HERMON LABORATORIES

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839.01
Electrical

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ELECTROMAGNETIC EMISSION TEST REPORT

ACCORDING TO 47CFR PART 15, SUBPART C § 15.209, 15.205 and SUBPART B

for

Given Imaging Ltd.

EQUIPMENT UNDER TEST:

Patency scanner

Brand name: M2A

Model: PS1

Document ID: GIVRAD_FCC.15361.rev1.doc
Date of Issue: August 2003

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Contents

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1 Project information

Description of equipment under test

Test item	Patency scanner
Manufacturer	Given Imaging Ltd.
Brand name	M2A
Type (Model)	PS1
Equipment FCC code[1]	DCD

Applicant information

Applicant's responsible person	Mr. Hezi Erez, project manager
Company	Given Imaging Ltd.
Address	2 Carmel street
City	Yokneam
Postal code	20692
Country	Israel
Telephone number	+972 4 909 7777
Telefax number	+972 4 959 3859

Test performance

Project number:	15361
Location	Hermon Laboratories
Receipt date	December 3, 2002
Test performed	December 22, 2002
Purpose of test	Apparatus compliance verification in accordance with emission requirements
Test specifications	47CFR Part 15, §15.209, 15.205 and subpart B

[1] FCC Equipment codes – see Appendix D

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2 Summary of tests

The tests listed in the table below were performed. The EUT was found complying with the limits of 47CFR Part 15, §15.209, 15.205 and subpart B.

Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
Intentional radiation, §15.209								
Field strength of emission	(a)	**C**				Mr. M. Feldman, test engineer	December 3, 23, 2002	
Unintentional radiation, §15.107, §15.109								
Conducted emissions	15.107				**NA**			
Radiated emissions	15.109	**C**				Mr. M. Feldman, test engineer	December 4, 2002	

NOTE: C: The parameter is compliant with the requirements.
NC: The parameter is not compliant with the requirements.
NT: The parameter is not tested.
NA: The test of this parameter is not applicable.

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Parameter	Subclause	C	NC	NT	NA	Remarks
General conditions under Part 15						
The Intentional radiator operates at 128 kHz.	15.209	**C**				
The intentional radiator does not operate in the restricted bands of operation.	15.205	**C**				
The intentional radiator has permanently attached antenna or antenna that uses a unique coupling to the intentional radiator.	15.203	**C**				
The intentional radiator has a standard connector and must be professionally installed. To demonstrate that professional installation is required, the following three points must be addressed: (a) the application (or intended use) of the EUT; (b) the installation requirements of the EUT, and (c) the method by which the EUT will be marketed.	15.203				**NA**	
No antenna other than that furnished by the responsible party can be used with the device.	15.203				**NA**	
Antenna technical characteristics, as referred to in "Transmitter description" table in the test report	15.204	**C**				

Test report prepared by: Mrs. V. Mednikov, certification engineer

Test report approved by: Mr. A. Usoskin, QA manager

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3 EUT description

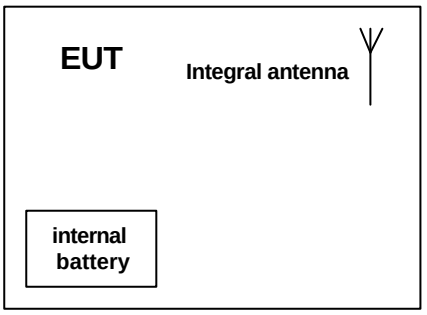
3.1 General description

The hand-held scanner is used for detecting a tag inside a human body by transmitting and receiving the retransmitted RF signals from the tag.
The device transmits at 126 kHz, receives signals at 64 kHz and is powered from eight light 1.5 V batteries.

3.2 EUT test configuration

The EUT test configuration is shown in Figure 3.2.1.

Figure 3.2.1 EUT test configuration



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3.3 Transmitter description

Type of equipment					
Ú	Stand-alone (Equipment with or without its own control provisions)				
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
	Plug-in card (Equipment intended for a variety of host systems)				
	Other:				
Operating frequency	126 kHz				
Transmitter aggregate data rate (bits per second)					
Normal test signal	Transmits carrier				
Maximum rated output power					
At transmitter permanent external 50Ω rf output connector (dBm)					
Effective radiated power (for equipment with integral antenna) (dBm)	106 dB(µV/m)				
Is transmitter output power variable?	Ú	No			
		Yes		continuous variable	
				stepped variable	
				stepsize (dB):	
				minimum RF power (dBm):	
				maximum RF power (dBm):	
Transmitter power source					
Ú	**Battery**	**Nominal rated voltage (VDC)**	**12**		
	Nickel Cadmium				
	Lithium				
Ú	Other: 8 “AA” type 1.5 V batteries				
	DC	**Nominal rated voltage (VDC)**			
	AC mains	**Nominal rated voltage (VAC)**			
Is there common power source for transmitter and receiver			Ú	yes	no

Antenna technical characteristics						
			Type	**Manufacturer**	**Model number**	**Gain**
Integral		with temporary RF connector				
	Ú	without temporary RF connector	Loop	EID Aalten b.v.	LID650PATENCY zendpoel v11	0
External						

External antenna connection - NA			

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4 Tests results

4.1 Field strength of emission according to §15.209

Carrier field strength

METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.4
DATE: December 3, 2002
RELATIVE HUMIDITY: 42 %
AMBIENT TEMPERATURE: 23 °C
TEST PERFORMED IN: OATS
DISTANCE BETWEEN ANTENNA AND EUT: 6 m
ANTENNA TYPE: LOOP

Frequency, kHz	Measured field strength, dB(uV/m)	Average factor, dB	Calculated result, dB(uV/m)	Specification limit, dB(uV/m)	Reference to plot in Annex A
125.9	115.48	-10.0	105.48	114.0	A1
Measurement uncertainty, dB			-5.73 dB/ -5.57 dB		

4.1.1 Average factor calculation, §15.35

Tx ON	Duty cycle	Average factor	Reference to plot in Annex A
31.5	0.315	-10.0	A2, A3

LIMIT

Frequency, MHz	Limit dB(■V/m)	Measurement distance, m
0.009 – 0.490	67.60-20logF*	300**
0.490 – 1.705	87.60-20logF*	30**
1.705 - 30	29.5	30**
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960*	54.0	3

* F is frequency in kHz.

**The limit for 6 m distance was calculated using the distance extrapolation factor (DEF) as follows:

$Lim S_2 = Lim S_1 + DEF \times \log (S_1/S_2)$, where $S_1 = 300$ m, $S_2 = 6$ m.
The DEF was calculated for 3 pairs of distances (15 and 10 m, 10 and 6 m, 6 and 3 m) as follows:
$DEF = (E_2 – E_1) / \log (d_2/d_1)$, where E_i is the field strength at distance d_i .
The worst case result was 52.48 dB/decade.
At 125.9 kHz frequency the limit was calculated, using DEF= 52 dB/decade:

$Lim_{3m} = 67.60 – 20 \log 125.9 + 52 \log (300/6) = 114.0$ dB(μV/m)

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4.2 Spurious emission measurements

METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.4
DATE: December 3, 23, 2002
RELATIVE HUMIDITY: 42 %
AMBIENT TEMPERATURE: 23 °C
TEST PERFORMED IN: Anechoic chamber
DISTANCE BETWEEN ANTENNA AND EUT: 3 m
ANTENNA TYPE: LOOP

Frequency, MHz	Measured peak field strength, dB(uV/m)	Calculated average value*, dB(uV/m)	Specification limit, dB(uV/m)	Reference to plot in Annex A
0.25186	80.69	70.69	99.53**	A6
0.377235	72.71	62.71	96.16**	A6
0.504125	68.82	-	73.58***	A6
0.755565	61.90	-	70.16***	A6
0.883625	58.59	-	68.76***	A6
Measurement uncertainty, dB		-5.73 dB/ -5.57 dB		

* Calculated average value = Measured peak field strength + Average factor (see paragraph 4.1.1)
** Average specification limit
*** Quasi-peak specification limit.
For all test results see Plots A4 to A7.

LIMIT

Frequency, MHz	Limit dB(■V/m)	Measurement distance, m
0.009 – 0.490	67.60-20logF*	300**
0.490 – 1.705	87.60-20logF*	30**
1.705 - 30	29.5	30**
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960*	54.0	3

* F is frequency in kHz.

**The limit for 3 m distance, at frequency F kHz, was calculated using the inverse square distance extrapolation factor as follows:

$Lim S_2 = 67.60 – 20 \log F + 40 \log (S_1/S_2)$, where $S_1 = 300$ m or 30 m, $S_2 = 3$ m.

TEST EQUIPMENT USED:

HL 0415	HL 0465	HL 0521	HL 0812	HL 1430	HL 1915	

TEST PROCEDURE

The EUT was tested, being placed on a wooden 80 cm height table in each of three orthogonal planes in turn.

The loop antenna was positioned with its plane horizontal. The loop center was 1 meter above the ground plane. To find maximum radiation the turntable was rotated 360°. Then the loop position was changed to vertical. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated about its vertical axis.

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4.3 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT: ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
TEST PERFORMED IN: ANECHOIC CHAMBER
DATE: December 4, 2002
RELATIVE HUMIDITY: 46 %
AMBIENT TEMPERATURE: 23 °C
DISTANCE BETWEEN ANTENNA AND EUT: 3 m
THE EUT WAS TESTED AS: TABLE-TOP

	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

30 – 1000 MHz frequency range

DETECTOR TYPE: PEAK
RESOLUTION BANDWIDTH: 120 kHz
ANTENNA TYPE: BICONILOG

Frequency, MHz	TT position, (°)	Field strength, dB(uV/m)	Specification limit, dB(uV/m)	Reference to plot in Annex A
46.222327	46	12.43	40	A8
80.006168	173	20.68	40	A8
90.021513	179	18.06	43.5	A8
Measurement uncertainty, dB		-5.73 dB/ -5.57 dB		

Radiated emission dB(μV/m) = measured results dB(μV) + correction factor dB(1/m).
Correction factor = antenna factor + cable loss (for antenna factor and cable loss refer to Appendix B).
TT pos. = turntable position in degrees, (EUT front panel = 0°).

Test results recorded in the Table were obtained throughout the measurements with biconilog antenna at 1 m height.

TEST EQUIPMENT USED:

HL 0465	HL 0521	HL 0589	HL 0604	HL 1004	HL 2009	

LIMIT (§ 15.109)

Frequency, MHz	Class A equipment @ 10 m dB(■V/m)	Class B equipment @ 3 m dB(■V/m)
30 - 88	39.0	40
88 - 216	43.5	43.5
216 - 960	46.4	46
960 - 5000	49.5	54

TEST PROCEDURE

The EUT was tested, being 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.

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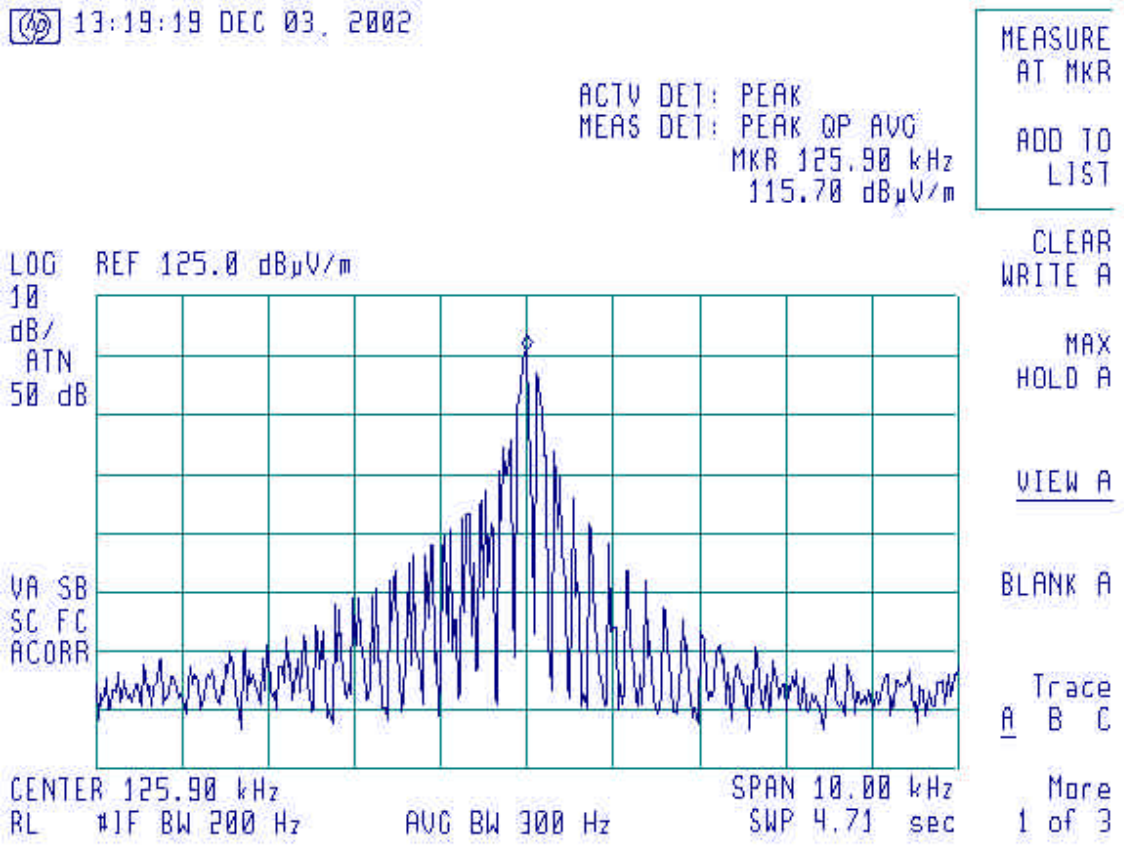
Appendix A
Plots

Plot A1

Field strength of fundamental test result, 125.9 kHz carrier



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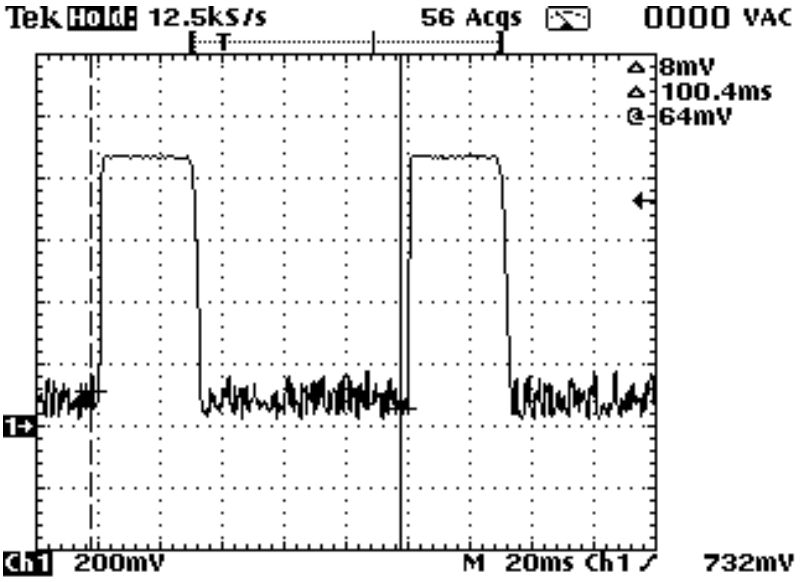
Plot A2

Interval between two successive transmissions



The interval between two successive transmissions is 100.4 ms

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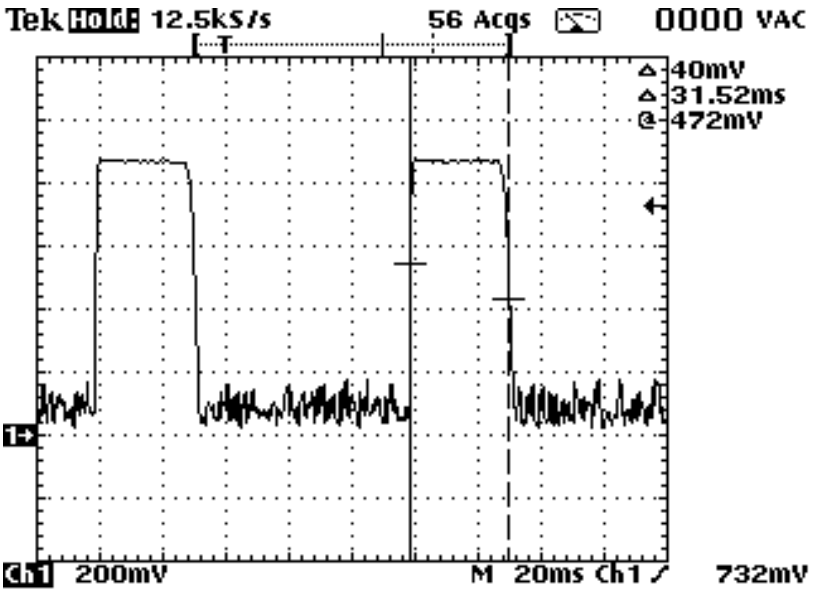
Plot A3

One transmission duration



One transmission duration is 31.5 ms

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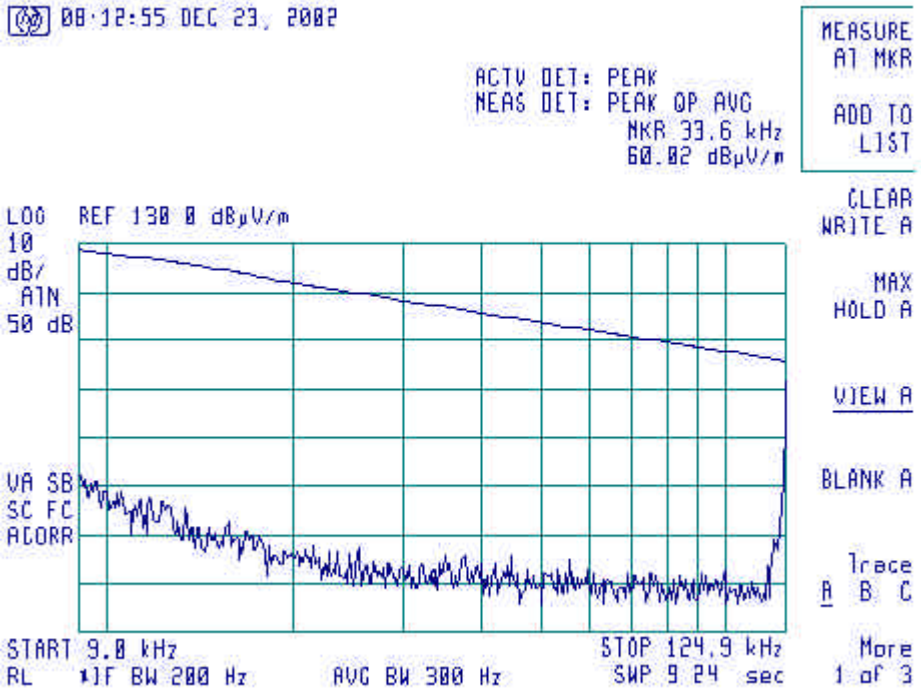
Plot A4

Spurious emission measurement results

9 kHz – 124.9 kHz



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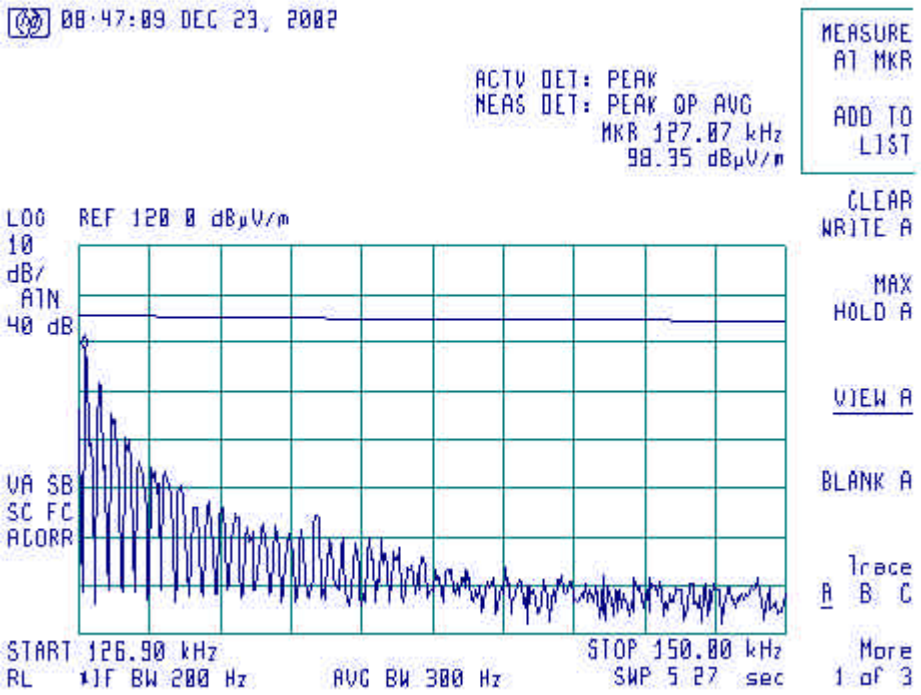
Plot A5

Spurious emission measurement results

126.9 kHz – 150 kHz



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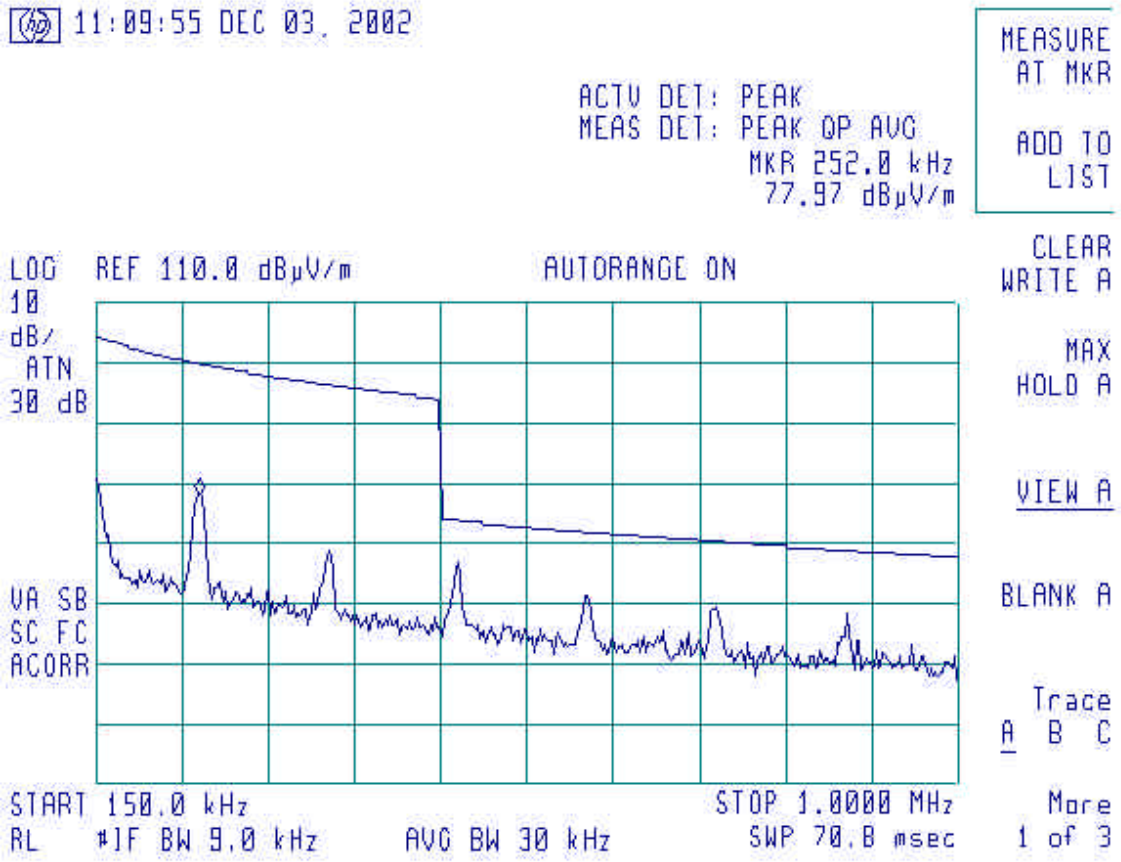
Plot A6

Spurious emission measurement results

150 kHz – 1 MHz



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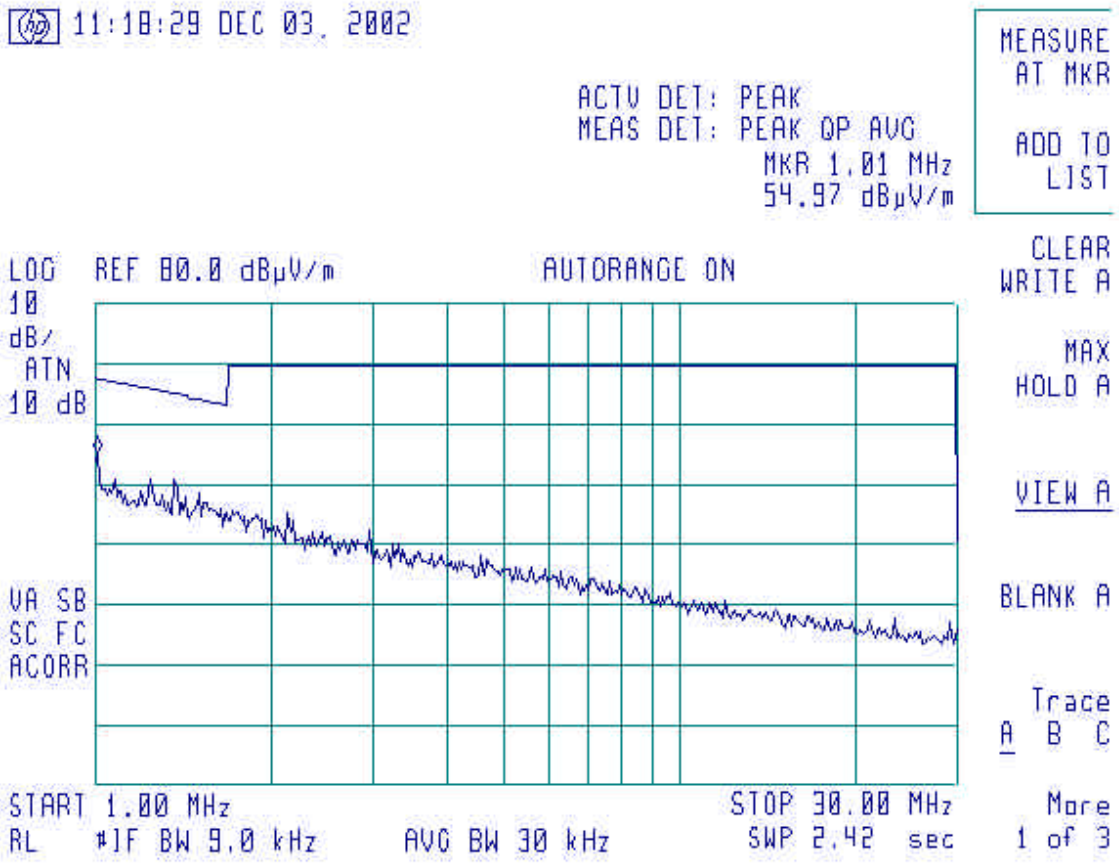
Plot A7

Spurious emission measurement results

1 – 30 MHz



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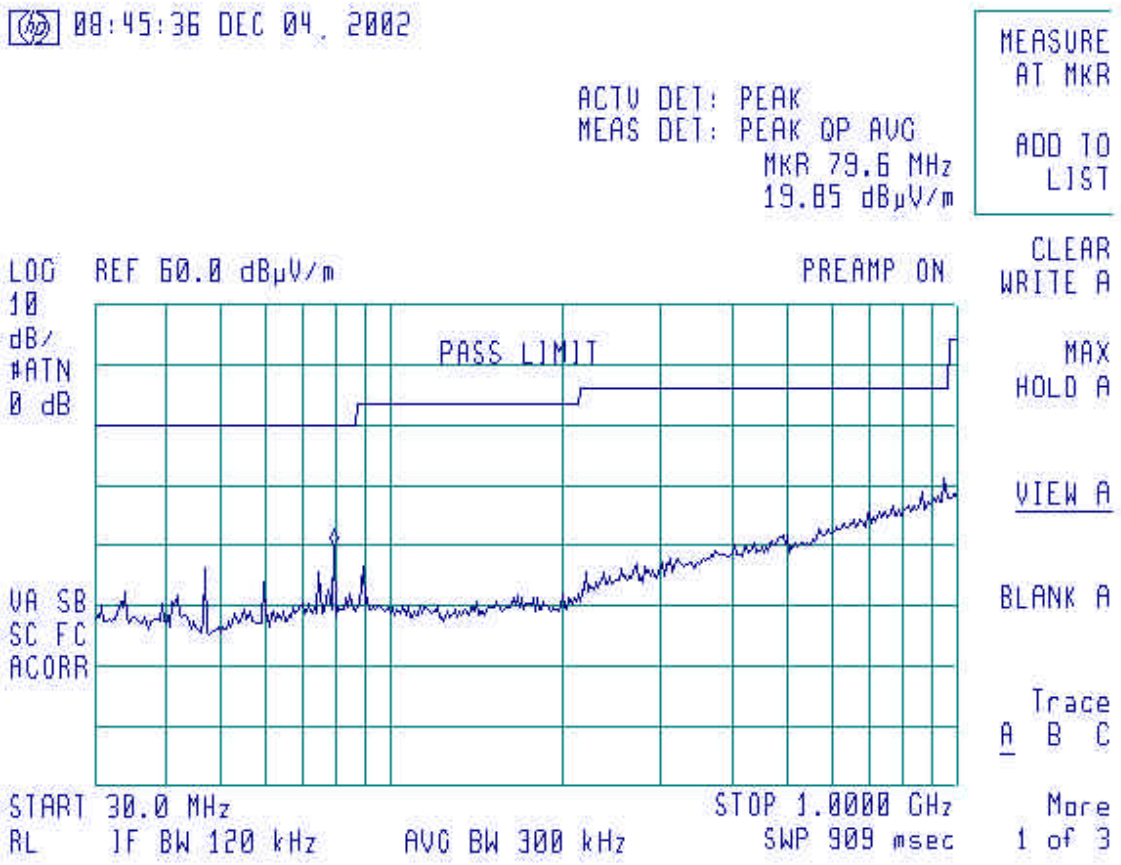
Plot A8

Unintentional radiated emissions test results

FREQUENCY RANGE: 30 – 1000 MHz



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Appendix B
Test setup photographs

Photograph 1

Field strength of fundamental measurements test setup with loop antenna, OATS method, EUT positioned vertically

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Photograph 2

Field strength of fundamental measurements test setup with loop antenna, OATS method, EUT positioned horizontally

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Photograph 3

Radiated emission measurements test setup with biconilog antenna, 30 MHz – 1000 MHz frequency range, anechoic chamber method

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Appendix C
Test equipment used for tests

HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ Year
		Name	Model No.	Serial No.	
0415	Cable coax RF, RG-58	Hermon Labs	CC-3	056	5/04
0465	Anechoic chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	11/03
0521	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/03
0589	Cable coaxial, GORE A2POL118.2, 3m	Hermon Labs	GORE-3	589	11/03
0604	Antenna biconilog log-periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	1/04
0812	Cable, coax, RG-214, 11.5 m, N-type connectors	Hermon Labs	C214-11	148	5/04
1004	Cable, coaxial ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/03
1430	EMI Receiver System, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3807A00262	9/03
1915	Active receiving loop antenna, 1 kHz – 30 MHz	EMC test systems	6507	1457	6/04
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	12/03

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Appendix D
General information

Test facility description

Tests were performed at Hermon Laboratories Ltd., 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) 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, 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).

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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:

cm	centimeter
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
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
RF	radio frequency
RE	radiated emission
s	second
V	volt
W	width

Specification references

47CFR part 15: 2001	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: 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.

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FCC Equipment codes and descriptions

CYY	Communications Receiver used w/ P.15 transmitter
DCD	Part 15 Low Power transmitter Below 1705 kHz
DSC	Part 15 Security/Remote Control Transmitter
DSR	Part 15 Remote Control/Security Device Transceiver
DSS	Part 15 Spread Spectrum Transmitter
DXX	Part 15 Low Power Communication Device Transmitter
EAV	Part 15 Automatic Vehicle Identification System
ETB	Part 15 Cordless Telephone Base Transceiver
ETR	Part 15 Cordless Telephone Remote Transceiver
ETS	Part 15 Cordless telephone system
FAP	Part 15 Anti-Pilferage Device
FDS	Part 15 Field Disturbance Sensor
GAT	Part 15 Auditory Assistance Device (Transmitter)
HID	Part 15 TV Interface Device
JBC	Part 15 Class B Computing Device/ Personal Computer
JBP	Part 15 Class B Computing Device Peripheral
PUB	Part 15 Unlicensed PCS base station
PUE	Part 15 Unlicensed PCS portable Tx held to ear
PUF	Part 15 Unlicensed PCS portable Tx held to face
PUT	Part 15 Unlicensed PCS portable Tx worn on body

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Appendix E
Test equipment correction factors

Antenna Factor
Active Loop Antenna
Model 6502
S/N 2857

Frequency, MHz	Antenna Factor, dB
0.009	-32.8
0.010	-33.8
0.020	-38.3
0.050	-41.1
0.075	-41.3
0.100	-41.6
0.150	-41.7
0.250	-41.6
0.500	-41.8
0.750	-41.9
1.000	-41.4
2.000	-41.5
3.000	-41.4
4.000	-41.4
5.000	-41.5
10.000	-41.9
15.000	-41.9
20.000	-42.2
25.000	-42.8
30.000	-44.0

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

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

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Cable Coaxial, GORE A2P01POL118, 2.3 m, model:GORE-3, s/n 176 (HL 0589)
+ Cable Coaxial, ANDREW PSWJ4, 6m, model: ANDREW-6, s/n 163 (HL 1004)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation, dB	Tolerance (Specification), dB	Meas. Uncert., dB	Notes
1	Insertion	30	0.33	-			
2	Loss	50	0.40	-			
3		100	0.57	-			
4		300	0.97	-			
5		500	1.25	-			
6		800	1.59	-			
7		1000	1.81	-			
8		1200	1.97	-	6.5	±0.12	
9		1400	2.15	-			
10		1600	2.28	-			
11		1800	2.43	-			
12		2000	2.61	-			
13		2200	2.75	-			
14		2400	2.89	-			
15		2600	2.97	-			
16	Insertion	2800	3.21	-	6.5	±0.12	
17	Loss	3000	3.32	-			
18		3300	3.47	-			
19		3600	3.62	-			
20		3900	3.84	-			
21		4200	3.92	-		±0.17	
22		4500	4.07	-			
23		4800	4.36	-			
24		5100	4.62	-			
25		5400	4.78	-			
26		5700	5.16	-			
27		6000	5.67	-			
28		6500	5.99	-			

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Cable RF, 8 m, model:RG-214, s/n C-56 (HL 2009)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation	Tolerance (Specification)	Meas. Uncert., dB	Notes
1	Insertion Loss	1	0.10	NA	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				