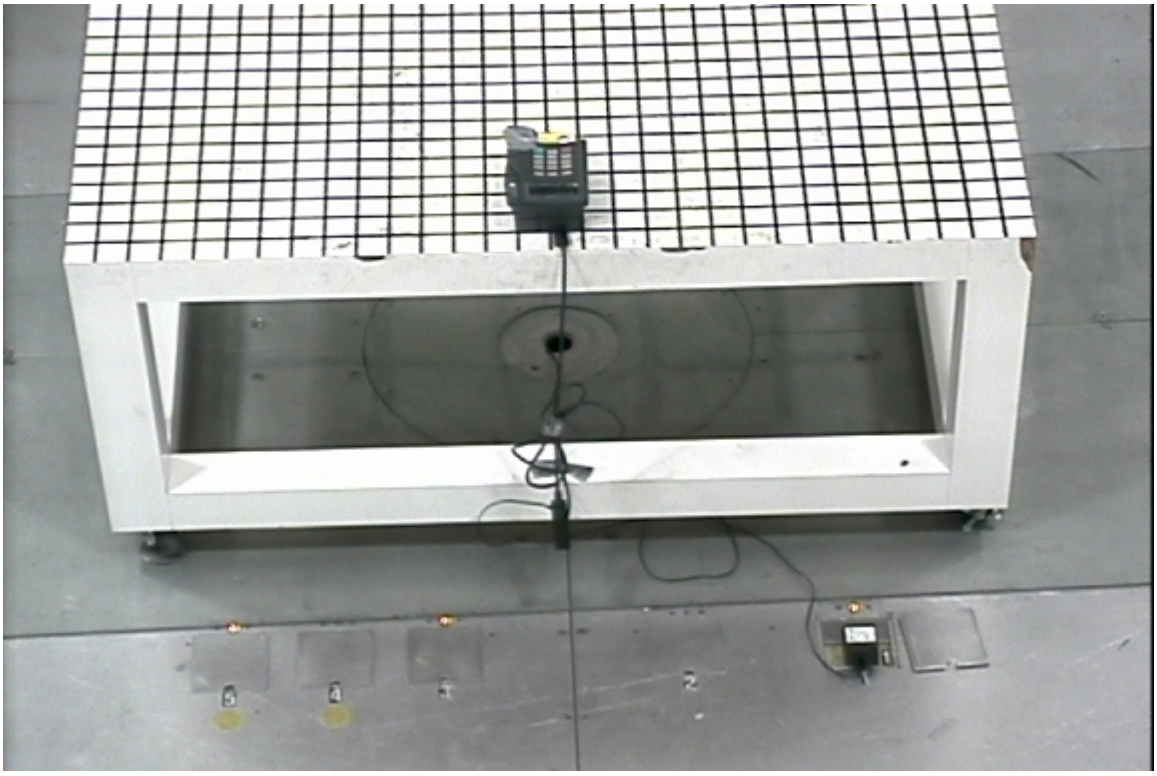


Side view



Rear view close-up

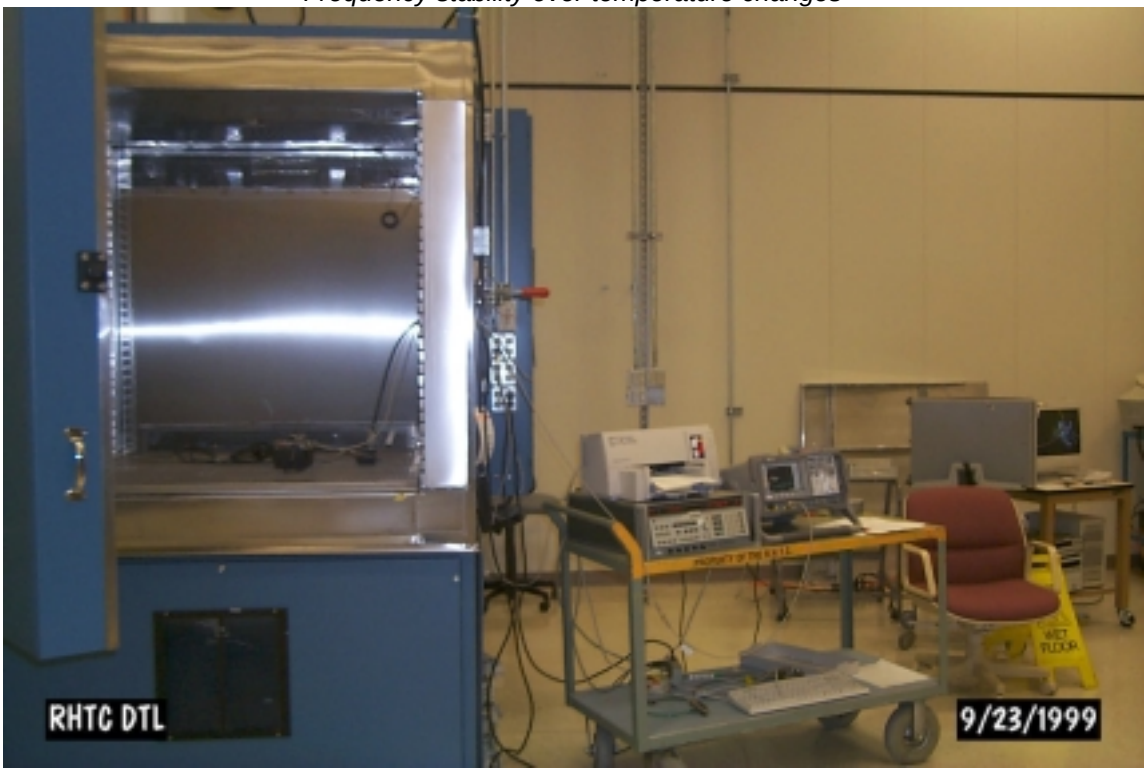
Rear view



Support equipment in basement

Frequency stability supply voltage variation

Frequency stability over temperature changes



RHTC TEST AND MEASUREMENT EQUIPMENT:

Test equipment	Model	Manufacturer	Ser. No.	Cal Due
10 M Radiated				
10 M. Semi-ane. Chamber	None	Lindgren/TDK	None	28 Dec 1999
EMI Receiver	85462A	Hewlett Packard	3441A00213	10March2000
EMI Receiver	85462A	Hewlett Packard	3441A00211	15Jan2000
EMI Receiver Filter Section	85460A	Hewlett Packard	3245A00057	15Jan2000
EMI Receiver Filter Section	85460A	Hewlett Packard	3245A00056	10March2000
Chase Bi-Log Antenna	CBL6112A	Chase	2171 (East)	21Oct99
Chase Bi-Log Antenna	CBL6112A	Chase	2311 (West)	21Oct99
EMCO East Horn antenna	3115	EMCO	4988 (East)	21 Nov.99
EMCO West Horn antenna	3115	EMCO	3877 (West)	21 Nov.99
Active Monopole	3301B	EMCO	92043230	23Aug00
Environmental sensor	ENV-50HUM	SensorMetrics	2	9 Dec 01
10 M Conducted				
Quasi Peak Adapter	85650A	Hewlett Packard	2811A01052	13 March2000
Spectrum Analyzer IF Sec.	85662A	Hewlett Packard	2816A15924	13 March2000
Spectrum Analyzer RF Sec.	85680B	Hewlett Packard	2732A03883	13 March2000
RF Preselector	85685A	Hewlett Packard	2837A00844	13 March2000
Fischer Custom LISN	FCC #1	Fischer Comm.	9515	6March2000
Fischer Custom LISN	FCC #2	Fischer Comm.	9515	6March2000
Fischer Custom LISN	FCC #3	Fischer Comm.	9516	6March2000
Fischer Custom LISN	FCC #4	Fischer Comm.	9516	6March2000
Fischer Custom LISN	FCC #5	Fischer Comm.	9516	6March2000
Fischer Custom LISN	FCC #6	Fischer Comm.	None	6March2000
Fischer Custom LISN	FCC #7	Fischer Comm.	None	6March2000
Fischer Custom LISN	FCC #8	Fischer Comm.	None	6March2000
Fischer Custom LISN	FCC #9	Fischer Comm.	None	6March2000
Conducted Path	Cable Path	Various		8Sept2000
East path Gain (RED)	Cable Path	Various		8Sept2000
West path Gain (GREEN)	Cable Path	Various		8Sept2000
Radiated Software	REM 2.0.12	SofTest	None	Cal Not Req
Conducted Software	RHTC 85869	Hewlett Packard	None	Cal Not Req
Frequency Stability				
Temperature chamber	RD-64	Russell		13Sept00
EMC Analyzer	E7405A	Hewlett Packard	US391500106	25Jun00
Synthesized Sweeper	8340B	Hewlett Packard	2650A00431	16Mar00
AC Power Source	6813A	Hewlett Packard	3503A00193	26May00

RHTC “REM Revision 2.0.12 in the Test Executive is the software program used in the 10-Meter semi-anechoic chamber.
RHTC HP85869 is the software program used conducted emissions measurements

Error of Uncertainty: Radiated disturbance
OATS uncertainty per ANSI C63.6-1988

Site imperfections +/- 1 dB
Antennas Tx/Rx +/- 2 dB < 800 MHz +/- 3.0 dB > 800 MHz
EMI system +/- 2 dB
Total < 800 MHz +/- 5 dB
> 800 MHz +/- 6 dB

Error of Uncertainty: Conducted disturbance

EMI measurement system 8546 & E7405
Frequency resolution 1 Hz
accuracy +/- (frequency X 5X10^-6)
Amplitude accuracy +/- 2 dB (10 kHz to 1500 MHz)

Error of Uncertainty: Frequency Stability

8340B	Frequency resolution 1 Hz
	accuracy +/- (1X10^-11)
6813A	Voltage accuracy +/- 0.15% + 0.3V
	Frequency accuracy +/- 0.01% + 0..01 Hz

Error of Uncertainty: Environmental ENV-50-HUM

Temperature +/- 1 degree C
Humidity +/- 5 %
Pressure - +/- .1 referenced to local weather station

CONDITION OF EUT(s):

Start of test:	x	New	____	Used	____	Proto	Other _____
End of test:	x	New	____	Used	____	Proto	Other _____

INITIAL DISTRIBUTION LIST:
JEFF BROWER
Russ Carlson - Regulatory Engineer
RHTC Archive File
RHTC Test Record File Name: D:\TEST DATA NEW\20669\RE_20669_RF 350.DOC

ATTACHMENTS: 5 pages

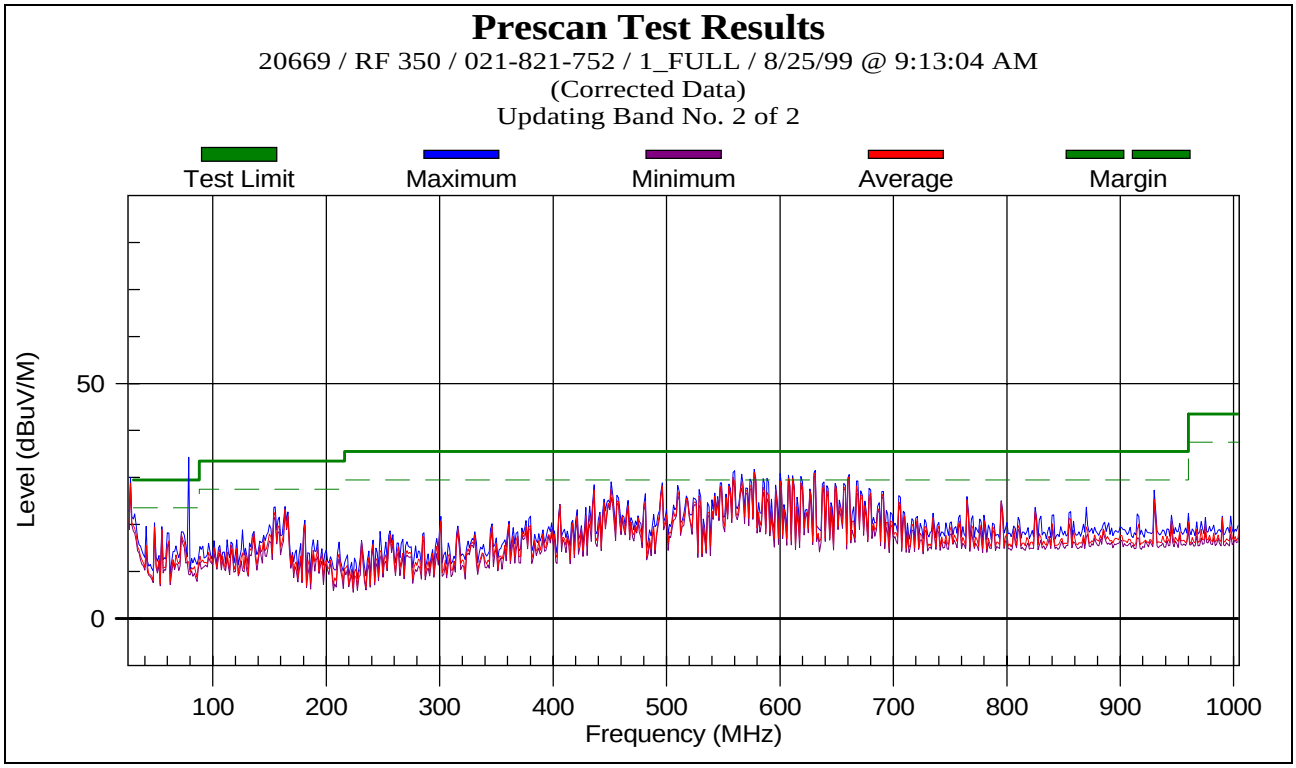
Conducted disturbance data

REFERENCES:

EN 55022 1994 & A2 1996
CISPR 22: 1993
ANSI C63.4 (1992)
CNS 13438
CFR 47
BOILER FORMAT FILE: RE Full Report.doc

THE RESULTS OF THIS REPORT ARE INCLUSIVE TO THE UNITS TESTED ONLY.
THIS REPORT MAY NOT BE REPRODUCED IN PART WITHOUT THE EXPRESSED WRITTEN CONSENT OF THE ROSEVILLE HARDWARE TEST CENTER.

Data for: RF 350, Unit: 021-821-752



File: D:\TEST DATA NEW\20669\RE_RF 350_021-821-752_1_FULL\FINALTEST_FINAL.DAT															
Work Order=20669,Project=RF 350,EUT M/N=P088-200-01,EUT S/N=021-821-752,Operator=Frederick,Doug															
120 Volts AC @ 60 Hz1-Phase Power															
21.7 Deg C, 44.0 % RH, 100.5 kPa															
PreScan Test Data					**Final Test Data**										
	Freq MHz	Limit dBuV/m	Max Corr Lvl dBuV/m	Margin dB	Pol	Ht cm.	Azm Deg.	Corr Freq MHz	Value dBuV	Corr Value dBuV/m	Cor Mar	RBW	Det	Method	Note
P	631.25	35.5	31.5	4.0	H	130	124	630.02	57.0	33.3	2.2	120	Qpk	Normal	""
P	661.25	35.5	30.6	4.9	H	128	144	660.03	56.7	32.6	2.9	120	Qpk	Normal	""
P	573.75	35.5	29.7	5.8	V	294	48	577.52	56.3	32.1	3.4	120	Qpk	Normal	""
P	660.00	35.5	29.9	5.6	H	147	296	660.02	56.1	32.1	3.4	120	Qpk	Normal	""
P	600.00	35.5	30.8	4.7	H	137	263	600.02	56.2	31.6	3.9	120	Qpk	Normal	""
P	560.00	35.5	31.5	4.0	V	324	45	558.77	55.1	31.1	4.4	120	Qpk	Normal	""
P	618.75	35.5	30.2	5.3	H	158	274	618.77	54.8	30.8	4.7	120	Qpk	Normal	""
P	566.25	35.5	30.7	4.8	V	307	45	566.28	54.7	30.7	4.8	120	Qpk	Normal	""
P	611.25	35.5	30.3	5.2	H	145	272	607.53	54.7	30.2	5.3	120	Qpk	Normal	""
P	588.75	35.5	29.8	5.7	H	146	263	588.76	51.8	27.3	8.2	120	Qpk	Normal	""
P	78.75	29.5	34.3	-4.8	V	321	196	76.02	50.1	12.8	16.7	120	Qpk	Normal	""