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Electrical

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ELECTROMAGNETIC EMISSIONS TEST REPORT

according to 47CFR Part 90, subpart I
for

Telematics Wireless Ltd.

EQUIPMENT UNDER TEST:

Mobile transponder
Model:FP100TA915

Document ID: TELRAD_FCC.15679_rev2.doc
Date of Issue: December 03

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Contents

1 Project information

Description of equipment under test

Test items	: Mobile transponder
Manufacturer	: Telematics Wireless Ltd.
Types (Models)	: FP100TA915

Applicant information

Applicant's responsible person	: Mr. Roman Sternberg, VP marketing
Company	: Telematics Wireless Ltd.
Address	: 26 Hamelacha street
P.O.Box	: 1911
City	: Holon
Postal code	: 58117
Country	: Israel
Telephone number	:+972-3557 5750
Telefax number	:+972-3557 5753

Test performance

Project Number:	: 15679
Location	: Hermon Laboratories
Receipt date	: September 15, 2003
Test started	: September 15, 2003
Test completed	: December 1, 2003
Purpose of test	: Apparatus compliance verification in accordance with emission requirements
Test specification(s)	47CFR part 90, §§90.205, 90.209, 90.210, part 15 §15.109

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2 Summary and signatures

The EUT, FP100TA915 mobile transponder, was tested according to FCC part 90 subpart I, §§90.205(k), 90.209, 90.210(k)(3), part 15 §15.109 and found to comply with the standard requirements.

Test description	Specification reference	Tested by	Date tested	Test report paragraph	Verdict
RF output power	90.205(k)	Mr. Y. Neuman, test engineer	September 15, 2003	4.1	Pass
Occupied bandwidth	90.209	Mr. Y. Neuman, test engineer	September 15, 2003	4.2	Pass
RF exposure	2.1091	Calculated	NA	4.3	Pass
Emission mask	90.210(k)(3)	Mr. Y. Neuman, test engineer	September 15, 16, 2003	4.4	Pass
Radiated spurious emissions	90.210	Mr. Y. Neuman, test engineer	September 15, 16, December 1, 2003	4.4	Pass
Radiated emissions	15.109	Mr. Y. Neuman, test engineer	September 15, 2003	4.5	Pass
Frequency stability	90.213, 2.1055	Mr. Y. Neuman, test engineer	December 1, 2003	4.6	Tested

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. ____________

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3 EUT description

3.1 General description

The EUT, a small LMS transponder, operating at 915 MHz with unipolar ASK modulation (Manchester encoded) and utilizing an internal antenna, is used to transmit data from a vehicle. Data bit rate is 500 kbps. The device is powered by 3 V internal battery.
The frequencies generated or used in the EUT are: 32.768 kHz, 8 MHz.

EUT general view

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4 Test results

4.1 Peak output power test according to part 90 §90.205(k)

DATE of TEST:	September 15, 2003
AMBIENT TEMPERATURE:	30°C
RELATIVE HUMIDITY:	38 %
AIR PRESSURE:	1014 hPa
MEASUREMENT UNCERTAINTY:	±3.5 dB

Carrier frequency, MHz	Radiated measured result, dB(uV/m)	Turntable position, °	Generator P_{out}, dBm	Cable loss, dB	Antenna gain, dBd	ERP, dBm	Limit, dBm	Margin, dB	Verdict
914.849	97.9	89	3.8	2.3	-0.4	1.1	44.7	43.6	Pass

The result recorded in the table was obtained throughout measurements with log periodic antenna in vertical polarization at 1.4 m height.

Notes:
Turntable position: 0^o = EUT front panel faces the receiving antenna
Margin= dB below (negative if above) specification limit.

LIMITATION ON POWER

Operating frequency range, MHz	Maximum effective radiated power (ERP)
902 - 927.25	30 W (44.7 dBm)

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TEST PROCEDURE

The EUT was set up on a wooden 80 cm height turntable at the OATS as shown in Figure 4.1.1. The measurements were performed at 3 m test distance with log periodic antenna. 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 EUT was replaced with a substitution dipole antenna connected to a signal generator. The measuring antenna height was changed from 1 to 4 m to find a maximum radiation. The level of the signal generator output was adjusted until the previously recorded field strength maximum reading was obtained as depicted in table above.

The equivalent power was calculated using the equation:

$$ERP\ (dBm) = P_{out\ gen}\ (dBm) - cable\ loss\ (dB) + G_a\ (dBd),\ where$$

$P_{out\ gen}$ is the generator output power
G_a is the gain of the substitution antenna used relative to an ideal half-wave dipole antenna.

TEST EQUIPMENT USED:

HL 0034	HL 0038	HL 0091	HL 0287	HL 0415	HL 0661	HL 0812
HL 1116	HL 1200	HL 1424	HL 1430	HL 1565	HL 1942	HL 1947
HL 2254	HL 2259	HL 2400	HL 2432			

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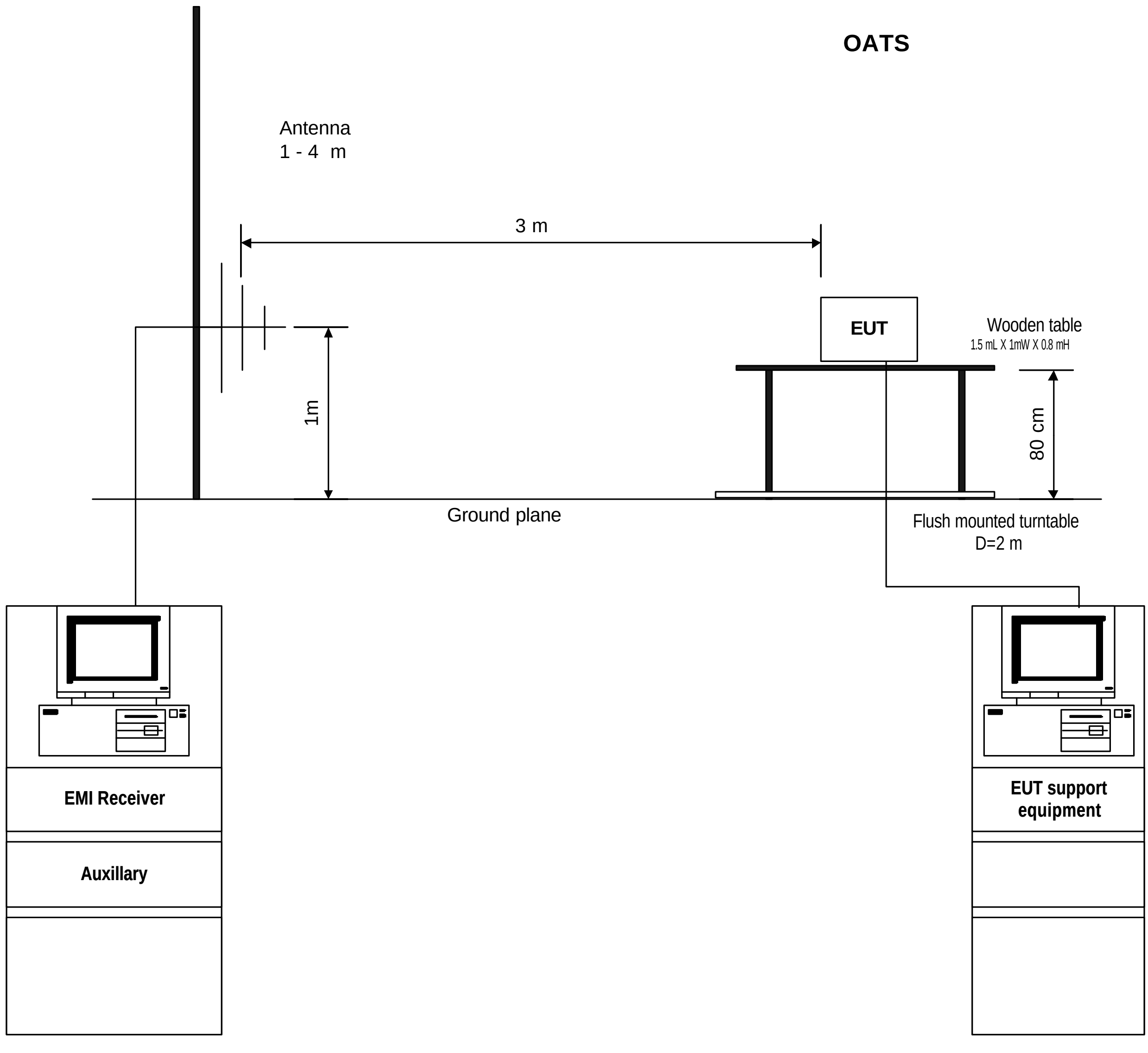
Figure 4.1.1

Setup for radiated emissions test



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4.2 Occupied bandwidth according to part 90 §90.209(5)

METHOD OF MEASUREMENTS	ANSI C63.4 §13.1.7
DATE of TEST:	September 15, 2003
AMBIENT TEMPERATURE:	30°C
RELATIVE HUMIDITY:	38 %
AIR PRESSURE:	1014 hPa
MEASUREMENT UNCERTAINTY:	±168 Hz
CARRIER FREQUENCY:	914.84 MHz

Measured 26 dB bandwidth, MHz	Authorized bandwidth, MHz	Margin, MHz	Reference to Plots in Appendix A	Verdict
5.1	12	6.9	A1	Pass

LIMIT

Operating frequency range, MHz	Authorized bandwidth, MHz
909.75 – 921.75	12

TEST PROCEDURE

The EUT was set up at open area test site (OATS) as shown in Figure 4.1.1. The measuring antenna was connected to spectrum analyzer, which settings are shown in plot. The measurements were performed at carrier frequency in continuous transmit mode of operation as frequency band between 26 dBc points.

TEST EQUIPMENT USED:

HL 0034	HL 0038	HL 0091	HL 0287	HL 0415	HL 0812	HL 1430

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4.3 Exposure limit according to §1.1310

Limit for power density for general population/uncontrolled exposure is f/1500 mW/cm^2 for 300 – 1500 MHz frequency range:

$P = 915/1500 = 0.61\ mW/cm^2$

The power density **$P\ (mW/cm^2) = P_T / 4p\ r^2$**, where

P_T is the maximum equivalent isotropically radiated power (EIRP), which is equal to:

$$P_T = 1.1\ dBm + 2.15\ dBi = 3.25\ dBm = 2.1\ mW,$$

where 2.15 dBi is the gain of unideal half-wave dipole antenna relative to the isotropical radiator.

The power density at 20 cm (minimum safe distance, required for mobile devices), calculated as follows:

$$2.1\ mW / 4\pi\ (20\ cm)^2 = 0.0004\ mW/cm^2 << 0.61\ mW/cm^2$$

was found far below the limit.

Hence, no safety hazard exists for human being.

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4.4 Emission mask and radiated spurious emissions test according to part 90 §90.210(k)(3)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4
DATE of TEST:	September 15, 16, December 1, 2003
AMBIENT TEMPERATURE:	30°C
RELATIVE HUMIDITY:	38 %
AIR PRESSURE:	1014 hPa
FREQUENCY RANGE:	9 kHz – 9.2 GHz
MEASUREMENT UNCERTAINTY:	±4.5 dB

The peak power of any emission shall be attenuated below the power of the highest emission contained within the licensee's sub-band in accordance with the following schedule:

1) On any frequency within the authorized bandwidth: zero dB;
2) On any frequency outside the licensee's sub-band edges: 55 + 10 log (P) dB, where (P) is the highest emission (in watts) of the transmitter inside the licensee's sub-band.

4.4.1 Test procedure

The EUT was set up on the 80 cm height wooden table in the anechoic chamber as shown in Figures 4.4.1 and 4.4.2.
The measurements were performed at 3-m test distance:
with the loop antenna in the 9 kHz to 30 MHz range,
the biconical - in the 30 MHz to 200 MHz range,
the log periodic - in the 200 MHz to 1 GHz range,
the double ridged guide – in 1 GHz to 9.2 GHz range.

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 – 9.2 GHz frequency range. 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 following calculated limit was applied to spurious emissions throughout the testing in transmit mode:
the specified limit 55 + 10 log (P) was converted in EIRP units – 25 dBm.

This limit was applied to spurious emissions throughout the following frequency ranges:

9 kHz to 909.75 MHz and 921.75 MHz to 9.2 GHz.

Emissions at the lower band edge and at the higher band edge were tested and provided in Plots A6, A7**.** The full test results are shown in Plots A2 to A9.
No spurious emissions except harmonics were found in 1 GHz – 9.2 GHz range, which were retested by substitution method at the OATS.
The EUT was replaced with a substitution antenna (double ridge guide for the mentioned range) connected to signal generator. The measuring antenna height was changed from 1 to 4 m to find a maximum radiation. The level of the signal generator output was adjusted until the previously recorded field strength maximum reading was obtained as depicted in Table 4.4.1. For calculation equation refer to section 4.1.

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Table 4.4.1
Radiated emissions measurement results

Frequency, MHz	Radiated measured result, dB(uV/m)	Antenna polarization	Generator P_{out}, dBm	Cable loss, dB	Antenna gain, dBd	ERP, dBm	Limit, dBm	Margin, dB	Verdict
1829.70	54.3	Vertical	-51.1	0.7	4.7	-47.1	-25	22.1	Pass
2744.55	43.34	Horizontal	-64.8	0.9	5.5	-60.2	-25	35.2	Pass
3659.39	51.17	Horizontal	-53.2	1.1	5.5	-48.8	-25	23.8	Pass
4574.22	51.5	Horizontal	-48.2	1.2	4.6	-44.8	-25	19.8	Pass
5489.08	52.33	Horizontal	-44.8	1.3	2.4	-43.7	-25	18.7	Pass
6403.93	57.67	Horizontal	-40.6	1.5	3.3	-38.8	-25	13.8	Pass
7318.79	58.83	Vertical	-41.2	1.6	4.1	-38.7	-25	13.7	Pass
8233.65	51.5	Vertical	-48.3	1.7	3.7	-46.3	-25	21.3	Pass
9148.49	56.55	Horizontal	-43.7	1.8	7.4	-38.1	-25	13.1	Pass

TEST EQUIPMENT USED IN ANECHOIC CHAMBER:

HL 0032	HL 0034	HL 0446	HL 1424	HL 1425	HL 1553	HL 1566
HL 1826	HL 1849	HL 1850	HL 1942	HL 1984	HL 2109	HL 2259

TEST EQUIPMENT USED AT OPEN AREA TEST SITE:

HL 0034	HL 0038	HL 0091	HL 0287	HL 0415	HL 0661	HL 0812
HL 1116	HL 1200	HL 1424	HL 1430	HL 1565	HL 1942	HL 1947
HL 2254	HL 2259	HL 2400	HL 2432			

Figure 4.4.1

Set up for radiated emissions measurement in 9 kHz to 30 MHz range

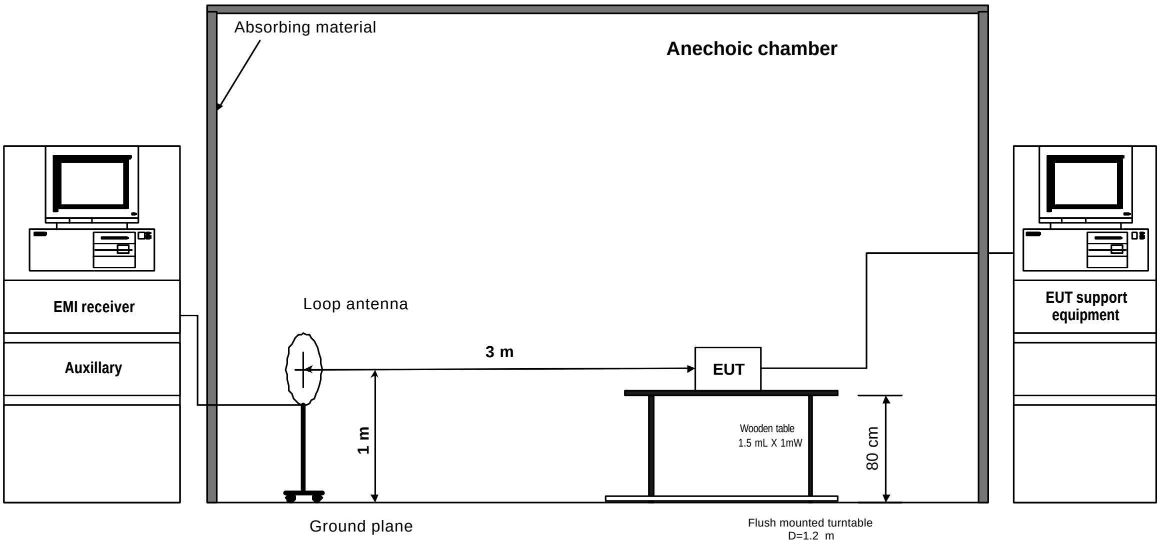
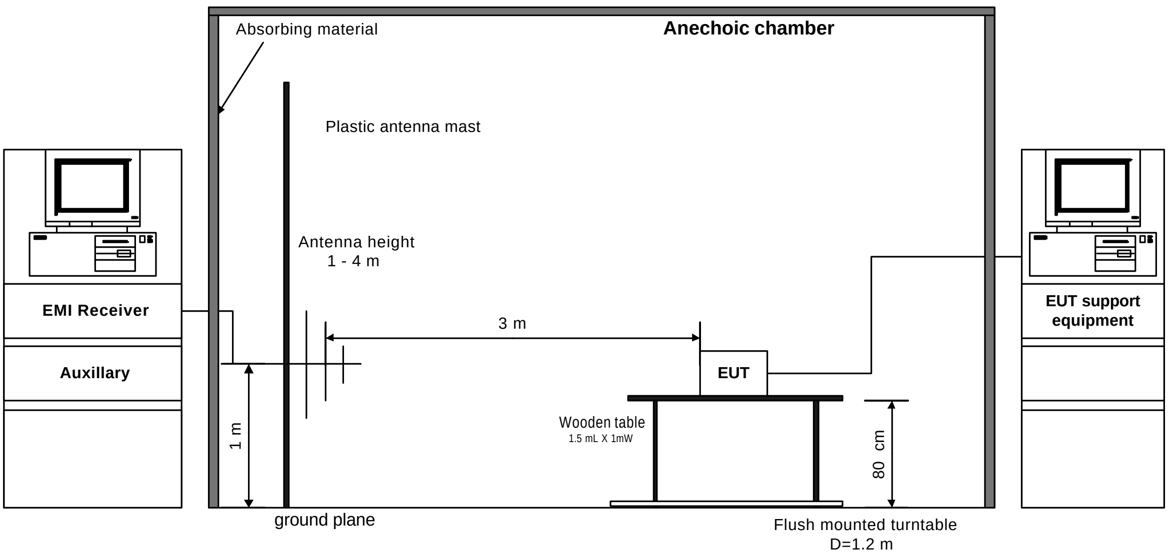


Figure 4.4.2

Set up for radiated emissions measurement



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4.5 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT:	ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
TEST PERFROMED AT:	Anechoic chamber
DATE of TEST:	September 15, 16, 2003
AMBIENT TEMPERATURE:	30°C
RELATIVE HUMIDITY:	38 %
AIR PRESSURE:	1014 hPa
DISTANCE BETWEEN ANTENNA AND EUT:	3 m
THE EUT WAS TESTED AS:	Table-top
FREQUECNY RANGE:	30 MHz – 1 GHz
DETECTOR TYPE:	Peak
MEASUREMENT UNCERTAINTY:	± 6 dB max

For test procedure and setup refer to section 4.4.

For full test results refer to plots A10, A11. No radiated emissions from EUT were found.

LIMIT (§ 15.109)

Frequency, MHz	Class B equipment @ 3 m dB(μV/m)
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 - 5000	54.0

TEST EQUIPMENT USED:

HL 0032	HL 0034	HL 1425	HL 1553	HL 1566	HL 1826	HL 1849
HL 1850	HL 2109					

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4.6 Frequency stability measurement according to §90.213

DATE of TEST:	December 1, 2003
AMBIENT TEMPERATURE:	22°C
RELATIVE HUMIDITY:	46 %
AIR PRESSURE:	1015 hPa

Frequency stability test results vs supply voltage

Voltage, V	Frequency, Hz	Displacement, Hz	Time, min
Ucc=3.6 V	914 974 463	-487	startup
	914 974 851	-99	+2
	914 974 938	-12	+5
	914 974 950	0	+10
Ucc=2.7 V	914 973 658	-1292	startup
	914 973 519	-1431	+2
	914 973 491	-1459	+5
	914 973 158	-1792	+10
Ucc=4.14 V	914 973 196	-1754	startup
	914 973 174	-1776	+2
	914 973 043	-1907	+5
	914 972 978	-1972	+10

Reference frequency: 914974950 Hz

For information only: 2.5 ppm = ± 2287 Hz

TEST PROCEDURE

The EUT frequency stability was measured with variation of supply voltage or ambient temperature in the range from –30°C to +50°C.

TEST EQUIPMENT USED:

HL 0026	HL 0481	HL 0493	HL 0559	HL 1188		

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Frequency stability test results vs ambient temperature

Temperature, °C	Frequency, Hz	Displacement, Hz	Time, min
t°=30°C	914977983	3033	startup
	914977918	2968	+2
	914977863	2913	+5
	914977816	2866	+10
t°=40°C	914968710	-6240	startup
	914967483	-7467	+2
	914967228	-7722	+5
	914966866	-8084	+10
t°=50°C	914954192	-20758	startup
	914951151	-23799	+2
	914949995	-24955	+5
	914949092	-25858	+10
t°=10°C	914951324	-23626	startup
	914952083	-22867	+2
	914952457	-22493	+5
	914952291	-22659	+10
t°=0°C	914923418	-51532	startup
	914925160	-49790	+2
	914922375	-52575	+5
	914924146	-50804	+10
t°=-10°C	914889467	-85483	startup
	914893940	-81010	+2
	914888087	-86863	+5
	914890881	-84069	+10
t°=-20°C	914841543	-133407	startup
	914850746	-124204	+2
	914853269	-121681	+5
	914842357	-132593	+10
t°=-30°C	914793982	-180968	startup
	914791055	-183895	+2
	914790853	-184097	+5
	914787819	-187131	+10

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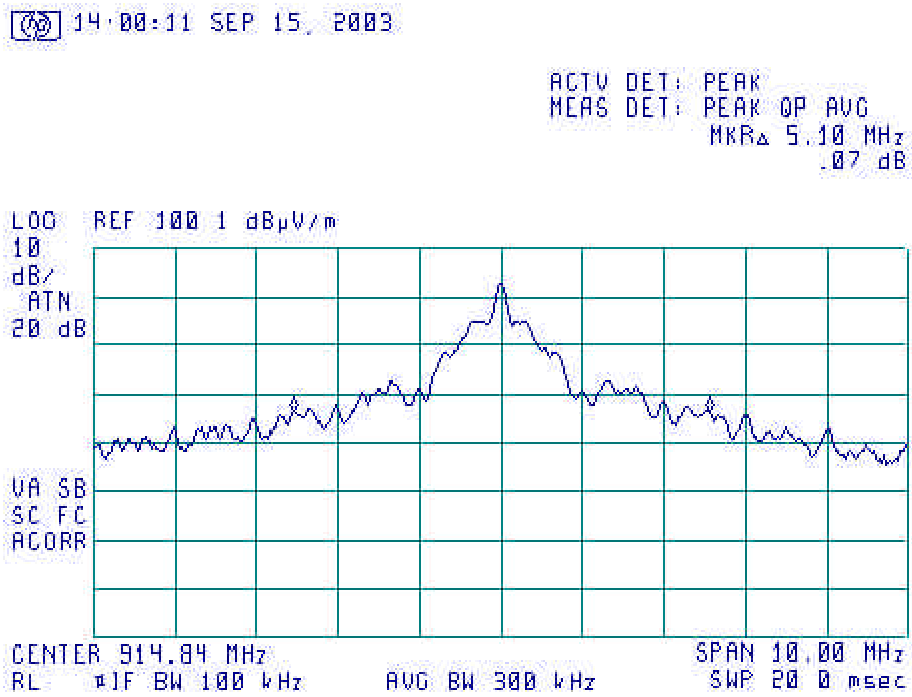
Appendix A Plots

Plot A 1

26 dB bandwidth measurement result



Note: Measurement was performed in continuous transmission mode

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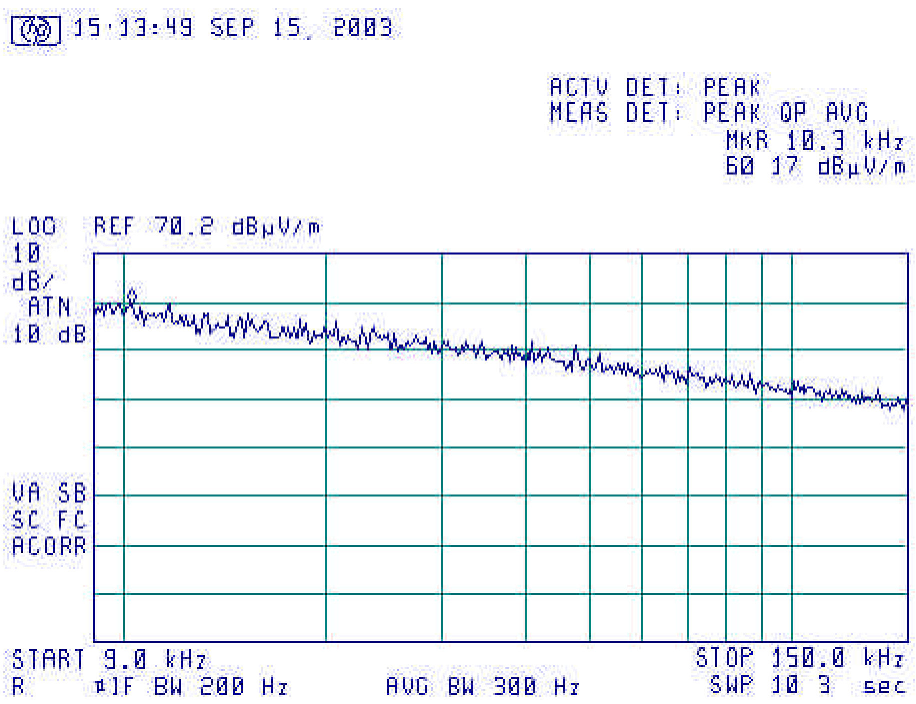
Plot A 2

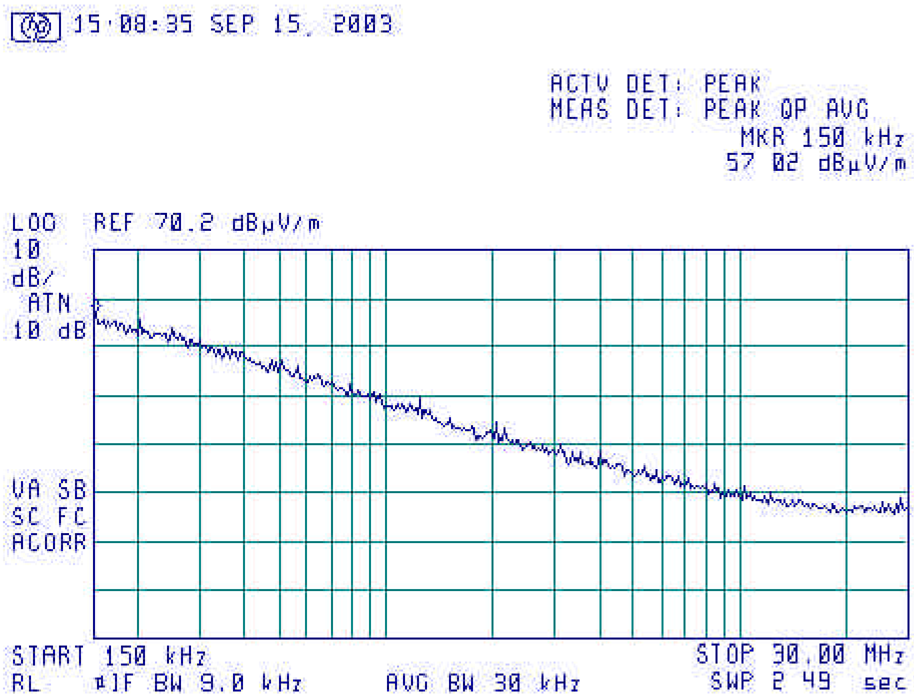
Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz



No spurious emissions were found

Plot A 3

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz



No spurious emissions were found

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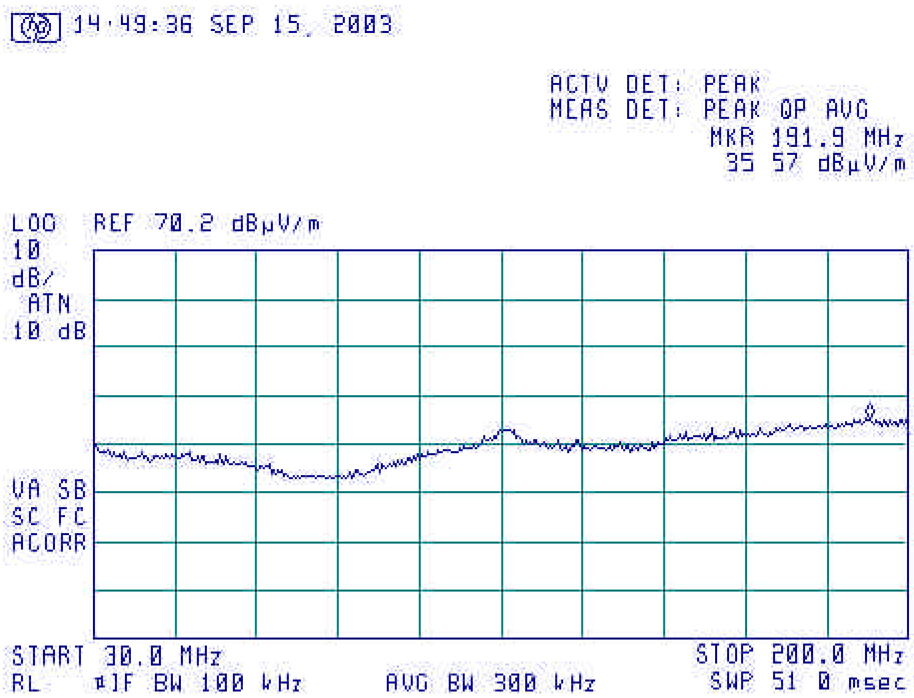
Plot A 4

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 200 MHz



No spurious emissions were found

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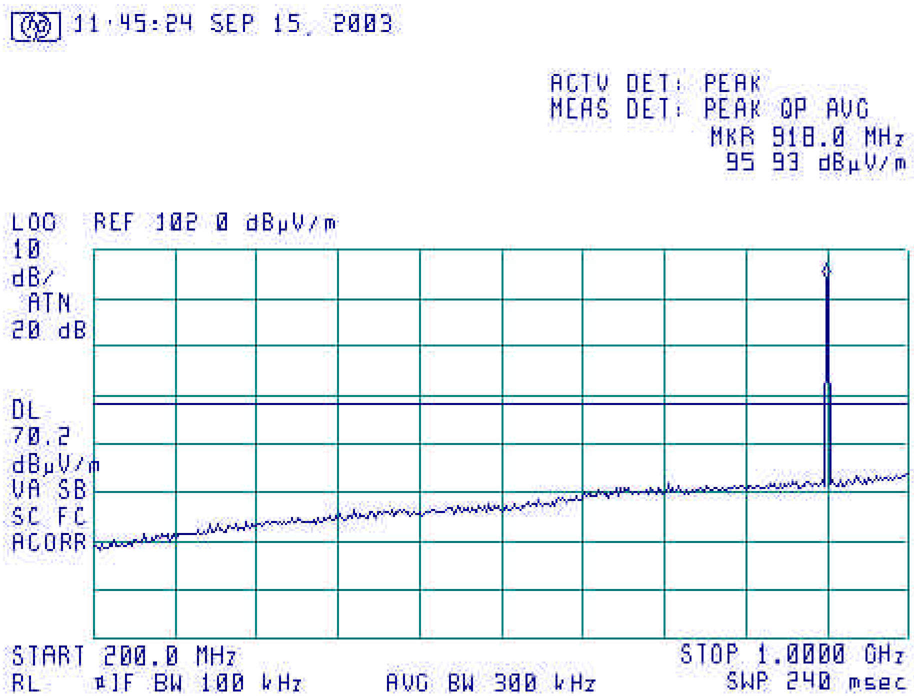
Plot A 5

Radiated spurious emission measurements in the anechoic chamber from 200 MHz to 1000 MHz



No spurious emissions were found

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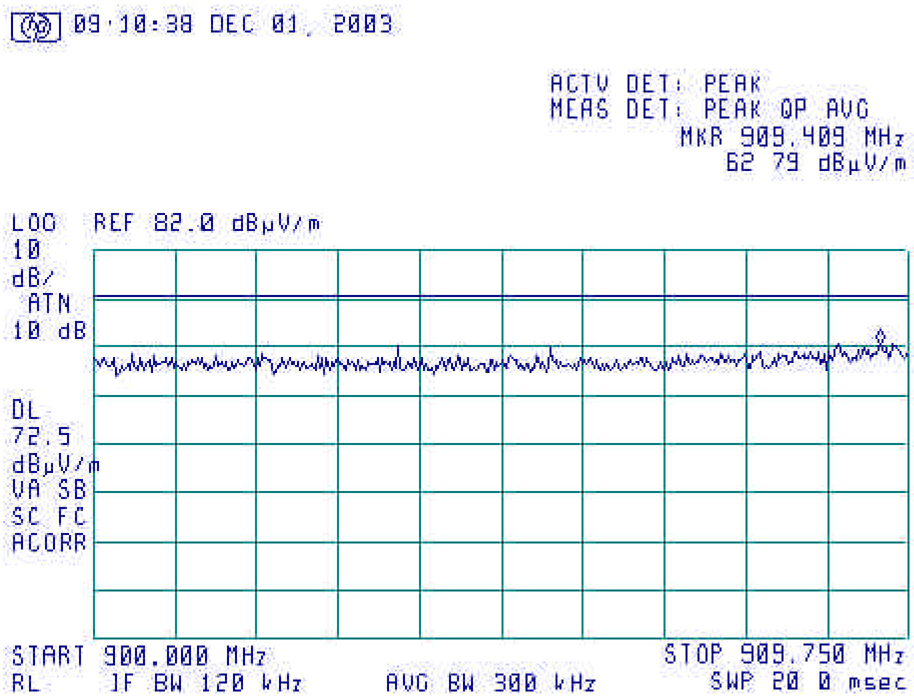
Plot A 6

Radiated spurious emission measurements at lower band edge (900 MHz to 909.75 MHz) at the OATS



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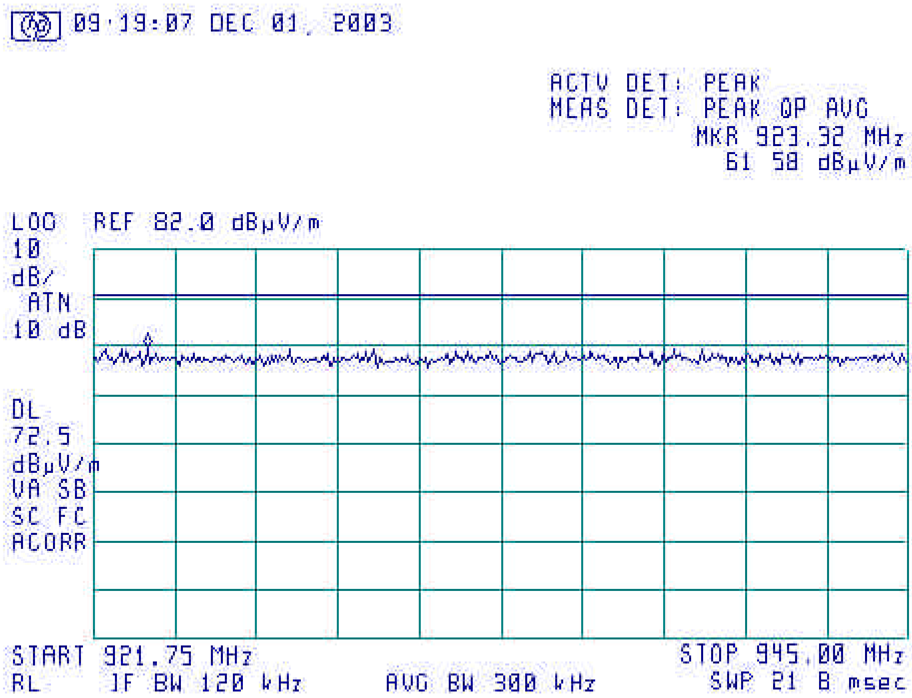
Plot A 7

Radiated spurious emission measurements at higher band edge (921.75 MHz to 945 MHz) at the OATS



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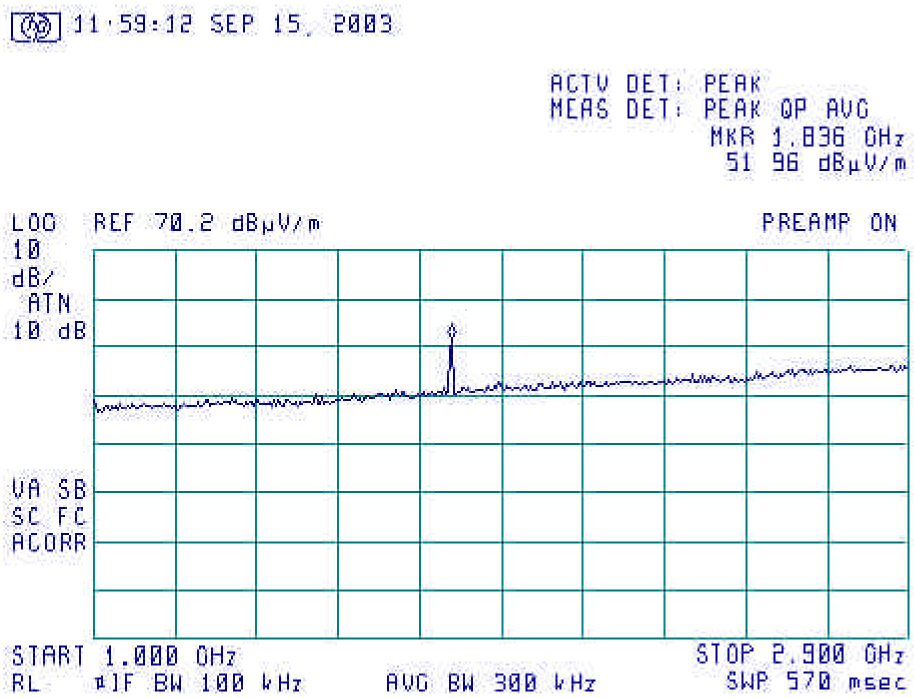
Plot A 8

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz



No spurious emissions were found except 2nd harmonic

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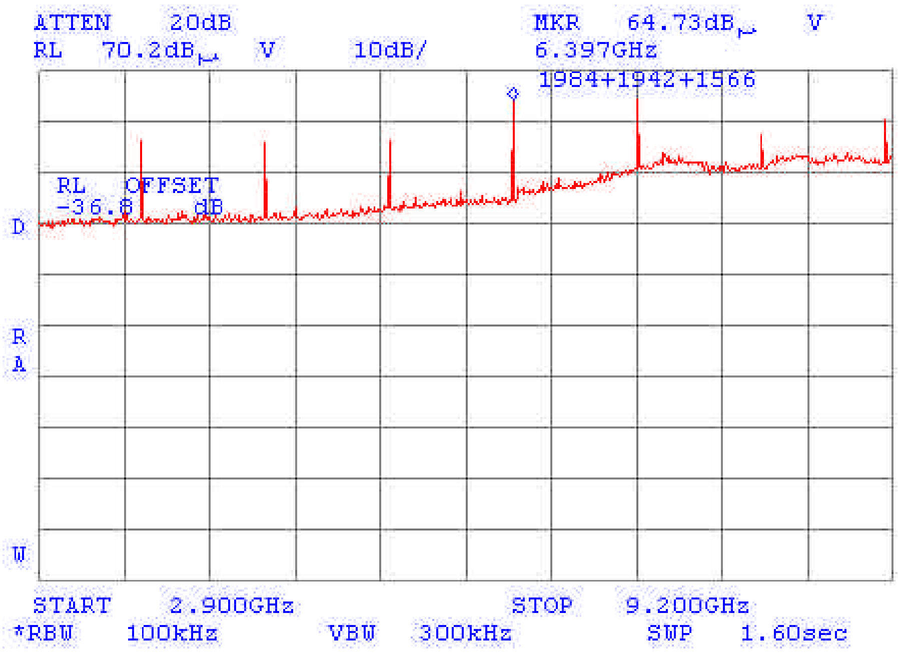
Plot A 9

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 9.200 GHz



No spurious emissions were found except harmonics.

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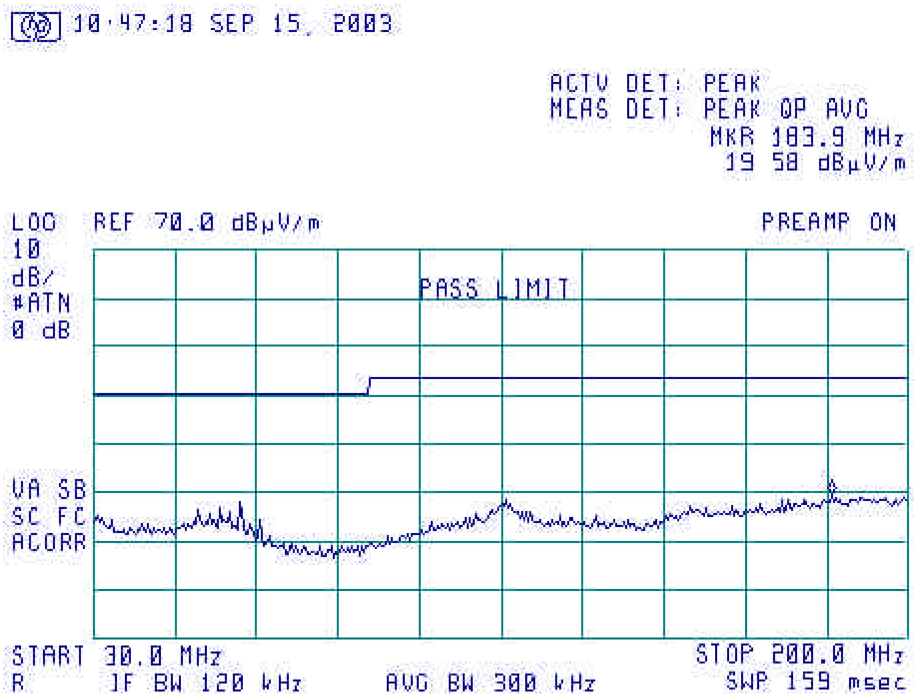
Plot A 10

Radiated emission measurements in the anechoic chamber from 30 MHz to 200 MHz, test distance 3 m, vertical & horizontal antenna polarization



No emissions were found.

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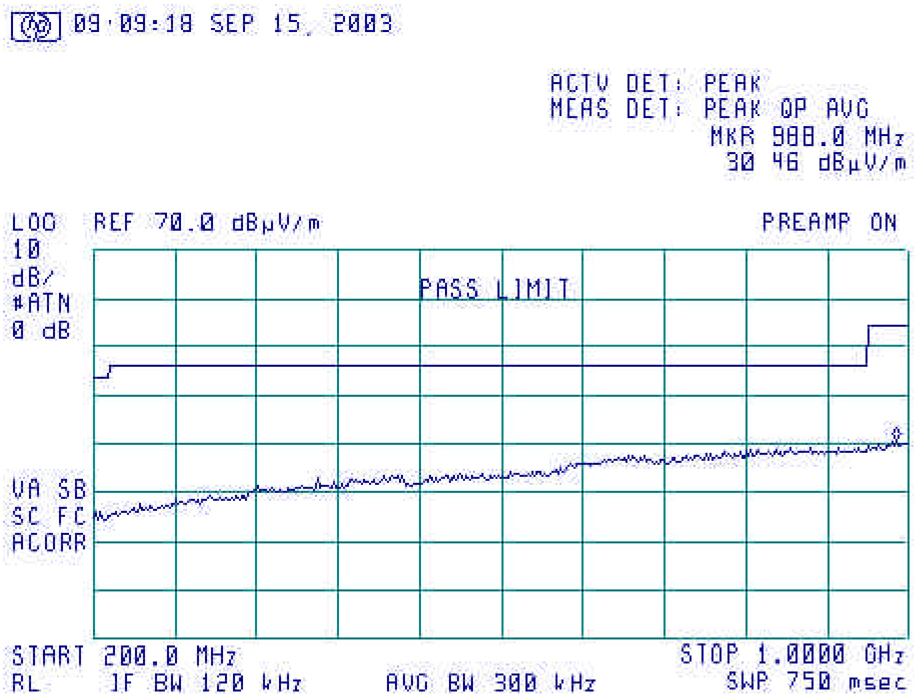
Plot A 11

Radiated emission measurements in the anechoic chamber from 200 MHz to 1 GHz, test distance 3 m, vertical & horizontal antenna polarization



No emissions were found.

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Appendix B Test equipment used for tests

HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ year
		Name	Model No.	Serial No.	
0026	Spectrum analyzer, 100 Hz-2.2 GHz	Anritsu	MS 2601A	3460	9/04
0032	Biconical antenna, 20 – 200 MHz	Electro-Metrics	BIA-25/30	3577	11/04
0034	Log periodic antenna, 200 – 1000 MHz	Electro-Metrics	LPA 25/30	1988	1/04
0038	Antenna mast, 1-4 m	Hermon Labs	AM-1	028	2/04 check
0091	Position controller for antenna mast + turntable, OFTS	Hermon Labs	CRL-2	091	4/04 check
0287	Turntable, motorized diameter, 2 m	Hermon Labs	TMD-2	042	11/04 check
0415	Cable coax RF, RG-58	Hermon Labs	CC-3	056	5/04
0446	Active loop antenna, 10 kHz-30 MHz	Electro-Mechanics	6502	2857	10/04
0481	Power supply 40 V/1 A	Horizon Electronics	DHP 40-1	7625	2/04
0493	Oven temperature	Thermotron	S-1.2 Mini-Max	4016	9/04
0559	Multimeter digital	Fluke	76	0903	10/04
0661	Generator swept signal, 10 MHz to 40 GHz+ 10 dBm	Hewlett Packard	83640B	0266	9/04
0812	Cable, coax, RG-214, 11.5 m, N-type connectors	Hermon Labs	C214-11	148	5/04
1116	Antenna horn, 1-18 GHz	Hermon Labs	A1-18	186	3/04
1188	Power supply, controllable, DC, 40V/30A	Power/Mate corp.PMC	0-40/3A	9677	1/04
1200	Quadruplexer, 1-12 GHz	Elettronica S.p.A.- Roma	UE 84	0240	4/04 check
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/04
1425	EMI receiver system, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3710A00222	9/04
1430	EMI receiver system, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3807A00262	9/04
1553	Cable RF, 3.5 m	Alpha wire	RG-214	NA	5/04
1565	Antenna, dipole, tunable, 500 - 1000 MHz	Electro-Metrics	TDS-30-2	334	1/04
1566	Cable RF, 2 m	Huber-Suhner	Sucoflex 104PE	13094/4PE	12/03
1826	Antenna mast and turntable position controller	Sh. I. Machines	CRL-4	1	5/04 check
1849	Antenna mast with polarity control	Sh. I. Mashines	AM-F4	NA	1/04 check
1850	Turntable	Sh. I. Mashines	TT-M-3	NA	1/04 check
1942	Cable 18 GHz, 4 m, blue	Rhophase Microwave Ltd	SPS-1803A-4000-NPS	T4658	10/04
1947	Cable 18 GHz, 6.5 m, blue	Rhophase Microwave Ltd	NPS-1803A-6500-NPS	T4974	10/04

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HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ year
		Name	Model No.	Serial No.	
1984	Antenna, double ridged waveguide horn, 1-18 GHz, 300W, N-type	EMC Test Systems	3115	9911-5964	3/04
2109	Anechoic chamber 6 (L) x 5.5 (W) x 2.95 (H) m	Hermon Labs	AC-2	NA	12/03 check
2254	Cable 40 GHz, 0.8 m, blue	Rhophase Microwave	KPS-1503A-800-KPS	W4907	11/04
2259	Amplifier Low Noise 2-20 GHz	Sophia Wireless	LNA0220-C	0223	11/03
2400	Cable 40 GHz, 1.5 m, green	Rhophase Microwave Ltd.	KPS-1503A-1500-KPS	X2946	6/04
2432	Antenna, double-ridged waveguide horn, 1-18 GHz	EMC Test Systems	3115	000271777	7/04

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Appendix C Antenna factors and cable loss

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).

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Antenna factor
Double ridged guide antenna
Hermon Laboratoriies, model A1-18, S/N 186, HL 1116

Frequency, MHz	**Antenna factor. dB(1/m)**
1000.0	24.6
1500.0	26.4
2000.0	29.7
2500.0	31.1
3000.0	31.5
3500.0	32.7
4000.0	36.1
4500.0	36.1
5000.0	39.9
5500.0	40.5
6000.0	40.4
6500.0	41.0
7000.0	41.2
7500.0	41.2
8000.0	44.3
8500.0	40.7
9000.0	39.3
9500.0	41.3
10000.0	42.8
10500.0	43.8
11000.0	47.0
11500.0	46.3
12000.0	43.4
12500.0	41.8
13000.0	41.9
13500.0	44.5
14000.0	44.8
14500.0	44.9
15000.0	44.4
15500.0	43.4
16000.0	42.6
16500.0	43.6
17000.0	42.3
17500.0	45.9
18000.0	45.3

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).

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Antenna factor
Double-ridged guide horn antenna
Model 3115, serial number: 00027177, HL 2432

Frequency, MHz	Antenna factor. dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.8
2500.0	28.9
3000.0	30.7
3500.0	31.8
4000.0	33.0
4500.0	32.8
5000.0	34.2
5500.0	34.9
6000.0	35.2
6500.0	35.4
7000.0	36.3
7500.0	37.3
8000.0	37.5
8500.0	38.0
9000.0	38.3
9500.0	38.3
10000.0	38.7
10500.0	38.7
11000.0	38.9
11500.0	39.5
12000.0	39.5
12500.0	39.4
13000.0	40.5
13500.0	40.8
14000.0	41.5
14500.0	41.3
15000.0	40.2
15500.0	38.7
16000.0	38.5
16500.0	39.8
17000.0	41.9
17500.0	45.8
18000.0	49.1

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).

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Antenna factor
Biconical antenna
Electro-Metrics, model BIA-25/30
Ser.No.3577

Frequency MHz	Antenna Factor dB(1/m)	Frequency MHz	Antenna Factor dB(1/m)
20	15.1	115	16.7
25	14.6	120	14.1
30	13.7	125	13.1
35	11.8	130	13.0
40	11.4	135	12.9
45	11.7	140	12.7
50	11.4	145	12.5
55	10.5	150	14.3
60	10.3	155	14.8
65	8.9	160	14.7
70	7.6	165	15.1
75	7.3	170	15.6
80	7.3	175	16.5
85	7.8	180	16.7
90	9.4	185	17.3
95	10.6	190	17.9
100	11.8	195	17.6
105	12.5	200	17.9
110	13.7		

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
Log periodic antenna
Electro-Metrics, model LPA-25/30
Ser.No.1988

Frequency MHz	Antenna Factor dB(1/m)	Frequency MHz	Antenna Factor dB(1/m)
200	12.6	625	20.4
225	12.2	650	20.9
250	13.4	675	22.0
275	14.3	700	22.2
300	15.2	725	22.7
325	15.7	750	22.5
350	15.9	775	22.7
375	16.4	800	22.8
400	17.0	825	23.2
425	17.4	850	23.5
450	17.9	875	23.9
475	18.6	900	24.0
500	19.1	925	24.0
525	19.3	950	24.2
550	19.6	975	24.7
575	19.8	1000	25.1
600	20.0		

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).

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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).

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Cable loss
Cable Coaxial, RG-58/RG-214, s/n 056, HL 0415
+ Cable Coaxial, RG-214, 11.5m, s/n 148, HL 0812

No.	Frequency, MHz	Cable loss, dB	Measured uncertainty, dB
1	20	0.73	±0.12
2	30	0.91	
3	50	1.2	
4	80	1.56	
5	100	1.76	
6	200	2.59	
7	300	3.26	
8	400	3.93	
9	500	4.42	
10	600	4.92	
11	700	5.36	
12	800	5.88	
13	900	6.41	
14	1000	6.71	
15	1500	8.63	
16	2000	10.39	

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Cable loss
RF cable 3.5 m, Alpha Wire, model RG-214, S/N 149, HL 1553

No.	Frequency, MHz	Cable loss, dB	Measurement uncertainty, dB
1	1	0.01	±0.05
2	10	0.07	
3	30	0.12	
4	50	0.22	
5	100	0.26	
6	200	0.40	
7	300	0.52	
8	400	0.60	
9	500	0.70	
10	600	0.77	
11	700	0.84	
12	800	1.00	
13	900	1.00	
14	1000	1.05	
15	2000	1.70	

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Cable loss
Cable RF, 2m, model: Sucoflex 104PE, S/N 13094/4PE, HL 1566

No.	Frequency, MHz	Cable loss, dB	Tolerance, dB	Measurement uncertainty, dB
1	30	0.10	5.0	±0.12
2	50	0.13		
3	100	0.20		
4	300	0.33		
5	500	0.45		
6	800	0.60		
7	1000	0.65		
8	1500	0.91		
9	2000	1.08		
10	2500	1.19		
11	3000	1.28		
12	3500	1.49		
13	4000	1.63		
14	4500	1.63	5.0	±0.17
15	5000	1.66		
16	5500	1.88		
17	6000	1.96		
18	6500	1.93		
19	7000	2.07		
20	7500	2.37		
21	8000	2.34		
22	8500	2.64		
23	9000	2.68		
24	9500	2.64		
25	10000	2.70		
26	10500	2.84		
27	11000	2.88		
28	11500	3.19		
29	12000	3.15		
30	12500	3.20	5.0	±0.26
31	13000	3.22		
32	13500	3.47		
33	14000	3.41		
34	14500	3.59		
35	15000	3.79		
36	15500	4.24		
37	16000	4.12		
38	16500	4.46		
39	17000	4.50		
40	17500	4.49		
41	18000	4.45		

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Cable loss
Cable 18 GHz, 4 m, blue, model: SPS-1803A-4000-NPS, S/N T4658, HL 1942

Frequency, GHz	Cable loss, dB
0.03	0.21
0.05	0.26
0.10	0.36
0.20	0.50
0.30	0.61
0.40	0.70
0.50	0.78
0.60	0.85
0.70	0.93
0.80	0.99
0.90	1.04
1.00	1.10
1.10	1.16
1.20	1.22
1.30	1.26
1.40	1.31
1.50	1.35
1.60	1.41
1.70	1.45
1.80	1.49
1.90	1.53
2.00	1.57
2.10	1.61
2.20	1.65
2.30	1.69
2.40	1.72
2.50	1.76
2.60	1.79
2.70	1.83
2.80	1.87
2.90	1.90
3.10	1.97
3.30	2.04
3.50	2.11
3.70	2.18
3.90	2.24
4.10	2.31
4.30	2.38
4.50	2.43
4.70	2.53
4.90	2.53
5.10	2.63
5.30	2.65
5.50	2.72
5.70	2.76
5.90	2.79

Frequency, GHz	Cable loss, dB
6.10	2.88
6.30	2.90
6.50	2.97
6.70	3.02
6.90	3.04
7.10	3.07
7.30	3.12
7.50	3.13
7.70	3.19
7.90	3.24
8.10	3.30
8.30	3.36
8.50	3.45
8.70	3.41
8.90	3.45
9.10	3.42
9.30	3.55
9.50	3.48
9.70	3.58
9.90	3.61
10.10	3.66
10.30	3.68
10.50	3.70
10.70	3.70
10.90	3.75
11.10	3.78
11.30	3.86
11.50	3.98
11.70	4.10
11.90	4.12
12.10	4.09
12.40	4.13
13.00	4.23
13.50	4.35
14.00	4.40
14.50	4.44
15.00	4.57
15.50	4.66
16.00	4.64
16.50	4.66
17.00	4.75
17.50	4.85
18.00	4.93

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Cable loss
Cable 18 GHz, 6.5 m, blue, model: NPS-1803A-6500-NPS, S/N T4974, HL 1947

Frequency, GHz	Cable loss, dB
0.03	0.30
0.05	0.38
0.10	0.53
0.20	0.74
0.30	0.91
0.40	1.05
0.50	1.18
0.60	1.29
0.70	1.40
0.80	1.50
0.90	1.59
1.00	1.68
1.10	1.77
1.20	1.86
1.30	1.94
1.40	2.01
1.50	2.08
1.60	2.16
1.70	2.22
1.80	2.29
1.90	2.36
2.00	2.42
2.10	2.48
2.20	2.54
2.30	2.60
2.40	2.66
2.50	2.71
2.60	2.77
2.70	2.83
2.80	2.89
2.90	2.95
3.10	3.06
3.30	3.17
3.50	3.28
3.70	3.39
3.90	3.51
4.10	3.62
4.30	3.76
4.50	3.87
4.70	4.01
4.90	4.10
5.10	4.21
5.30	4.31
5.50	4.43
5.70	4.56
5.90	4.71

Frequency, GHz	Cable loss, dB
6.10	4.87
6.30	4.95
6.50	4.94
6.70	4.88
6.90	4.87
7.10	4.83
7.30	4.85
7.50	4.86
7.70	4.91
7.90	4.96
8.10	5.03
8.30	5.08
8.50	5.13
8.70	5.21
8.90	5.22
9.10	5.34
9.30	5.35
9.50	5.52
9.70	5.51
9.90	5.66
10.10	5.70
10.30	5.78
10.50	5.79
10.70	5.82
10.90	5.86
11.10	5.94
11.30	6.06
11.50	6.21
11.70	6.44
11.90	6.61
12.10	6.76
12.40	6.68
13.00	6.66
13.50	6.81
14.00	6.90
14.50	6.90
15.00	6.97
15.50	7.17
16.00	7.28
16.50	7.27
17.00	7.38
17.50	7.68
18.00	7.92

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Cable loss
Cable 40 GHz, 0.8 m, blue, model: KPS-1503A-800-KPS, S/N W4907, HL 2254

Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB
0.03	0.04	5.10	0.80	15.00	1.49
0.05	0.07	5.30	0.83	15.50	1.49
0.10	0.09	5.50	0.83	16.00	1.46
0.20	0.15	5.70	0.84	16.50	1.47
0.30	0.19	5.90	0.87	17.00	1.50
0.40	0.25	6.10	0.86	17.50	1.57
0.50	0.29	6.30	0.89	18.00	1.63
0.60	0.33	6.50	0.90	18.50	1.57
0.70	0.37	6.70	0.89	19.00	1.63
0.80	0.41	6.90	0.93	19.50	1.65
0.90	0.44	7.10	0.92	20.00	1.64
1.00	0.45	7.30	0.95	20.50	1.75
1.10	0.48	7.50	0.96	21.00	1.72
1.20	0.51	7.70	0.97	21.50	1.78
1.30	0.53	7.90	1.01	22.00	1.76
1.40	0.54	8.10	1.00	22.50	1.72
1.50	0.57	8.30	1.05	23.00	1.83
1.60	0.59	8.50	1.04	23.50	1.80
1.70	0.04	8.70	1.07	24.00	1.90
1.80	0.07	8.90	1.11	24.50	1.81
1.90	0.09	9.10	1.09	25.00	1.98
2.00	0.15	9.30	1.14	25.50	1.91
2.10	0.19	9.50	1.12	26.00	2.02
2.20	0.25	9.70	1.15	26.50	1.92
2.30	0.29	9.90	1.16	27.00	1.97
2.40	0.33	10.10	1.16	28.00	2.02
2.50	0.37	10.30	1.19	29.00	1.95
2.60	0.41	10.50	1.14	30.00	1.94
2.70	0.44	10.70	1.19	31.00	2.11
2.80	0.45	10.90	1.17	32.00	2.17
2.90	0.48	11.10	1.13	33.00	2.27
3.10	0.61	11.30	1.20	34.00	2.27
3.30	0.64	11.50	1.13	35.00	2.29
3.50	0.65	11.70	1.20	36.00	2.35
3.70	0.68	11.90	1.18	37.00	2.37
3.90	0.69	12.10	1.14	38.00	2.40
4.10	0.71	12.40	1.19	39.00	2.57
4.30	0.73	13.00	1.34	40.00	2.36
4.50	0.75	13.50	1.33		
4.70	0.77	14.00	1.48		
4.90	0.79	14.50	1.45		

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Cable loss
Cable coaxial, 40GHz, 1.5 m, green, Rhophase Microwave Limited, model: KPS-1503A-1500-KPS, HL 2400

Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB
0.03	0.06	6.5	1.46	15.50	2.34
0.05	0.08	6.7	1.49	16.00	2.34
0.1	0.15	6.9	1.50	16.50	2.40
0.2	0.23	7.1	1.51	17.00	2.46
0.3	0.29	7.3	1.55	17.50	2.54
0.5	0.37	7.5	1.56	18.00	2.61
0.7	0.46	7.7	1.58	18.50	2.59
0.9	0.53	7.9	1.60	19.00	2.59
1.1	0.58	8.1	1.61	19.50	2.67
1.3	0.65	8.3	1.68	20.00	2.62
1.5	0.66	8.5	1.68	20.50	2.73
1.7	0.72	8.7	1.75	21.00	2.71
1.9	0.76	8.9	1.74	21.50	2.78
2.1	0.79	9.1	1.81	22.00	2.83
2.3	0.85	9.3	1.79	22.50	2.81
2.5	0.90	9.5	1.86	23.50	2.91
2.7	0.91	9.7	1.85	24.00	2.97
2.9	0.97	9.9	1.87	24.50	2.98
3.1	0.97	10.1	1.88	25.00	2.97
3.3	1.03	10.30	1.82	25.50	3.03
3.5	1.06	10.50	1.92	26.00	3.04
3.7	1.10	10.70	1.86	26.50	3.11
3.9	1.13	10.90	1.96	27.00	2.97
4.1	1.16	11.10	1.90	28.00	3.15
4.3	1.18	11.30	1.99	29.00	3.07
4.5	1.21	11.50	1.95	30.00	3.13
4.7	1.23	11.70	2.00	31.00	3.13
4.9	1.26	11.90	2.01	32.00	3.18
5.1	1.28	12.10	1.99	33.00	3.31
5.3	1.31	12.40	2.06	34.00	3.32
5.5	1.32	13.00	2.11	35.00	3.37
5.7	1.36	13.50	2.17	36.00	3.36
5.9	1.37	14.00	2.36	37.00	3.46
6.1	1.38	14.50	2.32	39.00	3.49
6.3	1.44	15.00	2.30	40.00	3.52

Appendix D 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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Abbreviations and acronyms

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

ASK	amplitude shift keying
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
LNA	low noise amplifier
LMS	location and monitoring service
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
RF	radio frequency
rms	root mean square
s	second
V	volt
W	width

Specification references

47CFR part 90: 2002	Private land mobile radio services
ANSI C63.2:96	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.