HERMON LABORATORIES

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Electrical

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RADIO TEST REPORT

according to 47 CFR Part 15 subpart C §15.231 and subpart B
for

Electronics Line 3000 Ltd.

EQUIPMENT UNDER TEST:

Passive infrared detector

Model: EL2645PI

Document ID: ELERAD_FCC.15840.doc
Date of issue: March 04

Contents

1 Project information

Description of equipment under test

Test items	Passive infrared (PIR) detector
Manufacturer	Electronics Line 3000 Ltd.
Type (Model)	EL2645PI
Equipment FCC code	DSR

Applicant information

Applicant's responsible person	Mr. Shaul Aviezer, Quality and Approvals Manager
Company	Electronics Line 3000 Ltd.
Address	58, Amal street
P.O.Box	3253
City	Petah Tikva
Postal code	49130
Country	Israel
Telephone number	+972 3921 1117
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Test performance

Project number:	15840
Location	Hermon Laboratories
Test performed	on March 2, 16, 2004
Purpose of test	Apparatus compliance verification in accordance with emission requirements
Test specification(s)	47CFR Part 15, subpart C, §15.231, §15.209, §15.205 and subpart B §15.109

2 Summary and signatures

The EUT, wireless PIR detector, was tested according to FCC part 15 subpart C, §§15.231, 15.209, part 15 §15.109 and found to comply with the standard requirements.

Test description	Specification reference	Tested by	Date tested	Test report paragraph	Verdict
Field strength of fundamental	15.231(b)(2)	Mr. A.Troupiansky, test engineer	March 2, 2004	4.1	Pass
Field strength of spurious radiation	15.231(b)(3)	Mr. A.Troupiansky, test engineer	March 2, 2004	4.2	Pass
Bandwidth of emission	15.231(c)	Mr. Y. Neuman, test engineer	October 26, 2003	4.3	Pass
Periodic operation requirements	15. 231(a)(2)	Mr. A.Troupiansky, test engineer	March 16, 2004	4.4	Pass
Radiated emissions	15.109	Mr. A.Troupiansky, test engineer	March 2, 2004	4.5	Pass

Test report prepared by:

Mrs. M. Cherniavsky, MScEE, certification engineer _____

Test report approved by:

Mr. Michael Nikishin, MScEE, group leader _____

Mr. Edward Usoskin, PhD, C.E.O. _____

3 EUT description

3.1 General

The EUT, model number EL2645PI, is a wireless PIR detector transmitter operating at 418 MHz with FSK modulated signal and designed for use with Electronics Line's supervised wireless receivers. The device utilizes integral, built-in whip antenna and is powered by 3.6 V lithium battery; its clock generates 4 MHz. The EL2645PI general view is shown in Photograph 3.1.1.

Photograph 3.1.1

EUT general view

4 Test results

4.1 Field strength of fundamental, § 15.231(b)(2)

METHOD OF MEASUREMENT:	ANSI 63.4 §13.1.5
DATE of TEST:	March 2, 2004
AMBIENT TEMPERATURE:	23°C
RELATIVE HUMIDITY:	52 %
AIR PRESSURE:	1015 hPa
TEST PERFORMED IN:	Anechoic chamber
DISTANCE BETWEEN ANTENNA AND EUT:	3 m
MODULATION:	ON
ANTENNA TYPE:	Log periodic
MEASUREMENT UNCERTAINTY:	± 5.3 dB

	§ 15.231 (b)	§ 15.231 (e)
The EUT complies with the requirements of	X	

Peak detector

Frequency, MHz	Measured field strength, dB(µV/m)	Antenna polariz.	Antenna height, m	Turntable position, (^{o})	Specification limit, dB(µV/m)	Margin, dB	Verdict	Reference to plot in Annex A
417.983	68.8	Horizontal	1.9	142	80.3	11.5	Pass	A1

Turntable position in degrees, EUT front panel = 0^o.
Margin = dB below (negative if above) specification limit.

LIMIT § 15.231 (b)

Fundamental frequency, MHz	Field strength of fundamental @ 3 m, dB(µV/m)
418	80.3

The above field strength limits are based on average limits.
The section 15.35 requirements for limiting peak emissions provided.

TEST PROCEDURE

The EUT was tested, being placed on a wooden 80 cm height table in typical installation position (as wall-mounted device). 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.

TEST EQUIPMENT USED:

HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604
HL 2009						

4.2 Field strength of spurious radiation, § 15.231(b)(3)

METHOD OF MEASUREMENT:	ANSI 63.4 §13.1.4
DATE of TEST:	March 2, 2004
AMBIENT TEMPERATURE:	23°C
RELATIVE HUMIDITY:	52 %
AIR PRESSURE:	1015 hPa
TEST PERFORMED IN:	Anechoic chamber
DISTANCE BETWEEN ANTENNA AND EUT:	3 m
DETECTOR USED:	Peak
MEASUREMENT UNCERTAINTY:	± 6 dB max

The frequency spectrum was investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to the tenth harmonic (4.2 GHz)

Test was performed with loop antenna

Frequency, MHz	Antenna polarization	RBW, kHz	VBW, kHz	Radiated emission, dB (µV/m)	Limit @ 3 m, dB(µV/m)	Margin, dB	Verdict
0.009 – 0.150	V	0.2	0.3	All emissions were found 20 dB below the limit, refer to Plot A2			Pass
0.150 - 30	V	9	30	All emissions were found 20 dB below the limit, refer to Plot A3			Pass

Test was performed with biconilog antenna in 30 – 1000 MHz range and with double ridged guide - in 1000 to 4200 MHz range

Frequency, MHz	Antenna polarization	Antenna height, m	Turntable position, (^{o})	Radiated emissions, peak, dB (µV/m)	Limit (average) @ 3 m, dB (µV/m)	Margin, dB	Verdict
1671.920	V	1.00	196	47.0	54.0	7.0	Pass
2089.920	H	1.88	39	44.4	60.3	15.9	Pass

For full test results refer to Plots A2 to A7.

Notes to table:

Antenna polarization: V- vertical, H- horizontal
Resolution bandwidth (RBW) and video bandwidth (VBW) settings are shown in the plots
Turntable position in degrees, EUT front panel = 0^o.
Margin = dB below (negative if above) specification limit.

TEST PROCEDURE

The EUT was tested, being placed on a wooden 80 cm height turntable in typical installation position (as wall-mounted device).

9 kHz – 30 MHz frequency range. The loop antenna was positioned with its plane vertical. The loop center was 1 meter above the ground plane. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated about its vertical axis.

30 MHz – 4.2 GHz frequency range. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

TEST EQUIPMENT USED IN ANECHOIC CHAMBER:

HL 0446	HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594
HL 0604	HL 1984	HL 2009				

4.3 Bandwidth of emission according to § 15.231 (c)

METHOD OF MEASUREMENT:	ANSI 63.4 §13.1.7
DATE of TEST:	October 26, 2003
RELATIVE HUMIDITY:	42 %
AMBIENT TEMPERATURE:	24°C
AIR PRESSURE:	1009 hPa
MODULATION:	ON
DETECTOR USED:	Peak
MEASUREMENT UNCERTAINTY:	0.21 ppm

Carrier frequency MHz	Occupied bandwidth, kHz			Verdict
	Measured	Limit	Reference to plot in Annex A	
418	77.6	1045	A8	Pass

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

TEST PROCEDURE

The EUT was tested, being placed on a wooden 80 cm height table in typical installation position (as wall-mounted device). 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.

TEST EQUIPMENT USED:

HL 0026	HL 0337					

LIMIT § 15.231 (c)

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

4.4 Periodic operation requirements, § 15.231(a)(2)

DATE of TEST:	March 16, 2004
AMBIENT TEMPERATURE:	21°C
RELATIVE HUMIDITY:	35 %
AIR PRESSURE:	1018 hPa
TEST PERFORMED IN:	Anechoic chamber
MEASUREMENT UNCERTAINTY:	± 1.0 %

A transmitter activated automatically shall cease transmission within 5 seconds after activation

TEST PROCEDURE

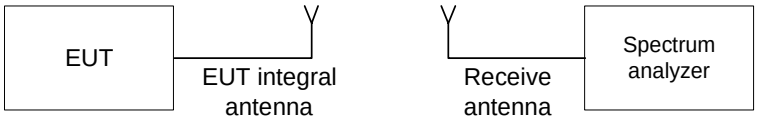
The EUT was set up as shown in Figure 4.4.1.
The spectrum analyzer center frequency was adjusted to the EUT carrier, span set to zero and video triggered for transmission. The transmitter was automatically activated.

The device transmits data in the following events:

1) The pattern of the detector is crossed by a burglar (PIR detector operation)
2) The tamper switch activation (in the moment of opening or closing the detector cover).
The transmission time was captured and shown in Plots A9, A10.

Figure 4.4.1

Setup for transmitter shut down test



Event	Transmission duration, s			Verdict
	Measured	Limit	Reference to plot in Annex A	
PIR detector operation	2	5	A9	Pass
Tamper switch activation	2.56		A10	Pass

TEST EQUIPMENT USED:

HL 0465	HL 0521	HL 1562				

4.5 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT:	ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
DATE of TEST:	March 2, 2004
AMBIENT TEMPERATURE:	23°C
RELATIVE HUMIDITY:	52 %
AIR PRESSURE:	1015 hPa
TEST PERFORMED IN:	Anechoic chamber
DISTANCE BETWEEN ANTENNA AND EUT:	3 m
THE EUT WAS TESTED AS:	Table-top
FREQUENCY RANGE:	30 MHz – 1 GHz
DETECTOR TYPE:	Quasi-peak
RESOLUTION BANDWIDTH:	120 kHz
ANTENNA TYPE:	Biconilog

The EUT highest used frequency (not including operating frequency), MHz	Upper frequency of measurement range, MHz
Below 1.705	30
1.705 – 108	**1000**
108 – 500	2000
500 – 1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

TEST RESULTS:

All the measured emissions were found at least 20 dB below specified limit, refer to Plot A11.

TEST PROCEDURE

The EUT was placed on a wooden 80 cm height table. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

TEST EQUIPMENT USED:

HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604
HL 2009						

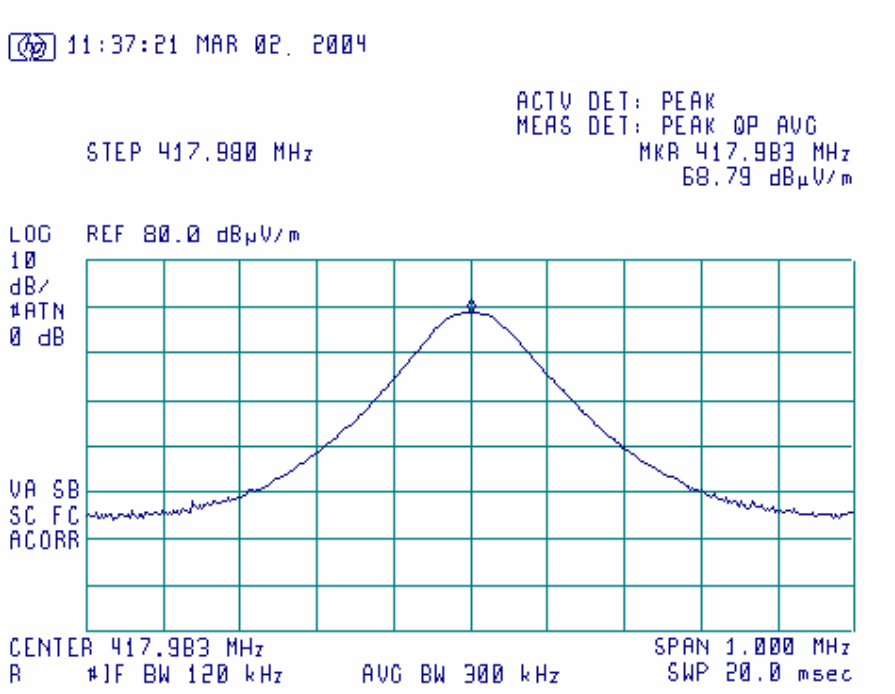
LIMIT § 15.109

Frequency, MHz	Class B equipment @ 3 m dB(µV/m)
30 - 88	40
88 - 216	43.5
216 - 960	46
960 - 5000	54

Appendix A - Plots

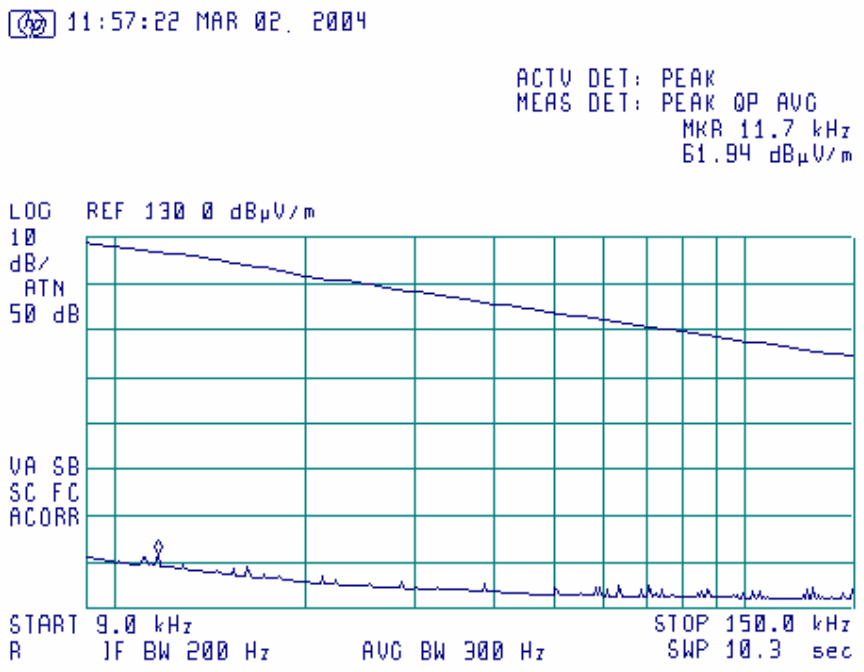
Plot A 1

Field strength of fundamental measurement result in the anechoic chamber, horizontal antenna polarization



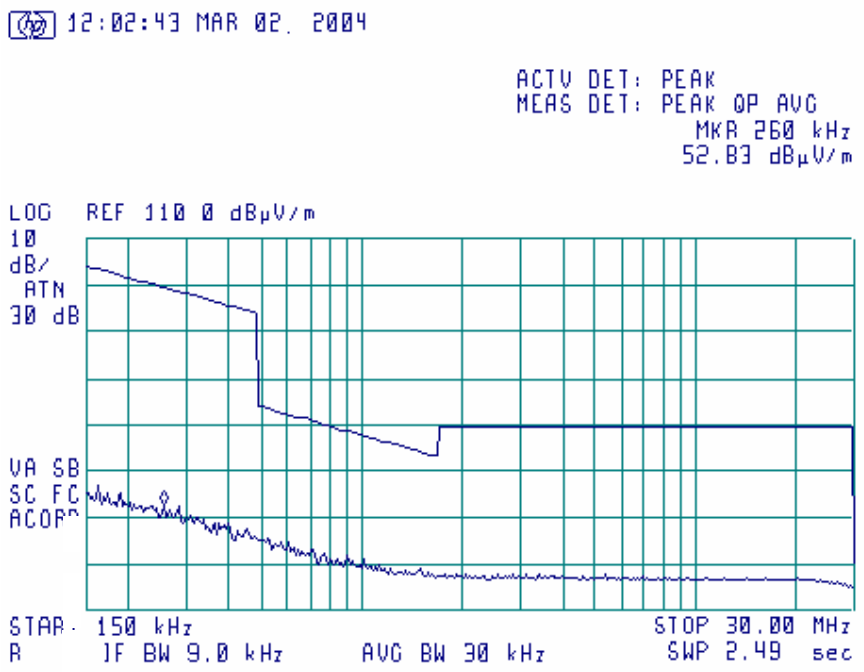
Plot A 2

Spurious emissions measurement test results in the anechoic chamber in 9 – 150 kHz range, vertical antenna polarization



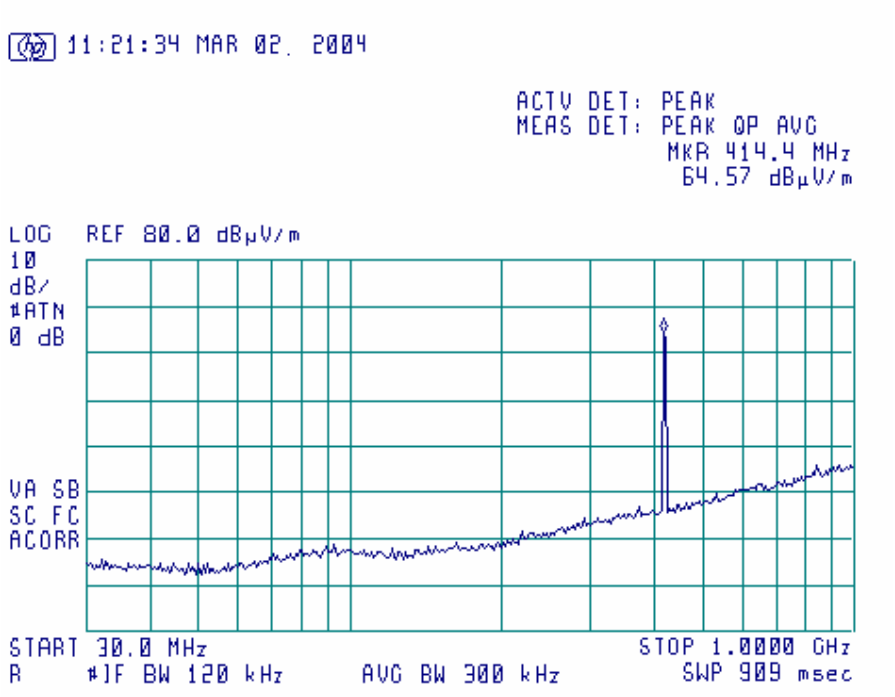
Plot A 3

Spurious emissions measurement test results in the anechoic chamber in 150 kHz – 30 MHz range, vertical antenna polarization



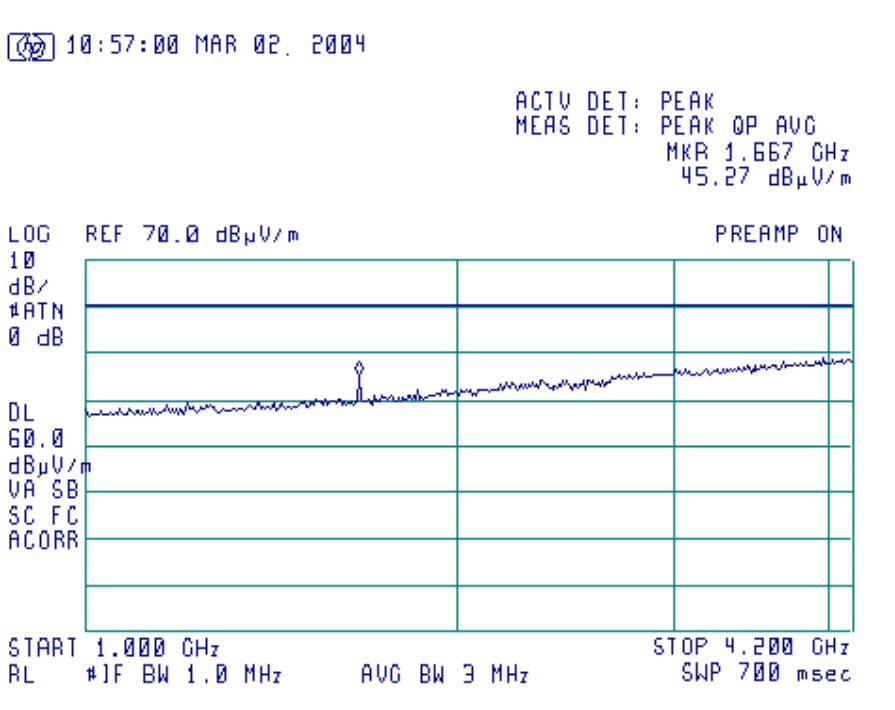
Plot A 4

Spurious emissions measurement test results in the anechoic chamber in 30 - 1000 MHz range, vertical and horizontal antenna polarization



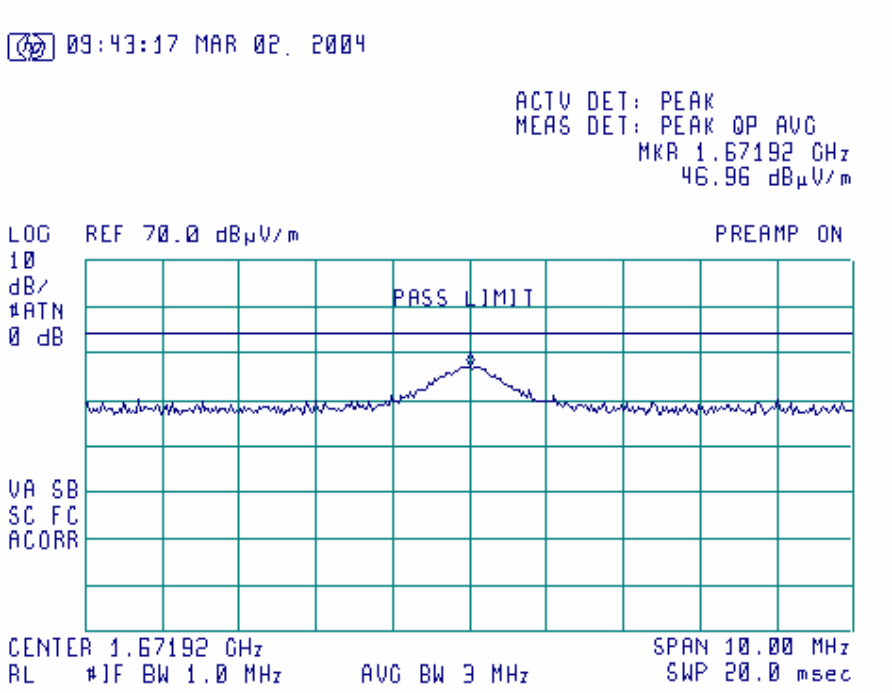
Plot A 5

Spurious emissions measurement test results in the anechoic chamber in 1000 – 4200 MHz range, vertical and horizontal antenna polarization



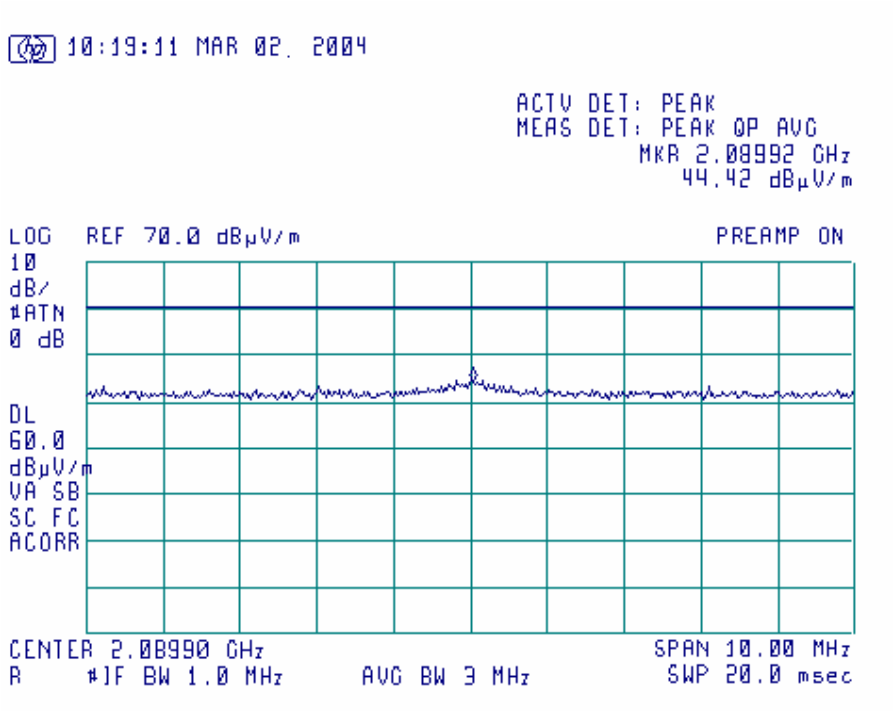
Plot A 6

Spurious emissions measurement test results in the anechoic chamber, vertical antenna polarization



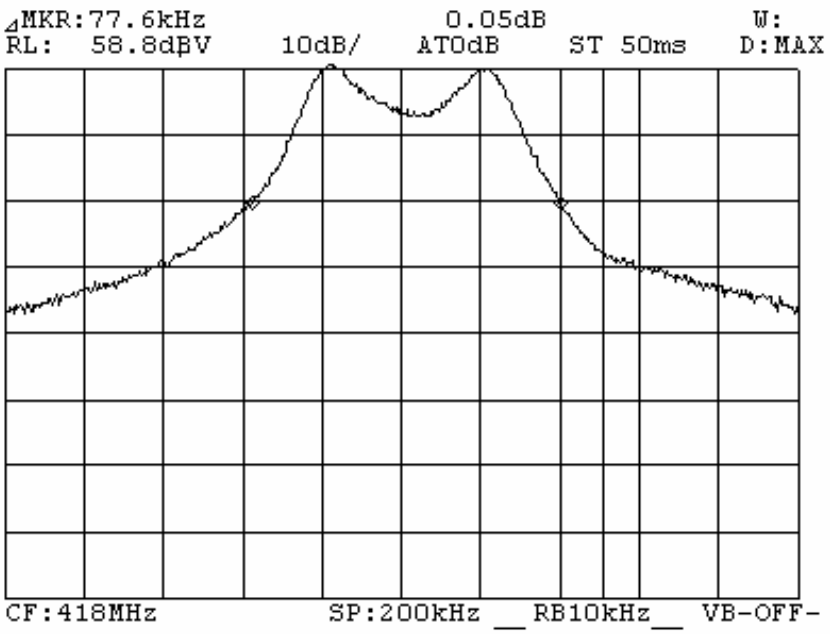
Plot A 7

Spurious emissions measurements results in the anechoic chamber, horizontal antenna polarization



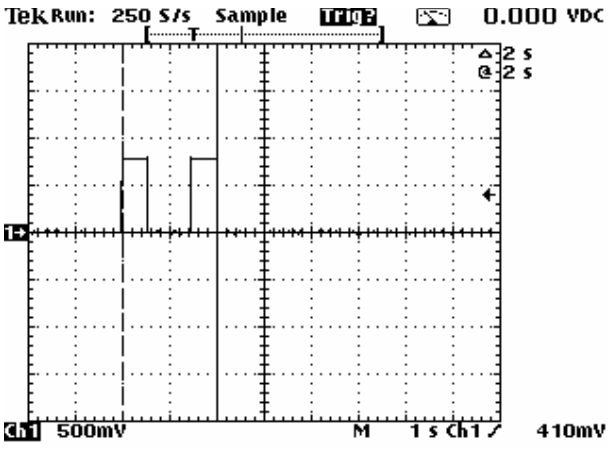
Plot A 8

Occupied bandwidth measurement test result



Plot A 9

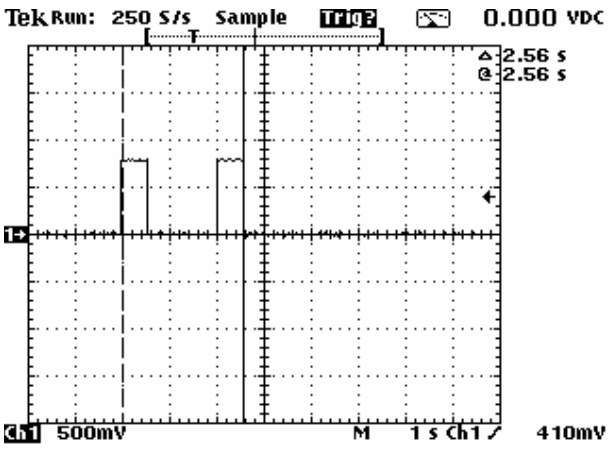
Transmission duration at PIR operation (crossing the pattern of the detector)



Transmission duration is 2 s

Plot A 10

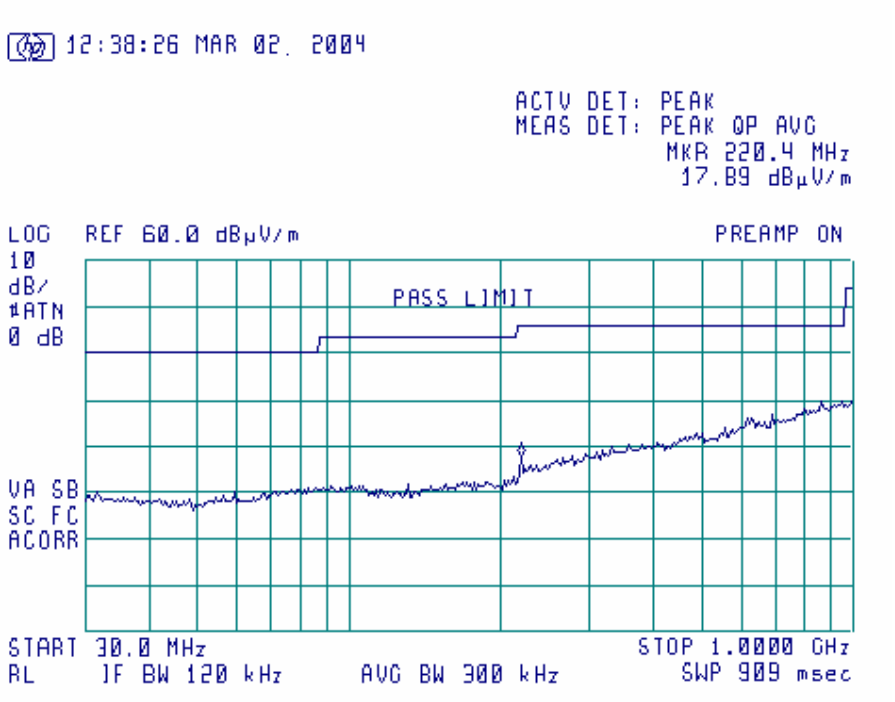
Transmission duration at the tamper switch activation



Transmission duration is 2.56 s

Plot A 11

Unintentional radiated emissions test results in the anechoic chamber, vertical and horizontal antenna polarization



Appendix B - Test equipment used for tests

HL Serial No.	Description	Manufacturer information			Due calibration Month/ year
		Name	Model No.	Serial No.	
0446	Active loop antenna, 10 kHz - 30 MHz	Electro-Mechanics	6502	2857	10/04
0465	Anechoic chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	10/05 check
0521	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/04
0589	Cable coaxial, GORE A2POL118.2, 3 m	Hermon Labs	GORE-3	589	11/04
0592	Position controller	Hermon Labs	L2-SR3000	100	5/04 check
0593	Antenna mast, 1-4 m/ 1-6 m Pneumatic	Hermon Labs	AM-F1	101	2/05 check
0594	Turntable for Anechoic Chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	102	1/05 check
0604	Antenna biconilog log-periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	1/05
1562	Oscilloscope 100 MHz, DMM	Tektronix	THS720A	9444	9/04
1984	Antenna, double ridged waveguide horn, 1-18 GHz, 300 W, N-type	EMC Test Systems	3115	9911-5964	3/05
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	12/04

Appendix C – Antenna factors and cable loss

Antenna factor
Active loop antenna
Model 6502
S/N 2857

Frequency, MHz	Magnetic antenna factor, dB	Electric antenna factor, dB
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.8
0.750	-41.9	9.7
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.2
4.000	-41.4	10.1
5.000	-41.5	10.1
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

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

Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011

Frequency, MHz	Antenna Factor, dB(1/m)	Frequency, MHz	Antenna Factor, dB(1/m)
26	7.8	940	24.0
28	7.8	960	24.1
30	7.8	980	24.5
40	7.2	1000	24.9
60	7.1	1020	25.0
70	8.5	1040	25.2
80	9.4	1060	25.4
90	9.8	1080	25.6
100	9.7	1100	25.7
110	9.3	1120	26.0
120	8.8	1140	26.4
130	8.7	1160	27.0
140	9.2	1180	27.0
150	9.8	1200	26.7
160	10.2	1220	26.5
170	10.4	1240	26.5
180	10.4	1260	26.5
190	10.3	1280	26.6
200	10.6	1300	27.0
220	11.6	1320	27.8
240	12.4	1340	28.3
260	12.8	1360	28.2
280	13.7	1380	27.9
300	14.7	1400	27.9
320	15.2	1420	27.9
340	15.4	1440	27.8
360	16.1	1460	27.8
380	16.4	1480	28.0
400	16.6	1500	28.5
420	16.7	1520	28.9
440	17.0	1540	29.6
460	17.7	1560	29.8
480	18.1	1580	29.6
500	18.5	1600	29.5
520	19.1	1620	29.3
540	19.5	1640	29.2
560	19.8	1660	29.4
580	20.6	1680	29.6
600	21.3	1700	29.8
620	21.5	1720	30.3
640	21.2	1740	30.8
660	21.4	1760	31.1
680	21.9	1780	31.0
700	22.2	1800	30.9
720	22.2	1820	30.7
740	22.1	1840	30.6
760	22.3	1860	30.6
780	22.6	1880	30.6
800	22.7	1900	30.6
820	22.9	1920	30.7
840	23.1	1940	30.9
860	23.4	1960	31.2
880	23.8	1980	31.6
900	24.1	2000	32.0
920	24.1		

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

Antenna factor
Double-ridged wave guide horn antenna
Model 3115, S/N 9911-5964, HL1984

Frequency, MHz	Antenna factor, dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.6
2500.0	28.9
3000.0	31.2
3500.0	32.0
4000.0	32.5
4500.0	32.7
5000.0	33.6
5500.0	35.1
6000.0	35.4
6500.0	34.9
7000.0	36.1
7500.0	37.8
8000.0	38.0
8500.0	38.1
9000.0	39.1
9500.0	38.3
10000.0	38.6
10500.0	38.2
11000.0	38.7
11500.0	39.5
12000.0	40.0
12500.0	40.4
13000.0	40.5
13500.0	41.1
14000.0	41.6
14500.0	41.7
15000.0	38.7
15500.0	38.2
16000.0	38.8
16500.0	40.5
17000.0	42.5
17500.0	45.9
18000.0	49.4

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

Cable loss
RF cable 8 m, model RG-214, HL 2009

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	1	0.10	NA	±0.12
2	10	0.14		
3	30	0.25		
4	50	0.34		
5	100	0.53		
6	300	0.99		
7	500	1.31		
8	800	1.73		
9	1000	1.98		
10	1100	2.11		
11	1200	2.21		
12	1300	2.35		
13	1400	2.46		
14	1500	2.55		
15	1600	2.68		
16	1700	2.78		
17	1800	2.88		
18	1900	2.98		
19	2000	3.09		

Appendix C - General information

Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental 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) and by Industry Canada for electromagnetic emissions (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-1082 for anechoic chamber, C-845 for conducted emissions site), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, telecommunications, environmental, safety standards, and by AMTAC (UK) for safety of medical devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01) and approved by Israel Ministry of environmental protection, radiation hazards department (Permit number 1158).

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

Abbreviations and acronyms

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

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
EMC	electromagnetic compatibility
EUT	equipment under test
GHz	gigahertz
H	height
Hz	hertz
kHz	kilohertz
kV	kilovolt
L	length
LNA	low noise amplifier
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
RF	radio frequency
RE	radiated emission
rms	root mean square
s	second
V	volt
W	width

Specification references

47CFR part 15: 2003	Radio Frequency Devices
ANSI C63.2:1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4:2001	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.