Test Report No.8112319723

For E-Drive Technology Ltd.

Equipment Under Test:
RF Modem

Model: CR012

From The Standards Institution
Of Israel
Industry Division
Telematics Laboratory
EMC Section

ACCREDITED
Certificate No.1487-01

Test Report No.: 8112319723	**Page 1 of 28 Pages**
Title: Test on RF Modem	**Model: CR012**

Order placed by:	E-Drive Technology Ltd.
Address:	18 Keren Hayesod Str., P.O.B. 2035 Tirat-Hacarmel 39120 Israel
Sample for test selected by:	The orderer
The date of test:	20/11**,** 25/11/2001.

Description of Equipment Under Test (EUT):	RF Modem
Model:	CR012
Manufactured by:	E-Drive Technology Ltd.

Reference Documents:

- CFR 47 FCC: "Rules and Regulations";
  Part 15. "Radio frequency devices";
  Subpart B: Unintentional radiators Sec.15.109
  Subpart C: Intentional radiators. Sec. 15.205, 15.207, 15.209,15.231

Test Results: The EUT was found to be in compliance with the requirements of FCC Rules Part 15
Subpart B Sec. 15.109
Subpart C Sec. 15.205, 15.207, 15.209, 15.231.

This Test Report contains 28 pages and may be used only in full.	This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.

Table of Contents

1 EUT Description and operation

1.1 General description:

Description of Equipment Under Test (EUT): RF Modem

Model: CR012

Manufactured by: E-Drive Technology Ltd.

The EUT is an RF Modem used in security and automatically fuel systems. The EUT is capable of transmitting/receiving data between two or more vehicles or fuel stations. Unique ID code allows more than 300 units to be networked at the same time.

The EUT's technical parameters are :

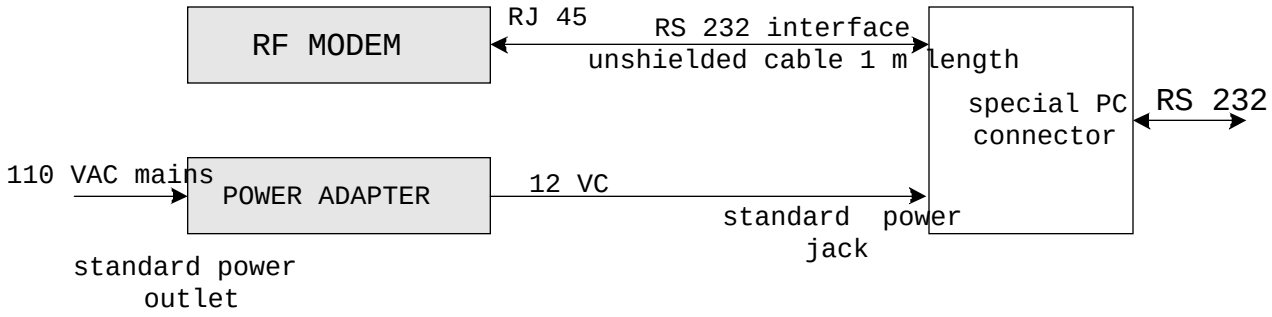
Operating frequency	433.92 MHz.
Type of modulation used	FSK (F3B)
Transmission power	< 1 mW
Interface RS 232	
Operating voltage:	12 VDC.

- Dimensions: 82 x 85 x 27 mm approx.
- The EUT is powered by 12 VDC from the external power adapter. The power adapter is connected to PC through the special connector which provides the power and RS 232 interface to EUT.

1.2 EUT's sub-assemblies list:

1. RF Modem, contains one PCB Motherboard P/N RS2 PCB 0220-0053
2. External power adapter mfr NEGBA 110 VAC/12 VDC.

1.3 EUT connectors diagram:



1.4 Auxiliary equipment used:

The auxiliary equipment used is detailed in Table 2.

Table 2. Auxiliary equipment used

Name	MFR	Model	Ser. No./FCC ID
PC computer	IBM	Machine type:6275-M20	S/N 559B704
Monitor	IBM	6547-OBN	S/N -55-DAA62
Printer	HP	DeslJet 895 Cxi	S/N ES93Q2COV8
Mouse	Made for IBM by Logitech	M-S34	S/N 23-171774 FCC ID: DZL 211029
Keyborad	IBM	KB-7953	S/N 2009

1.5 EUT setup and operation:

For testing purposes the EUT was connected to PC computer through RS232 interface and operated using the customer software.
The test setup is shown in Figure 1.

The EUT was tested with typical modulation applied.

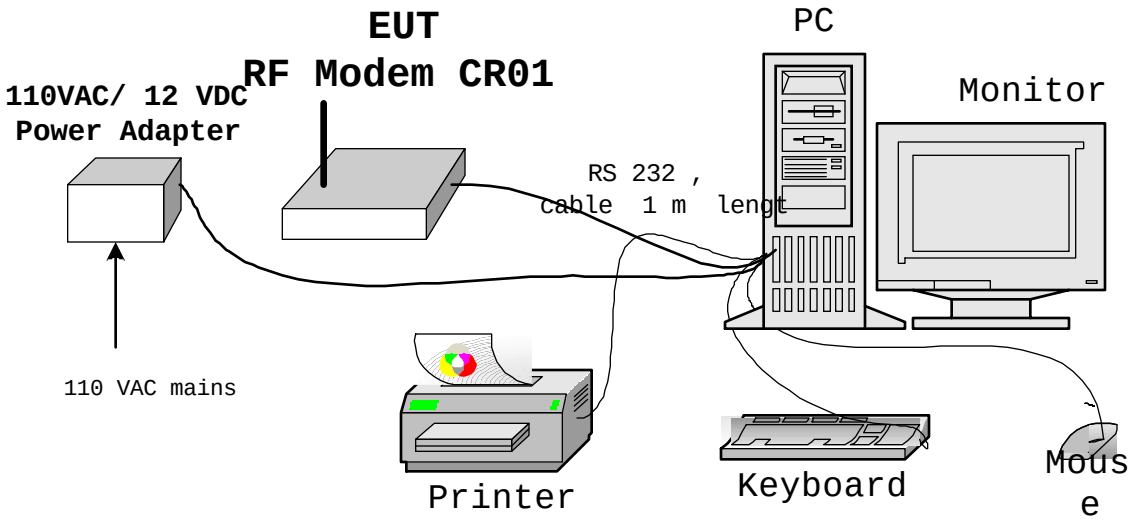


Figure 1. EUT test setup

2 Test specification, Methods and Procedures

Test Specification:

- CFR 47 FCC: "Rules and Regulations";
  Part 15. "Radio frequency devices";
  Subpart B: Unintentional radiators
  Subpart C: Intentional radiators.

Methods and Procedures:

- ANSI C63/4/1992: "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".

3 Measurements, examinations and derived results

3.1 Location of the Test Site:

EMC laboratory of the Standards Institution of Israel, Tel-Aviv.
Open Area Test Site located at Kibbutz Native Halamed Hai in Emek HaEla, Israel.

3.2 Test condition:

Temperature: 22 °C
Humidity: 60 %

3.3 Conducted emission test (Subpart C clause 15.207):

3.3.1 Test Configuration:

The measurements were performed on the mains input of the EUT power adapter.

The EUT connected to PC via RS232 was placed on a non-metallic table in a shielded chamber at a height of 80 cm from the floor of the shielded chamber and 40 cm from the wall of the shielded chamber.

3.3.2 Test procedure:

The EUT was operated to transmitting/receiving modes through the customer software. First, initial scans were performed. Final measurements were performed at the frequencies where emission exceeded the tolerance limit.

Test equipment (EMI receiver) setup was as follow:

Initial scan:

Detector type	Peak
Mode	Max hold
Bandwidth	9 kHz
Step size	Continuous sweep
Sweep time	>100 msec

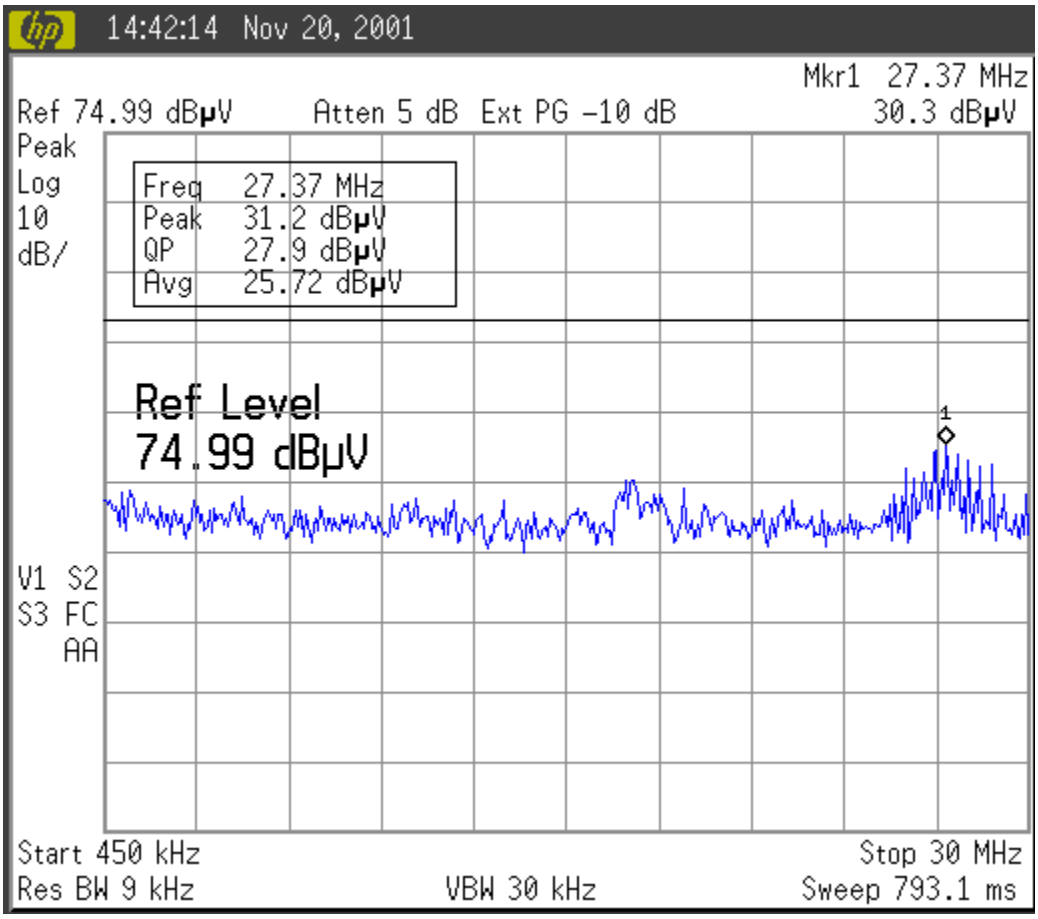
Measurements

Detector type	Quasi-peak (CISPR)
Bandwidth	9 kHz
Measurement time	200 seconds/MHz
Observation	>15 seconds

3.3.3 Test results:

The conducted emissions from the EUT were found below specified limit. Test results are shown in Plot #1.

The worst case result measured with peak detector at 27.37 MHz on phase line was 16.8 dB below specified limit.



Plot #1
Conducted emission test result
specified standard: Part 15 Subpart C clause 15.207

3.4 Radiated emission test. Transmitting mode (Subpart C clauses 15.231 (b), 15.205)

3.4.1 Preliminary radiated emission test:

Preliminary radiated measurements were performed in a semi-anechoic chamber at a distance of 3 meters. The EUT was setup in its typical configuration and operated to transmitting operation, the frequency spectrum was monitored. EUT configuration and cable configuration which produced the maximum level of emission was documented. A list of frequencies to be tested was prepared.

3.4.2 Final radiated emission test:

The final radiated measurements were performed at the Open Area Test Site.
The EUT and aux. equipment were arranged on a non-metallic table 0.8 m placed on the turntable.
All measurements at the Open Area Test Site were performed at a 3 m measurement distance.
Measuring antennas: BicLog antenna up to 2 GHz
Double Ridge antenna above 2 GHz

The measurements were performed up to 4 GHz at each frequency found previously.
The levels were maximized by:

- rotating the EUT in three orthogonal planes
- rotating the turntable through 360°
- varying the antenna height between 1 m and 4 m
- rerouting EUT cables
- changing antenna polarization from vertical to horizontal.

The following measuring detector function and bandwidths were used:

Detector type	Average	Peak
Resolution bandwidth	1MHz	1MHz
Video bandwidth	<3 kHz	1 MHz

3.4.3 Radiated emission test results:

The test results are shown in Table 3 and in Plots #2 to #5.

The signal at 1301.76 MHz is within a restricted band 1300 – 1427 MHz. As shown in Table 4 it complies with the limits in clause 15.205.

Table 3. Radiated emissions test results

Tested unit: RF Modem CR012
Specified stnd: Part 15 Subpart C clause 15.231 (b)

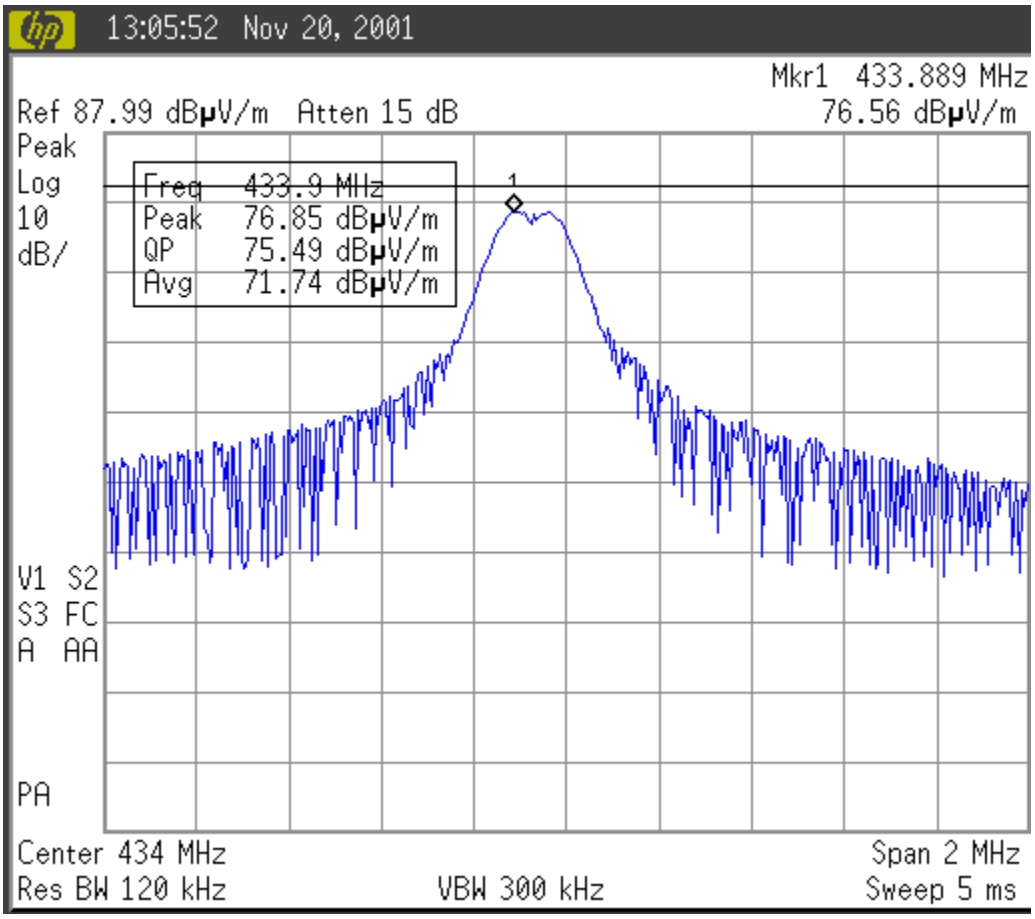
Frequency (MHz)	Emission Level (dBμV/m)		Limit @ 3m (dBμV/m)		Margin (dB)		Results
	Average	Peak	Average	Peak	Average	Peak	
433.92	71.7	76.9	80.8	100.8	9.1	23.9	Complies
867.84	34.6	63.6	60.8	80.8	26.2	17.2	Complies
1301.76	32.1	47.9			28.7	32.9	Complies
1735.68	54.5	66.2			6.3	14.6	Complies
At frequencies higher than 4th harmonic the emission was 30 dB at least below specified limit							

Note : Emission level = E Reading (dBμV) + Cable loss (dB) + Antenna Factor (dB/m)
For Measuring cable loss and Antenna Factor refer to Appendix 2

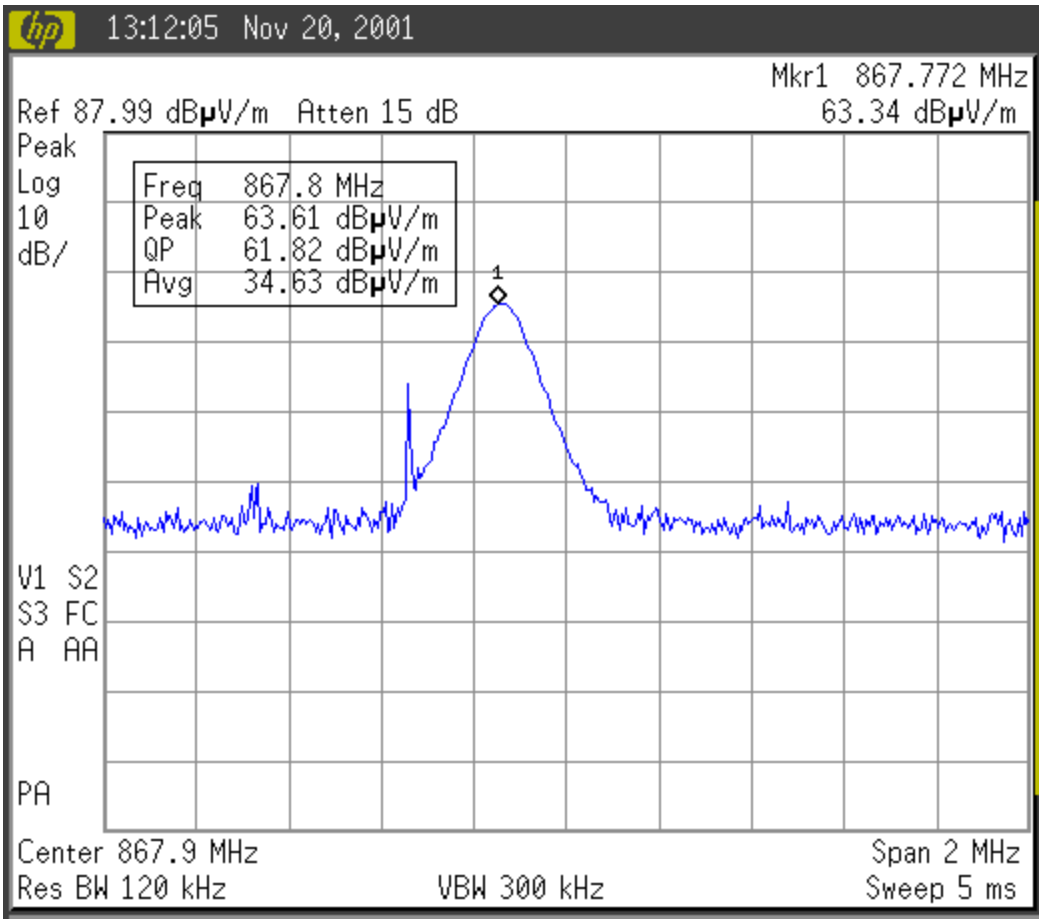
Table 4. Radiated emissions in restricted bands

Tested unit: RF Modem CR012
Specified stnd: Part 15 Subpart C clause 15.205 (a)

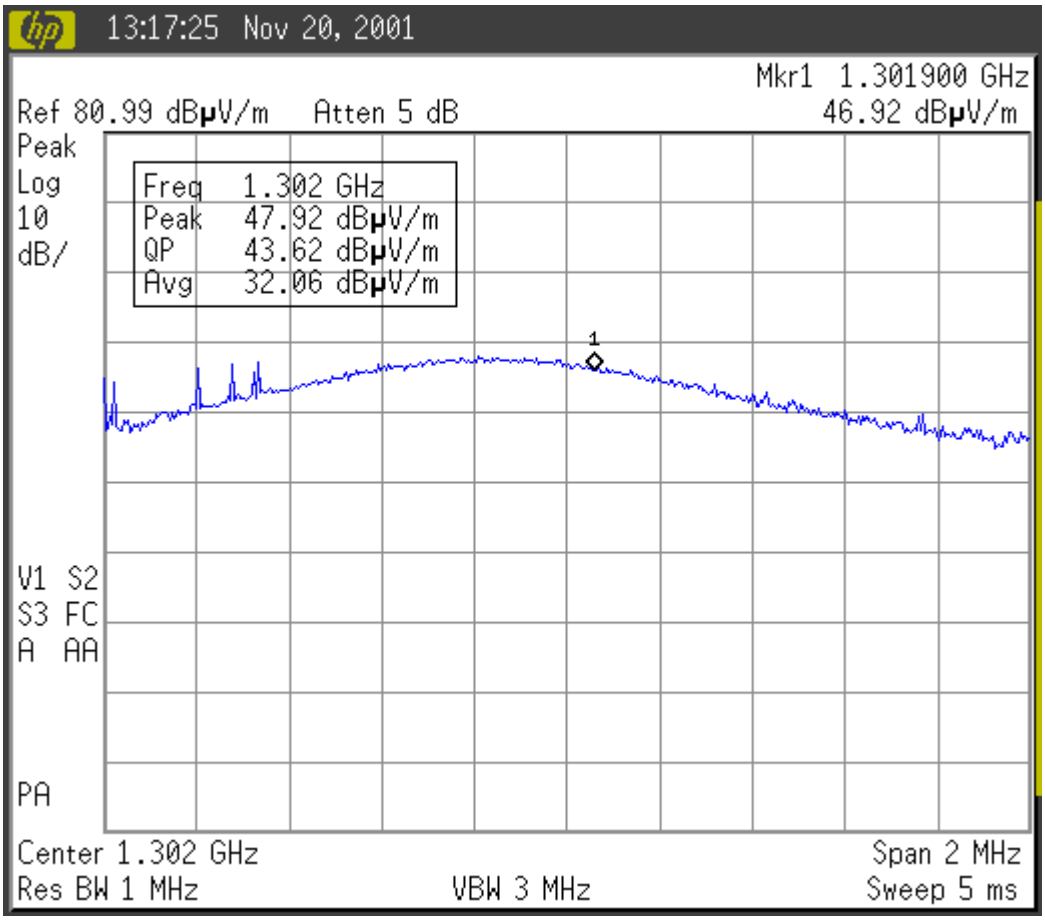
Restricted band frequency (MHz)	Emission Level (dBμV/m)		Limit @ 3m (dBμV/m)		Margin (dB)		Results
	Average	Peak	Average	Peak	Average	Peak	
1300 - 1427	32.1	47.9	54	74	21.9	26.1	Complies



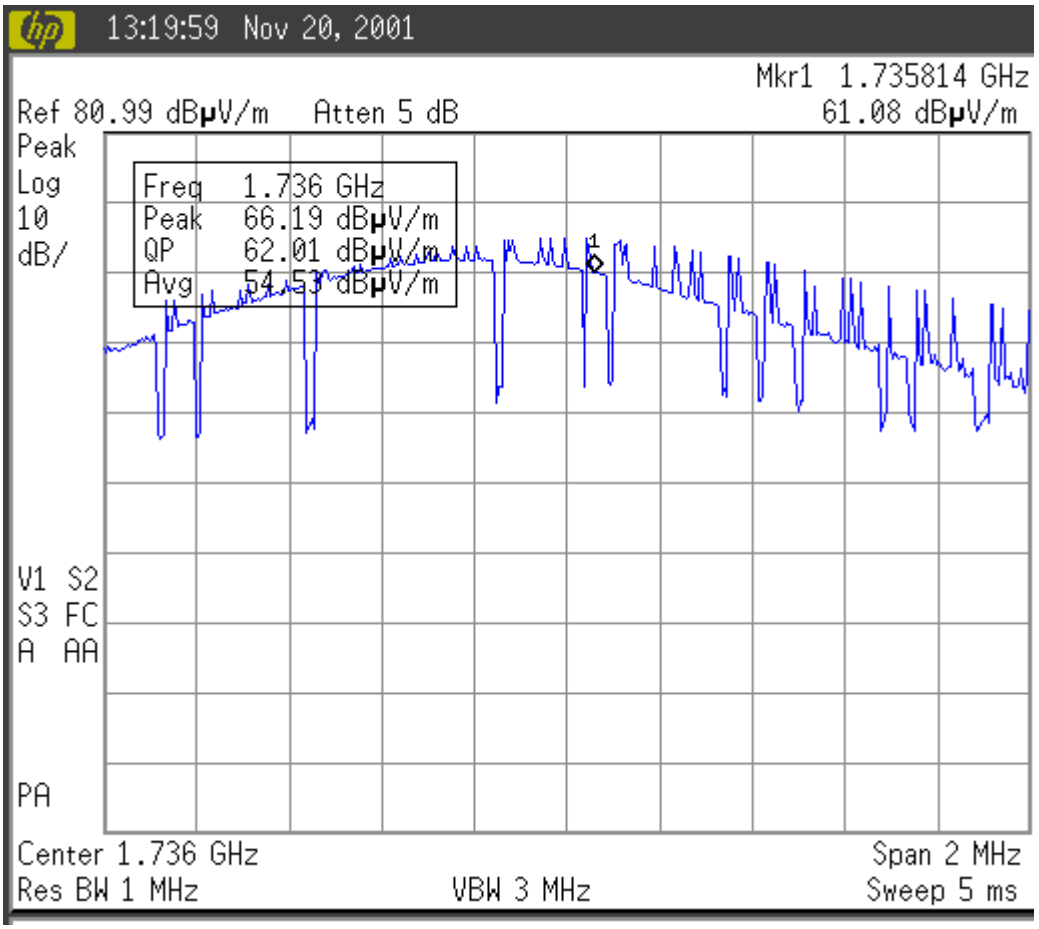
Plot #2
Field strength measurement of fundamental emission
Specified stnd: Subpart C clause 15.231 (b)



Plot #3
Field strength measurement of spurious emission
Specified stnd: Subpart C clause 15.231 (b)



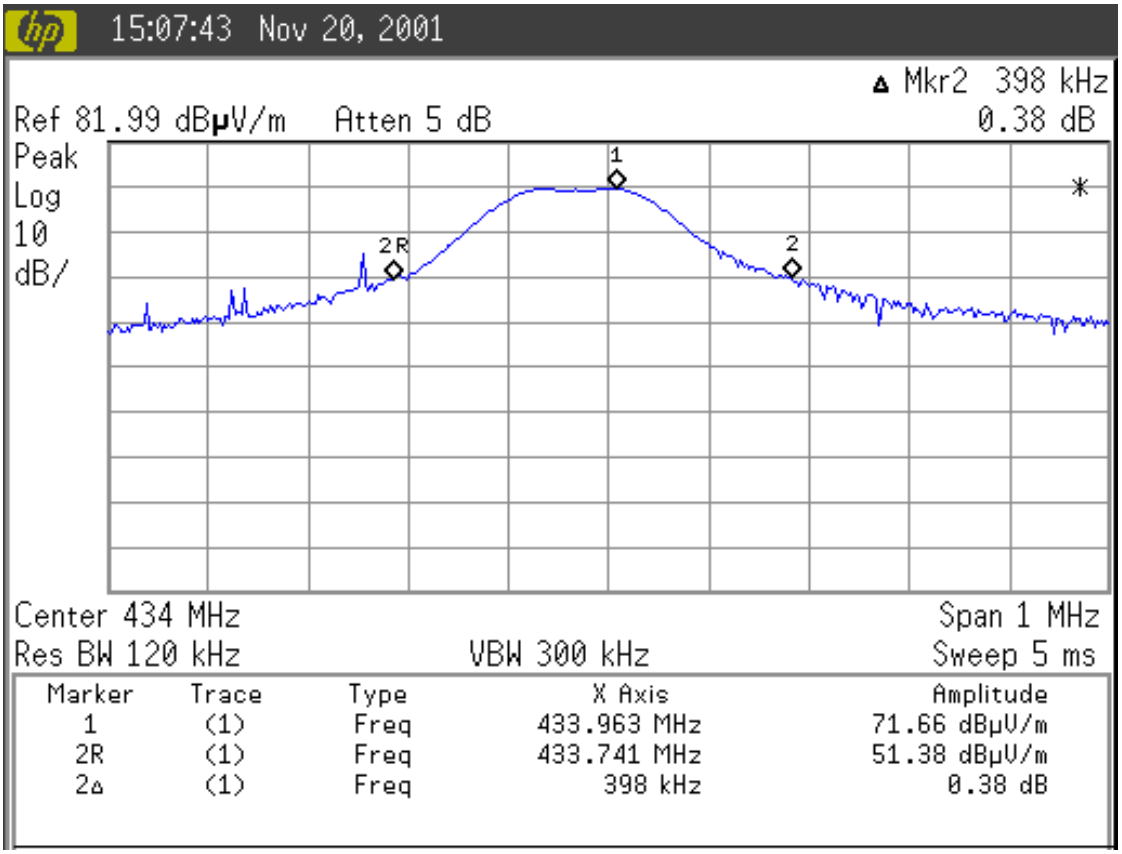
Plot #4
Field strength measurement of spurious emission
Specified stnd: Subpart C clause 15.231 (b), 15.205 (a)



Plot #5
Field strength measurement of spurious emission
Specified stnd: Subpart C clause 15.231 (b)

3.5 Bandwidth measurements (Subpart C clause 15.231 (c)) :

The bandwidth of the emission shall be no wider than 0.25% of the center frequency = 1.085 MHz.
The bandwidth was determined at the points 20 dB down from the modulated carrier. The measurements were performed on modulated carrier. The result is presented in plot # 6.
The measured bandwidth obtained graphically = 398 kHz.



Plot #6
The bandwidth measurement
Specified stnd: Subpart C clause 15.231 (c)

3.5.1 Signal duration (Subpart C clause 15.231 (a) (2)):

The EUT operated through the customer software ceases transmission within 5 seconds after activation.

3.6 Radiated emission test. Receiving mode (Subpart B clause 15.109):

3.6.1 Preliminary radiated emission test:

Preliminary radiated measurements were performed in a shielded chamber at a distance of 3 meters.
The EUT was operated to receiving mode. In order to "cohere" of the EUT's superregenerative receiver the unmodulated CW signal from the signal generator at the operating frequency was supplied to the EUT. The frequency spectrum was monitored, a list of frequencies to be tested was prepared.

3.6.2 Final measurements:

The final radiated measurements were performed at the Open Area Test Site. The EUT and aux. equipment were arranged on a non-metallic table 0.8 m placed on the turntable. All measurements at the Open Area Test Site were performed at a 10 m measurement distance.
Measuring antenna : bilog .30 – 2000 MHz.
The test procedure described in sec.3.6.1 was repeated. The frequency range from 30 to 2000 MHz was investigated. The measurements were performed at each frequency found previously and at frequencies at which the signal was 10 dB below the limit or less. The levels were maximized by:

- rotating the EUT in three orthogonal planes
- rotating the turntable through 360°
- varying the antenna height between 1 m and 4 m
- rerouting EUT cables
- changing antenna polarization from vertical to horizontal.

Unless stated otherwise, the measuring equipment settings were:

Initial scan:

Detector type	Peak
Mode	Max hold
Bandwidth	120 kHz
Step size	Continuous sweep
Sweep time	>1 seconds/MHz

Measurements:

Detector type	Quasi-peak (CISPR)
Bandwidth	120 kHz
Measurement time	20 seconds/MHz

3.6.3 Radiated emission test results:

The radiated emissions from the EUT were found below Class B specified limit. Test results are presented in Table 5.

Table 5. Radiated emission test results

Tested unit: RF Modem CR012
Specified stnd: Part 15 Subpart B clause 15.109 Class B

Frequency (MHz)	Turn-table Angle (°)	Antenna Polariz.	Antenna Height (m)	Emission Level (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)	Results
60	208	V	2.99	27.9	40	12.1	Complies
71.9	257	V	2.73	26.2	40	13.8	Complies
223.6	153	V	2.33	33.5	46	12.5	Complies
237.3	203	H	3.11	35.6	46	10.4	Complies
527.2	253	V	3.42	37.1	46	8.9	Complies
643.9	115	V	2.75	39.6	46	6.4	Complies
729.8	221	V	2.46	36.7	46	9.3	Complies
779.5	147	V	2.19	44.6	46	1.4	Complies
847.3	158	V	2.06	44.3	46	1.7	Complies

Note 1: Emission level = E Reading (dBμV) + Cable loss (dB) + Antenna Factor (dB/m) + Distance correction factor (dB)
For Cable Loss and Antenna Factor refer to Appendix 2.
Distance correction factor (dB) = 20 log (10/3) = 10.5 dB

4 Compliance with specification

Test	Standard	Test result
Conducted emission in frequency range 0.450 – 30 MHz	Subpart C clause 15.207	Complies
Radiated emissions (fundamental & spurious) Restricted bands Bandwidth Signal duration	Subpart C clause 15.231 clause 15.205	Complies
Radiated emissions in frequency range 30 – 2000 MHz	Subpart B clause 15.109	Complies

Telematics Laboratory
11 December 2001

Name: Eng. Yuri Rozenberg
Position: Head of EMC Branch

Name Albert Herzenshtein
Position: Test Technician

5 Appendix 1: Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding once a year.

Instrument	MFR	Model	Serial No.	Last calibration date	Next calibration date
EMI Receiver 9 kHz-6.5 GHz	HP	8546A	SII 4068	11/01	11/02
Spectrum analyzer 10 KHz-26.5 GHz	HP	E7405a	SII 4944	04/01	04/02
RF Generator 10 MHz-20 GHz	Anritsu	68347B	SII 4898	10/01	10/02
LISN 9kHz-30 MHz	Fischer Custom	LISN-50/250-32-4-16	SII 5023	05/01	05/02
Transient limiter 0.009-200 MHz	HP	11947A	31074A3105	05/01	05/02
Antenna Bilog 30-2000 MHz	Schaffner-Chase	CBL6112B	SII4853	12/01	12/02
Antenna Double Ridge 1-18 GHz	EMCO	3115	SII4873	03/01	03/02
Antenna Mast	R&S	HCM	100002	NA	NA
Metallic turntable	R&S	HCT12	100001	NA	NA
Positioning controller	R&S	HCC	100002	NA	NA

6 Appendix 2: Antenna Factor and Cable Loss

Cable Loss (3 m cable + Mast)

Point	Frequency (MHz)	Cable Loss (dB)	Point	Frequency (MHz)	Cable Loss (dB)
1	30	0.53	21	1000	3.68
2	50	0.75	22	1100	3.82
3	100	1.08	23	1200	4.07
4	150	1.39	24	1300	4.24
5	200	1.61	25	1400	4.43
6	250	1.752	26	1500	4.6
7	300	2.00	27	1600	4.7
8	350	2.15	28	1700	4.85
9	400	2.26	29	1800	4.98
10	450	2.383	30	1900	5.19
11	500	2.52	31	2000	5.34
12	550	2.606	32	2100	5.51
13	600	2.75	33	2200	5.69
14	650	2.856	34	2300	5.89
15	700	3.06	35	2400	6.07
16	750	3.201	36	2500	6.22
17	800	3.27	37	2600	6.28
18	850	3.38	38	2700	6.41
19	900	3.46	39	2800	6.53
20	950	3.55	40	2900	6.84

Antenna Factor @ 3 m
Antenna Biclog mfr Chase model CBL6112B

Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)
30	20.39	125	13.12	350	15.14	750	20.20	1300	23.66
32	19.04	130	12.85	360	15.83	760	20.24	1320	23.94
34	17.83	135	12.65	370	15.91	770	20.26	1340	23.91
36	16.61	140	12.26	380	16.07	780	20.26	1360	24.08
38	15.43	145	11.95	390	16.24	790	20.34	1380	24.16
40	14.28	150	11.54	400	16.49	800	20.23	1400	24.43
42	12.99	155	11.31	410	17.24	810	20.20	1420	24.80
44	11.84	160	11.08	420	17.28	820	20.26	1440	24.86
46	10.81	165	11.03	430	16.91	830	20.42	1460	24.93
48	9.75	170	10.59	440	16.84	840	20.29	1480	25.00
50	8.73	175	10.43	450	16.97	850	20.55	1500	25.06
52	7.89	180	10.07	460	17.29	860	20.61	1520	25.23
54	7.17	185	9.91	470	17.40	870	20.66	1540	25.19
56	6.68	190	9.84	480	17.1	880	20.73	1560	25.25
58	6.31	195	9.87	490	17.62	890	20.69	1580	25.31
60	6.17	200	9.99	500	17.63	900	20.74	1600	25.47
62	6.13	205	10.31	510	17.73	910	20.69	1620	25.63
64	6.37	210	10.12	520	17.63	920	20.85	1640	25.69
66	6.59	215	9.94	530	17.73	930	21.01	1660	25.94
68	7.01	220	10.35	540	18.13	940	20.96	1680	25.90
70	7.29	225	10.55	550	18.62	950	21.1	1700	25.96
72	7.63	230	10.95	560	18.61	960	21.27	1720	26.01
74	8.01	235	11.45	570	18.59	970	21.31	1740	26.06
76	8.37	240	11.95	580	18.58	980	21.37	1760	26.45
78	8.68	245	12.45	590	18.66	990	21.32	1780	26.66
80	9.08	250	12.73	600	18.65	1000	21.37	1800	26.72
85	9.91	255	13.25	610	18.73	1020	21.56	1820	26.57
90	10.85	260	13.79	620	18.91	1040	21.76	1840	26.83
95	11.54	265	13.71	630	18.98	1060	22.05	1860	26.98
100	12.12	270	13.13	640	19.06	1080	22.44	1880	26.93
105	12.52	275	13.18	650	19.04	1100	22.63	1900	26.28
110	12.71	280	13.34	660	18.91	1120	22.81	1920	27.13
115	12.97	285	13.38	670	18.98	1140	22.90	1940	27.38
120	13.02	290	13.42	680	19.15	1160	22.88	1960	27.53
		295	13.36	690	19.22	1180	23.16	1980	27.38
		300	13.49	700	19.08	1200	23.24	2000	27.43
		310	13.52	710	19.36	1220	23.52		
		320	13.74	720	19.62	1240	23.49		
		330	14.03	730	19.98	1260	23.42		
		340	14.49	740	20.05	1280	12.68		

Antenna Factor @ 10m
Antenna Biclog mfr Chase model CBL6112B

Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)
30	18.00	125	11.35	350	14.30	750	20.00	1300	23.10
32	16.90	130	11.00	360	14.50	760	20.00	1320	23.10
34	15.80	135	10.65	370	14.70	770	20.00	1340	23.30
36	14.80	140	10.40	380	14.80	780	20.00	1360	23.40
38	13.70	145	10.15	390	15.15	790	19.90	1380	23.80
40	12.60	150	9.70	400	15.70	800	19.90	1400	24.10
42	11.60	155	9.35	410	16.40	810	19.95	1420	24.40
44	10.60	160	9.10	420	16.70	820	20.20	1440	24.50
46	9.60	165	8.90	430	16.40	830	20.35	1460	24.70
48	8.80	170	8.80	440	16.30	840	20.40	1480	24.70
50	7.90	175	8.75	450	16.35	850	20.40	1500	25.00
52	7.20	180	8.60	460	16.70	860	20.30	1520	25.10
54	6.60	185	8.50	470	17.00	870	20.30	1540	25.10
56	6.00	190	8.40	480	17.20	880	20.30	1560	25.20
58	5.60	185	8.50	490	17.35	890	20.30	1580	25.20
60	5.20	200	8.70	500	17.40	900	20.30	1600	25.20
62	5.00	205	8.95	510	17.45	910	20.35	1620	25.30
64	4.80	210	8.80	520	17.50	920	20.40	1640	25.50
66	4.80	215	8.55	530	17.95	930	20.40	1660	25.70
68	4.90	220	8.90	540	18.80	940	20.60	1680	25.90
70	5.00	225	9.30	550	19.05	950	20.60	1700	25.90
72	5.30	230	9.80	560	18.80	960	20.60	1720	26.00
74	5.60	235	10.40	570	18.70	970	20.60	1740	25.90
76	6.10	240	10.90	580	18.60	980	20.70	1760	25.90
78	6.40	245	11.25	590	18.60	990	20.80	1780	25.70
80	6.90	250	11.70	600	18.80	1000	20.90	1800	25.80
82	7.30	255	12.20	610	19.10	1020	21.30	1820	25.90
84	7.60	260	12.80	620	19.20	1040	21.50	1840	26.10
86	8.00	265	12.80	630	19.20	1060	21.70	1860	26.30
88	8.40	270	12.40	640	19.20	1080	21.90	1880	26.50
90	8.80	275	12.30	650	19.10	1100	21.90	1900	26.80
92	9.20	280	12.30	660	19.10	1120	22.00	1920	27.00
94	9.60	285	12.35	670	19.00	1140	22.20	1940	27.00
96	9.90	290	12.40	680	18.90	1160	22.30	1960	27.10
98	10.40	295	12.60	690	18.95	1180	22.40	1980	27.20
100	10.70	300	12.70	700	19.10	1200	22.50	2000	27.30
105	11.15	310	13.15	710	19.35	1220	22.70		
110	11.40	320	13.50	720	19.60	1240	22.90		
115	11.50	330	13.60	730	19.90	1260	23.00		
120	11.50	340	13.80	740	20.00	1280	12.80		

7 Appendix 3: Test configuration illustration

Photo #1.
Radiated emission setup

Photo #2.
Radiated emission setup

Photo #3
EUT **-** RF Modem

Photo #4
EUT **-** RF Modem

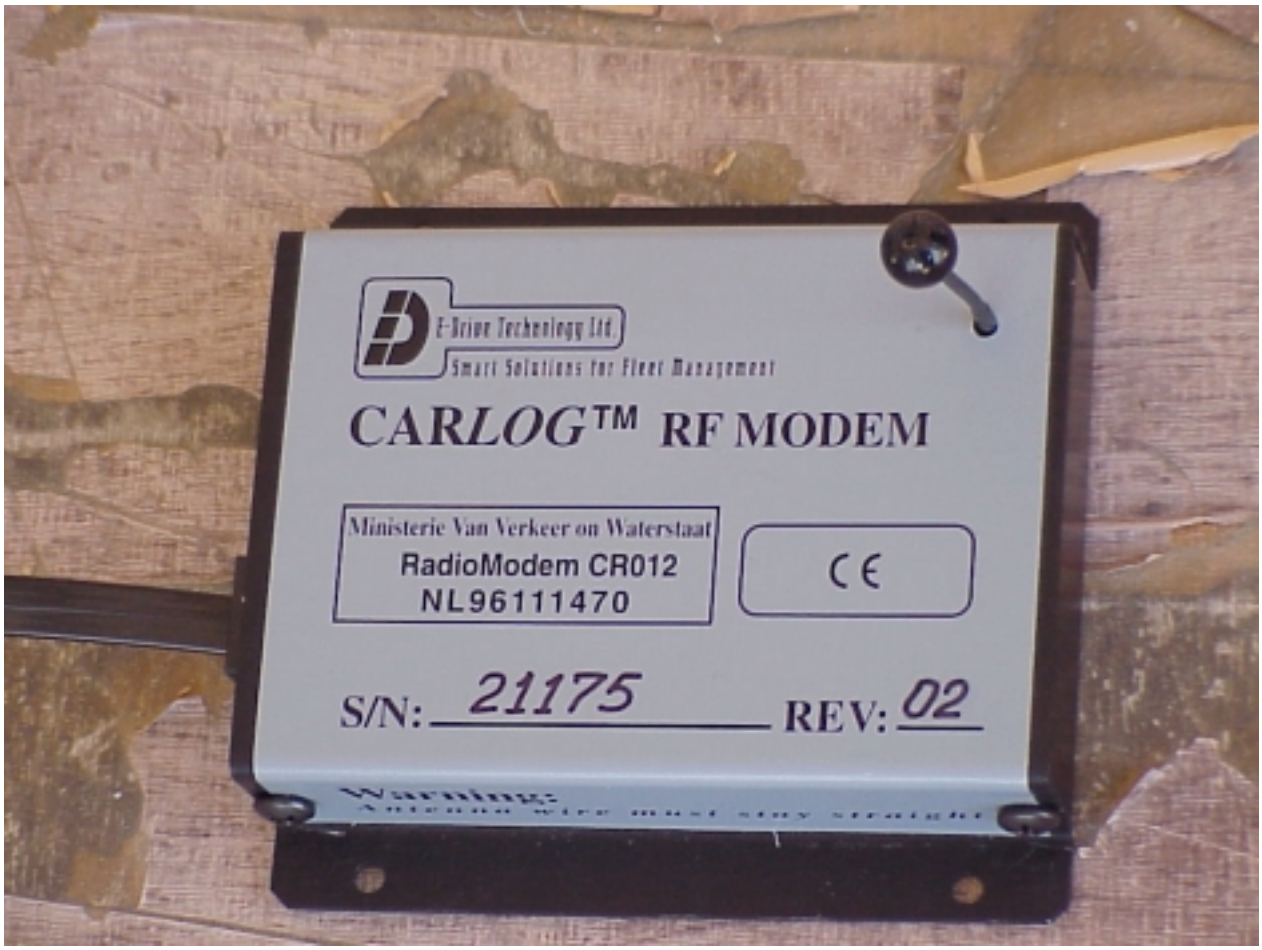


Photo #5
EUT **-** RF Modem

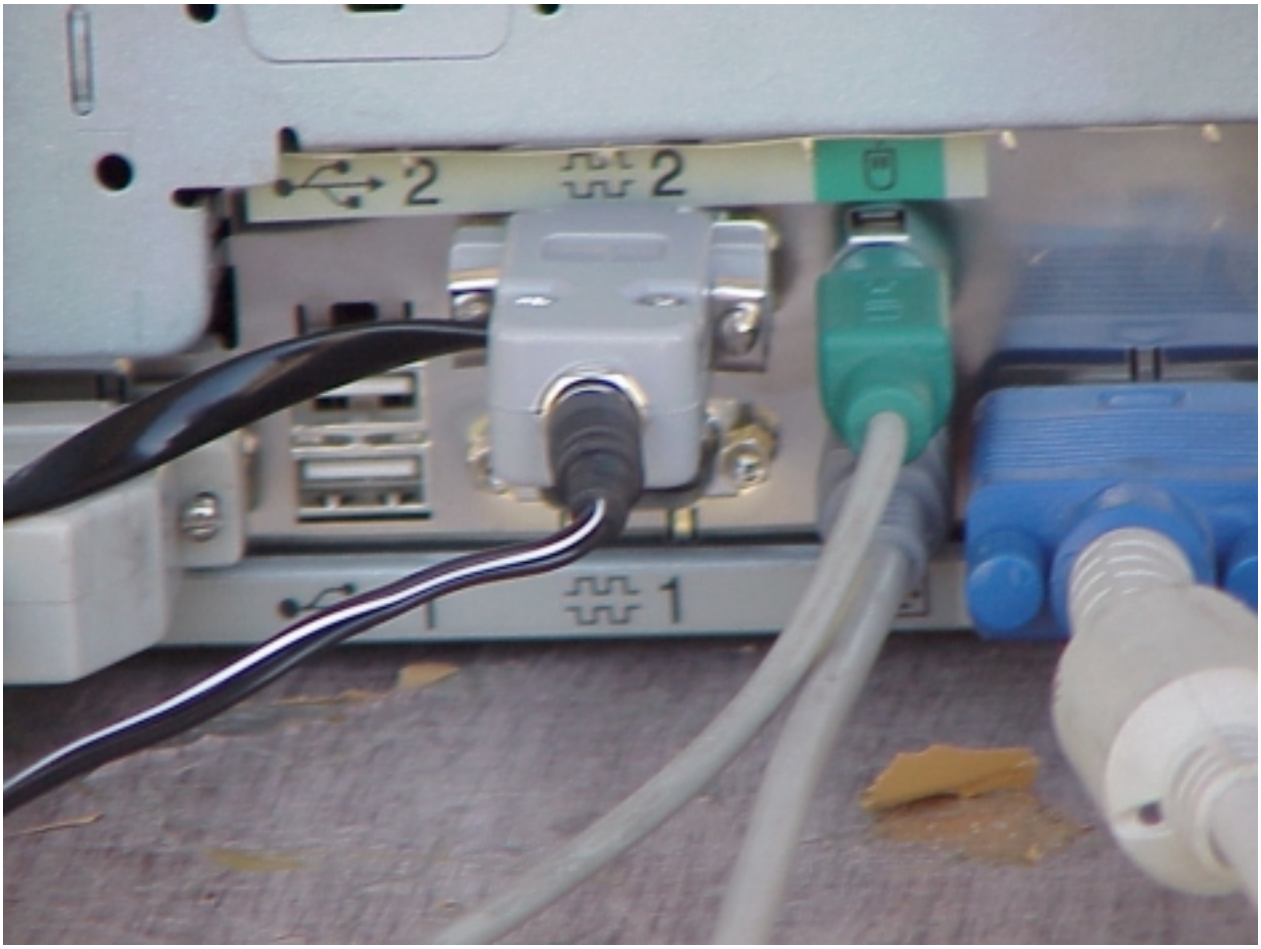


Photo #6
The EUT's adapter is connected to PC through the special connector which provides the power to EUT via RS 232 interface.