ELECTROMAGNETIC EMISSIONS TEST REPORT

ACCORDING TO FCC PART 15, SUBPART C, §15.231

FOR

ELECTRONICS LINE Ltd.

EQUIPMENT UNDER TEST

SECURITY SYSTEM TRANSMITTER, MasterLink EL-2501/2502

Prepared by: _____
Mrs. M. Cherniavsky, certif. engineer
Hermon Labs

Approved by: _____
Mr. A. Usoskin, QA manager
Hermon Labs

Approved by: _____
Dr. E. Usoskin, C.E.O.
Hermon Labs

Approved by: _____
Mr. Shaul Aviezer, QA manager
Electronics Line Ltd.

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ACCREDITED
ELECTRICAL

Description of equipment under test

Test items	Security transmitter, FCC ID:HNA2YUML
Manufacturer	Electronics Line Ltd.
Trade Mark	MasterLink
Type (Model)	EL-2501/2502

Applicant information

Applicant's representative & responsible person	Mr. Shaul Aviezer, QA Manager
Company	Electronics Line Ltd.
Address	58 Amal Street
P.O. Box	3253
Postal code	49130
City	Petach Tikva
Country	Israel
Telephone number	011 972-3921 1110
Telefax number	011 972-3921 1128

Test performance

Project Number	13293
Location of the test	Hermon Laboratories, Binyamina, Israel
Test started	April 14, 1999
Test completed	April 14, 1999
Purpose of test	The EUT certification in accordance with CFR 47, part 2, §2.1033
Test specification(s)	FCC part 15 subpart C §15.231, §15.209 subpart B, §15.109

The A2LA logo endorsement applies only to the test methods and the standards that are listed in the scope of Hermon Laboratories accreditation by A2LA.
Through this report period is used as decimal separator while thousands are separated by comma.
This report is in conformity with EN 45001 and ISO GUIDE 25.
The test results relate only to the items tested.

Table of Contents

1 General information

1.1 Abbreviations and acronyms

The following abbreviations and acronyms are applicable to this test report:

AVRG	average (detector)
BW	bandwidth
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
DC	direct current
EMC	electromagnetic compatibility
EUT	equipment under test
GHz	gigahertz
H	height
HL	Hermon Laboratories
Hz	hertz
IF	intermediate frequency
kHz	kilohertz
L	length
m	meter
mm	millimeter
MHz	megahertz
msec	millisecond
NA	not applicable
NARTE	National Association of Radio and Telecommunications Engineers, Inc.
QP	quasi-peak (detector)
RBW	resolution bandwidth
RF	radio frequency
RE	radiated emission
V	volt
W	watt

1.2 Specification references

CFR 47 part 15: October 1998	Radio Frequency Devices.
ANSI C63.2:06/1987	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
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.

1.3 EUT description

The EUT, MasterLink EL-2501/2502, is a low power transmitter. Both models are based on UHF radio telemetry transmit module and operating at 418 MHz. The EL-2501 and EL-2502 are employed in wireless security systems and used with the MasterLink supervised wireless receivers. The EL-2501 functions as supervised magnetic door and window contact, the EL-2502 functions as supervised universal transmitter. The EUT is supplied with built-in internal whip antenna and is powered by 2 x 3.6 V internal batteries.

1.4 Statement of manufacturer

I, Shaul Aviezer, QA manager of Electronics Line Ltd., declare that the transmitter EL 2501/ 2502, FCC ID:HNA2YML was tested on April 14, 1999 by Hermon Laboratories and which this test report applies to, is identical of the equipment that will be marketed.

The term identical means identical within the variations that can be expected to arise as a result of quantity production technique.

Shaul Aviezer, QA manager
Electronics Line Ltd.

Signature:_____

Date: May 26, 1999

2 Test facility description

2.1 General

Tests were performed at Hermon Laboratories, which is a fully independent, , private EMC, Safety and Telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), listed by Industry Canada for radiated measurements (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-809 for anechoic chamber, C-845 for conducted emissions site), assessed by NMi Certin B.V. (Netherlands) for a number of EMC, Telecommunications and Safety standards, and Accredited by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO GUIDE 25/EN 45001 for EMC, Telecommunications and Product Safety Information Technology Equipment (Certificate No. 839.01).

Address: PO Box 23, Binyamina 30550, Israel
Telephone: +972-6-628-8001
Fax: +972-6-628-8277

Person for contact: Mr. Alex Usoskin, testing and QA manager.

2.2 Equipment calibration

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error. The standards and instruments used in the calibration system conform to the present requirements of MIL-STD-45662A.
The laboratory standards are calibrated by the third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

2.2.1 Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Conducted emissions with LISN	9 kHz to 30 MHz: ± 2.1 dB
Radiated emissions in the open field test site at 10 m measuring distance	Biconilog antenna: ±3.2 dB Log periodic antenna: ±3 dB Biconical antenna: ±4 dB
Radiated emissions in the anechoic chamber at 3 m measuring distance	Biconilog antenna: ±3.2 dB

2.3 Laboratory personnel

The four people of Hermon Laboratories that have participated in measurements and documentation preparation are: Dr. Edward Usoskin - C.E.O., Mr. Michael Feldman - test technician, and Mrs. Marina Cherniavsky - certification engineer.
Dr. E. Usoskin is an EMC specialist and M. Cherniavsky is a telecommunication engineer certified by the National Association of Radio and Telecommunications Engineers (NARTE, USA.).
The Hermon Laboratories' personnel that participated in this project have more than 100 years combined experience time in EMC measurements and electronic products design.

2.4 Statement of qualification

The test measurement data supplied in this test measurement report having been received by me, is hereby duly certified. The following is a statement of my qualifications:
I am a technician, have obtained 30 years experience in electronics and measurements.
I have been with Hermon Laboratories since 1995.

Name: Mr. Michael Feldman Signature: _____
Position: test technician Date: May 26, 1999

I hereby certify that this test measurement report was prepared by me and is hereby duly certified. The following is a statement of my qualifications.
I am an engineer, graduated from University in 1971, with an MScEE degree, have obtained 26years experience in electronic products design and development and have been with Hermon Laboratories since 1991. Also, I am a Telecommunication Class II engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA.), the certificate no. is E2-03410.

Name: Mrs. Marina Cherniavsky Signature: _____
Position: certif. engineer Date: May 26, 1999

I hereby certify that this test measurement report was prepared under my direction and that to the best of my knowledge and belief, the facts set in the report and accompanying technical data are true and correct.
The following is a statement of my qualifications.
I have a Ph.D. degree in electronics, have obtained more than 42 years of experience in EMC measurements and electronic product design and have been with Hermon Laboratories since 1986.
. Also, I am an EMC engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA). The certificate no. is EMC-000623-NE, Senior Member.

Name: Dr. Edward Usoskin Signature: _____
Position: C.E.O. Date: May 26, 1999

3 Radiated emission measurements

3.1 Field strength of emissions according to § 15.231 (b)

3.1.1 Specified limits at 3 m distance

Fundamental frequency MHz	Field strength of fundamental dB (μV/m)	Field strength of spurious emissions dB (μV/m)
418	80.3	60.3

3.1.2 Test procedure and results

The test was performed in the Hermon Labs anechoic chamber at 3 meters test distance, i.e. the distance between measuring antenna and EUT boundary. The EUT was placed on the wooden turntable, as shown in Figure 3.1 and Photographs 3.1.1, 3.1.2. The EUT was operated in continuous transmitting mode and measured in three orthogonal axes during the testing. All the transmitter modes of operation were tested. The frequency range from 30 MHz up to 10^{th} harmonic was investigated.
Biconilog and double ridged guide antennas were used. To find maximum radiation the turntable was rotated 360^{o}, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.
The peak detector with RBW = 120 kHz at frequencies below 1 GHz and RBW = VBW = 1 MHz above 1 GHz was used in course of measurements.
The test results were recorded into Table 3.1. The pulse train duration measurement for average factor calculation is shown in Plot 3.1.1.
Average factor is equal to 20 log (23.6/100) = -12.5 dB,
where the pulse train duration within 0.1 sec is 0.0236 sec.

Reference numbers of test equipment used

HL 0041	HL 0275	HL 0465	HL 0521	HL 0593	HL 0594	HL 0604
HL 0815	HL 0816					

Full description is given in Appendix A.

Table 3.1

Radiated emission measurements - test results
(Field strength of fundamental frequency and spurious)

TEST SPECIFICATION: FCC part 15 subpart C § 15.231
COMPANY: Electronics Line Ltd.
EUT: EL 2501/2
DATE: April 14, 1999
RELATIVE HUMIDITY: 48%
AMBIENT TEMPERATURE: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

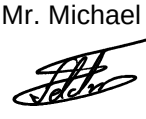
Frequency MHz	Measured Result dB (μV)	RWB MHz	Radiated Emissions dB (μV/m)	Specified Limit dB (μV/m)	Spec. Margin dB	Pass/ Fail
418.000	77.8	0.120	65.3	80.3	15	Pass
1254.030	51.2	1	39.0	60.3	21.3	Pass
2090.060	58.2	1	45.7	60.3	14.6	Pass

Notes to table:

Peak detector was used.
Radiated emission dB(μV/m) = measured result {dB(μV)} + average factor (dB).
Average factor = 20 log (23.6/100) = -12.5 dB, where 23.6 msec is transmitting time of each 100 msec (refer to Plot 3.1.1).
Specified limit is in accordance with § 15.231(b)

Table abbreviations:
Spec. Margin = Specification margins = dB below (negative if above) specification limit.

Test performed by:
Mr. Michael Feldman, test technician



Hermon Labs

Plot 3.1.1
Average factor measurement
Pulse train duration = 23.6 msec

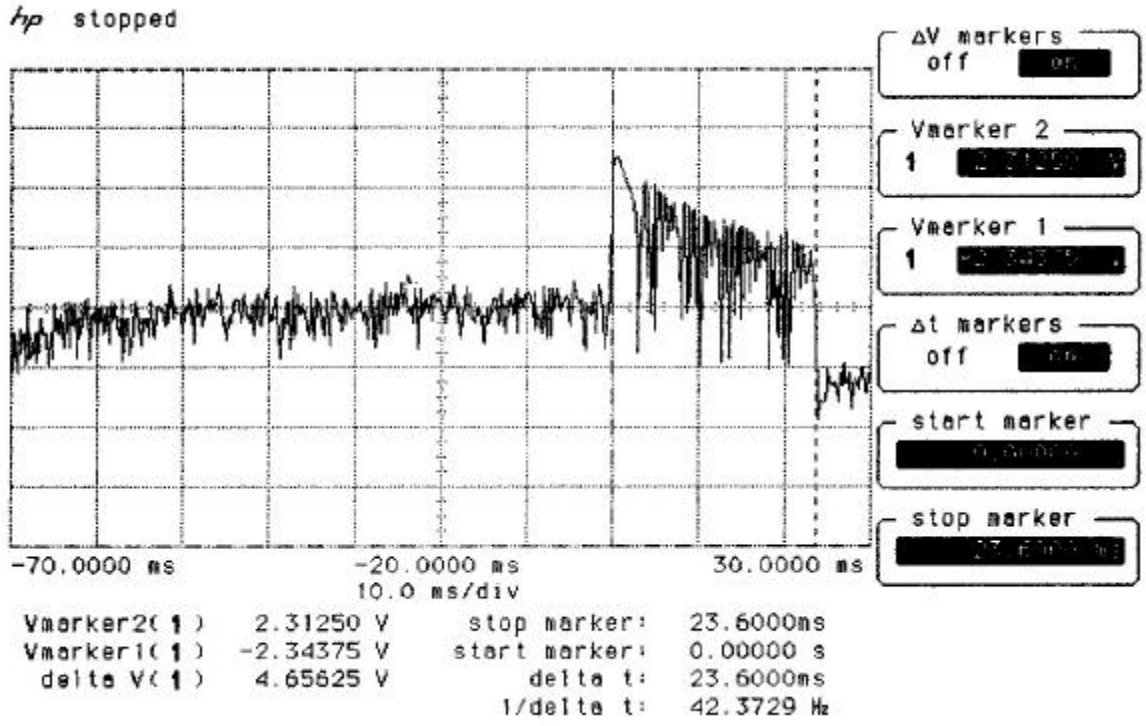
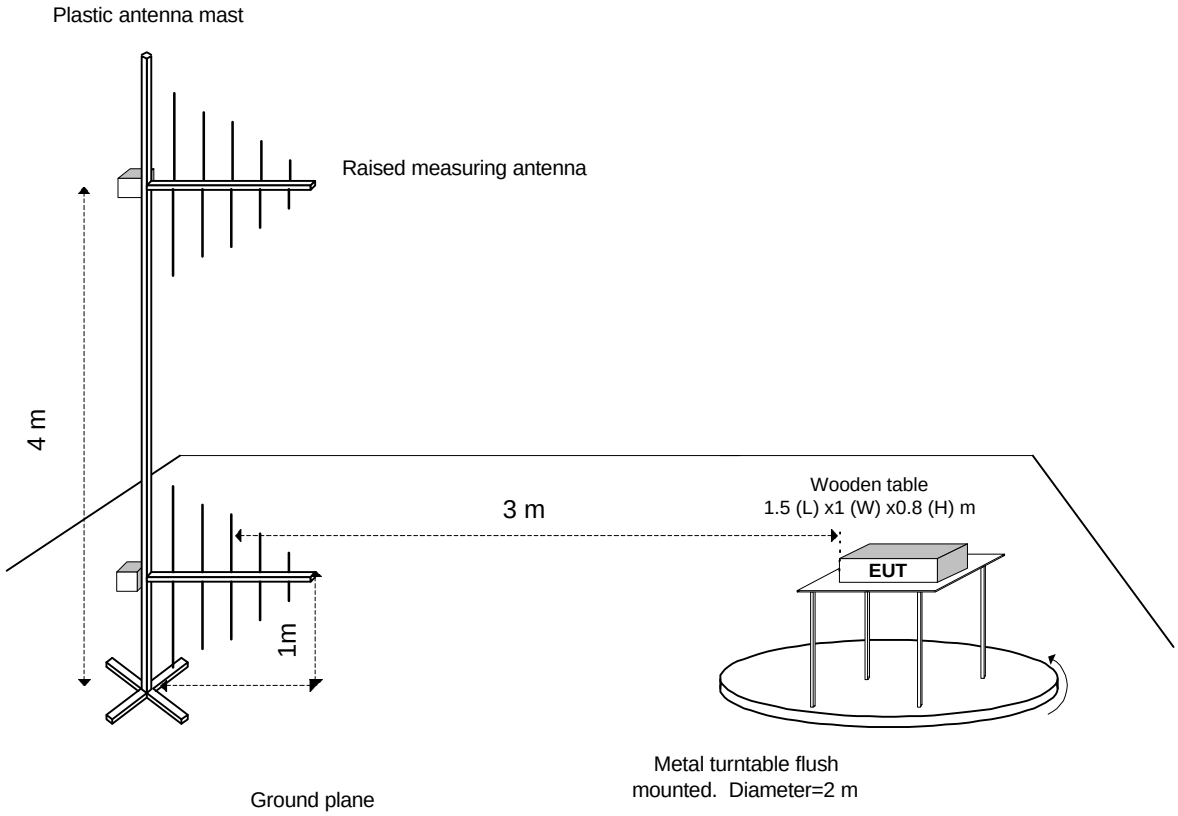
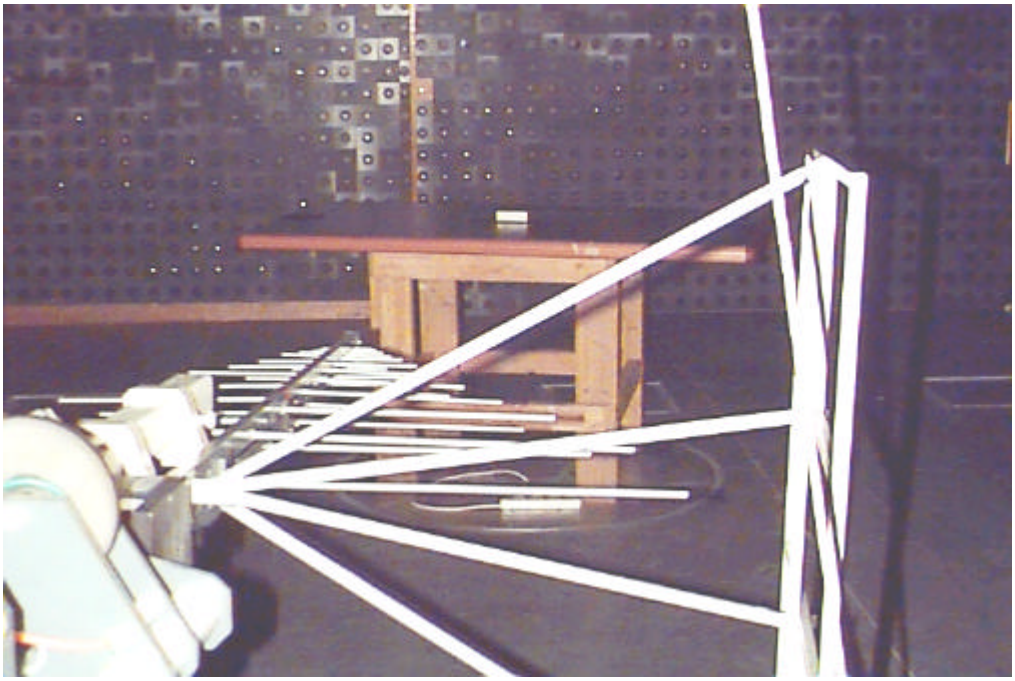


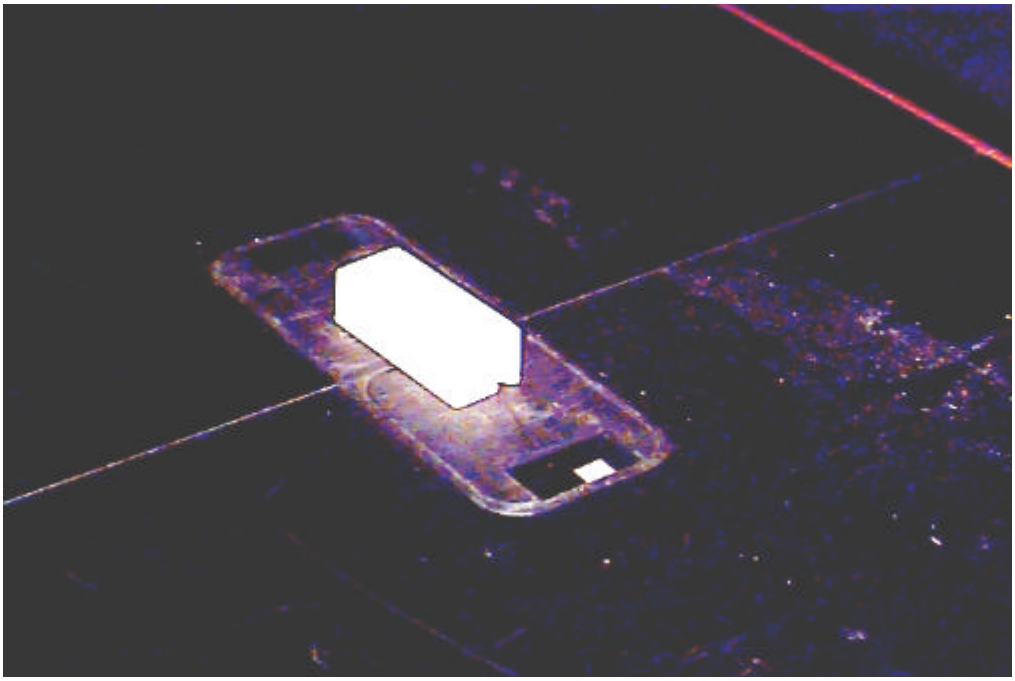
Figure 3.1
Radiated emission test setup



Photograph 3.1.1
Radiated emission measurements setup



Photograph 3.1.2
Radiated emission measurements setup



3.2 Bandwidth of emission according to § 15.231 (c)

3.2.1 Specified limits

The bandwidth of the emissions shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz.

3.2.2 Test procedure and results

The maximum allowed occupied bandwidth was calculated as 0.0025 of the center frequency:

0.0025 x 418 MHz = 1.045 MHz

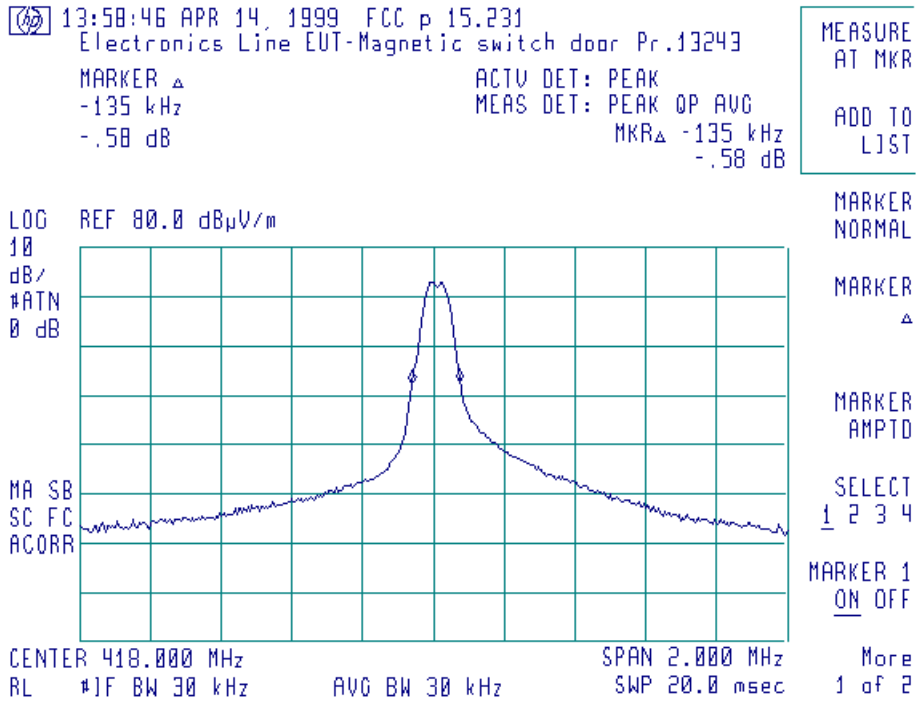
The spectrum trace data around transmitter fundamental frequency was obtained with the spectrum analyzer in “Max Hold” mode. The bandwidth value was determined between two points 20 dB down from the modulated carrier. The occupied bandwidth of 0.135 MHz was measured which is narrower than required 1.045 MHz.
The test results are shown in Plot 3.2.1.

Reference numbers of test equipment used

HL 0275	HL 0465	HL 0521	HL 0593	HL 0594	HL 0604	HL 0815
HL 0816						

Full description is given in Appendix A.

Plot 3.2.1
Emission bandwidth measurement results
Occupied bandwidth = 0.135 MHz



3.3 Periodic operation requirement §15.231(a)(1)

(1) The operation of the transmitter is as follows:

The device utilizes two switches to monitor open/close and tamper events, which are produced manually. The device used as a universal transmitter is provided with the external reed and tamper switches and without internal reed switch. The logic section detects transitions in the switches and activates the encoder and the transmitter to produce a 0.8 second transmission and ceases until the next event.

(2) The transmitter does not transmit automatically, except the supervision event. The supervision code is sent every hour.

3.4 Unintentional radiated emissions test according to §15.109

3.4.1 Definition of the test

This test was performed to measure radiated emissions from the incorporated digital device of the EUT and also to verify the EUT full compliance with §15.109, §15.209.

3.4.2 The test set-up configuration

The radiated emissions measurements of the EUT incorporated digital device were performed in the anechoic chamber at 3 meters measuring distance in the frequency range from 30 MHz to 5 GHz. The EUT was placed on the wooden table as shown in Figure 3.1 and Photographs 3.1.1, 3.1.2. The biconilog and double ridged guide antennas were used. To find maximum radiation the turntable was rotated 360^{o}, the measuring antenna height changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.
The measurements were performed with the EMI receiver settings:
from 30 MHz to 1 GHz RBW=120 kHz, quasi-peak detector;
from 1 GHz up to 5 GHz RBW = VBW = 1 MHz, peak detector.
The results of measurements are shown in Plots 3.4.1, 3.4.2. All the found emissions were at least 10 dB below limit. On Plot 3.4.2 recorded marker frequency 2.091 GHz reading was due to spurious and is brought in Table 3.1 of this test report.

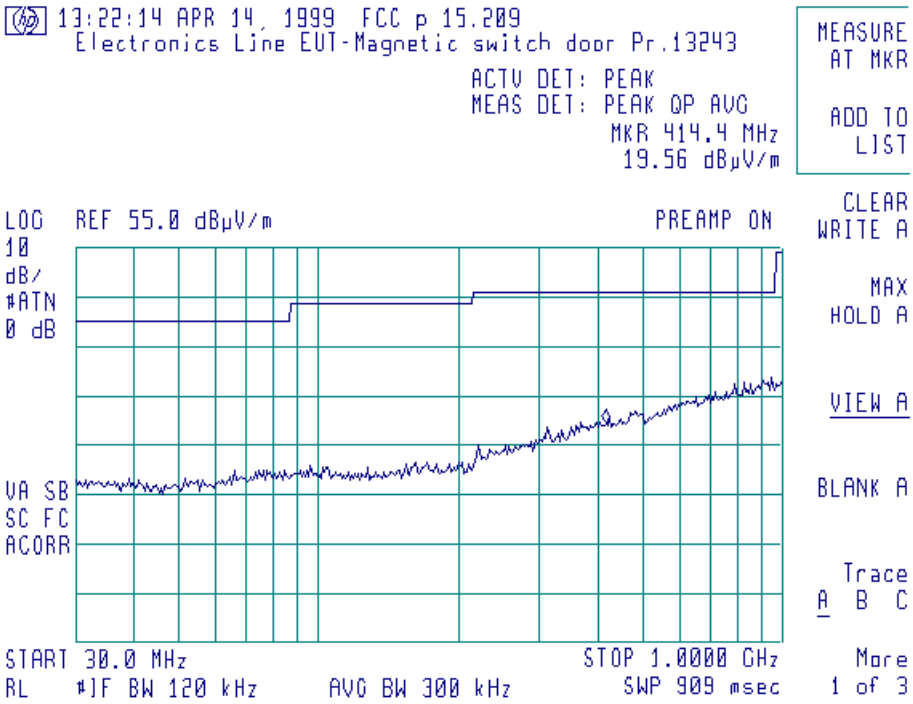
Reference numbers of test equipment used

HL 0041	HL 0275	HL 0465	HL 0521	HL 0593	HL 0594	HL 0604
HL 0815	HL 0816					

Full description is given in Appendix A.

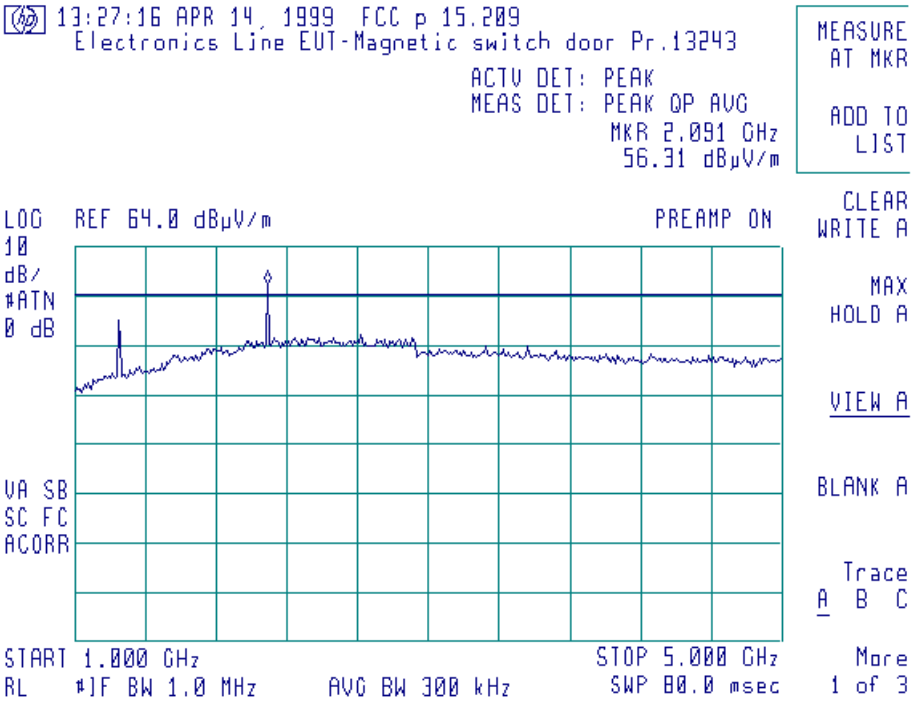
Plot 3.4.1

Test Specification: §15.109
Radiated emissions of digital incorporated device



Plot 3.4.2

Test Specification: §15.109
Radiated emissions of digital incorporated device



4 Summary and Signatures

The transmitter EL-2501/2502, FCC ID:HNA2YML was found to be in compliance with the requirements of FCC part 15 subpart C §§ 15.231, 15.209 and subpart B §15.109.

Test performed by:

Mr. Michael Feldman, test technician _____

Approved by:

Dr. Edward Usoskin, C.E.O. _____

Responsible person from Electronics Line Ltd.

Mr. Shaul Aviezer, QA manager _____

APPENDIX A - Test equipment and ancillaries used for tests

HL Serial No.	Serial No.	Description	Manufacturer	Model No.	Due Calibr.
0041	2811	Double Ridged Guide Antenna, 1-18 GHz	Electro-Metrics	RGA 50/60	8/99
0275	040	Table non-metallic, 1.5 x 1.0 x 0.8 m	Hermon Labs	WT-1	3/00 check
0465	023	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	10/99
0521	0319	Spectrum Analyzer with RF filter section (EMI Receiver 9 kHz – 6.5 GHz)	Hewlett Packard	8546A	7/99
0593	101	Antenna Mast, 1-4 m/ 1-6 m, pneumatic	Hermon Labs	AM-F1	4/00 check
0594	102	Turntable for Anechoic Chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	11/99 check
0604	1011	Antenna Log-Periodic/T Bow-Tie, 26 – 2000 MHz	EMCO	3141	12/99
0815	151	Cable, coax, RG-214, 7.3 m, N-type connectors, inside anechoic chamber	Hermon Labs	C214-7	8/99
0816	152	Cable, coax, RG-214, 8 m, N-type connectors, outside anechoic chamber	Hermon Labs	C214-8	8/99

APPENDIX B-Test Equipment Correction Factors

Antenna Factor at 3m calibration
Biconilog Antenna EMCO Model 3141
Ser.No.1011

Frequency, MHz	Antenna Factor, dB(1/m)
26	7.8
28	7.8
30	7.8
40	7.2
60	7.1
70	8.5
80	9.4
90	9.8
100	9.7
110	9.3
120	8.8
130	8.7
140	9.2
150	9.8
160	10.2
170	10.4
180	10.4
190	10.3
200	10.6
220	11.6
240	12.4
260	12.8
280	13.7
300	14.7
320	15.2
340	15.4
360	16.1
380	16.4
400	16.6
420	16.7
440	17.0
460	17.7
480	18.1
500	18.5
520	19.1
540	19.5
560	19.8
580	20.6
600	21.3
620	21.5
640	21.2
660	21.4
680	21.9
700	22.2
720	22.2
740	22.1
760	22.3
780	22.6
800	22.7
820	22.9
840	23.1
860	23.4
880	23.8
900	24.1
920	24.1

Frequency, MHz	Antenna Factor, dB(1/m)
940	24.0
960	24.1
980	24.5
1000	24.9
1020	25.0
1040	25.2
1060	25.4
1080	25.6
1100	25.7
1120	26.0
1140	26.4
1160	27.0
1180	27.0
1200	26.7
1220	26.5
1240	26.5
1260	26.5
1280	26.6
1300	27.0
1320	27.8
1340	28.3
1360	28.2
1380	27.9
1400	27.9
1420	27.9
1440	27.8
1460	27.8
1480	28.0
1500	28.5
1520	28.9
1540	29.6
1560	29.8
1580	29.6
1600	29.5
1620	29.3
1640	29.2
1660	29.4
1680	29.6
1700	29.8
1720	30.3
1740	30.8
1760	31.1
1780	31.0
1800	30.9
1820	30.7
1840	30.6
1860	30.6
1880	30.6
1900	30.6
1920	30.7
1940	30.9
1960	31.2
1980	31.6
2000	32.0

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field intensity in dB(μV/meter).

Antenna Factor
Double Ridged Guide Antenna
Electro-Metrics, Model RGA-50/60
Ser.No.2811

Frequency, MHz	Antenna Factor, dB(1/m)
1000	24.3
1500	25.4
2000	28.4
2500	29.2
3000	30.5
3500	31.6
4000	33.7
4500	32.2
5000	34.5
5500	34.5
6000	34.6
6500	35.3
7000	35.5
7500	35.9
8000	36.6
8500	37.3
9000	37.7
9500	37.7
10,000	38.2
10,500	38.5
11,000	39.0
11,500	40.1
12,000	40.2
12,500	39.3
13,000	39.9
13,500	40.6
14,000	41.1
14,500	40.5
15,000	39.9
15,500	37.8
16,000	39.1
16,500	41.1
17,000	41.7
17,500	45.1
18,000	44.3

Antenna factor dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field intensity in dB(μV/meter)