



HERMON LABORATORIES



Hermon Laboratories Ltd.
P.O.Box 23
Binyamina 30500, Israel
Tel. +972 4628 8001
Fax. +972 4628 8277
e-mail: mail@hermonlabs.com

ELECTROMAGNETIC EMISSIONS TEST REPORT

according to 47CFR Part 90, subpart I and part 15, subpart B
for

Hi-G-TEK Ltd.

EQUIPMENT UNDER TEST:

Data reader

Models: IG-RS-46D9-916, IG-RS-43D9-916

This report is in conformity with ISO/IEC 17025. The A2LA logo endorsement applies only to the test methods and the standards that are listed in the scope of Hermon Laboratories accreditation.
The test results relate only to the items tested. **This test report must not be reproduced in any form except in full with the approval of Hermon Laboratories Ltd.**

Page 1 of 81

Document ID: HIGRAD_FCC.15758_rev1.doc
Date of Issue: February 2004



Contents

1	Project information	3
2	Summary and signatures	4
3	EUT description	5
3.1	GENERAL DESCRIPTION.....	5
3.2	EUT TEST CONFIGURATION	5
4	Test results.....	8
4.1	PEAK OUTPUT POWER TEST ACCORDING TO PART 90 §90.205(k).....	8
4.2	OCCUPIED BANDWIDTH ACCORDING TO PART 90 §90.209(5)	9
4.3	EMISSION MASK AND RADIATED SPURIOUS EMISSIONS TEST ACCORDING TO PART 90 §90.210(k)(3)	10
4.4	UNINTENTIONAL RADIATED EMISSIONS TEST ACCORDING TO §15.109	13
4.5	FREQUENCY STABILITY MEASUREMENT ACCORDING TO §90.213	15
4.6	CONDUCTED EMISSIONS TEST ACCORDING TO §15.207, 15.107	17
	Appendix A Plots	21
	Appendix B Test equipment used for tests	63
	Appendix C Antenna factors and cable loss.....	65
	Appendix D General information	81
	TEST FACILITY DESCRIPTION	81
	ABBREVIATIONS AND ACRONYMS	81
	SPECIFICATION REFERENCES.....	81



1 Project information

Equipment under test attributes

Test items	: Data reader
Manufacturer	: Hi-G-Tek Ltd.
Types (Models)	: IG-RS-46D9-916, IG-RS-43D9-916

Applicant information

Applicant's responsible person	: Mr. Rony Cohen, hardware department manager
Company	: Hi-G-Tek Ltd.
Address	: 16, Hacharoshet street
City	: Or-Yehuda
Postal code	: 60375
Country	: Israel
Telephone number	: +972-3533 8328
Telefax number	: +972-3533 9225

Test performance

Project number:	: 15758
Location	: Hermon Laboratories
Test started	: December 7, 2003
Test completed	: December 22, 2003
Purpose of test	: Apparatus compliance verification in accordance with emission requirements
Test specification(s)	: 47CFR part 90, §§90.205, 90.209, 90.210, 90.213, part 15 §15.109, 15.107, 15.207



2 Summary and signatures

The EUT, data reader, was tested according to FCC part 90 subpart I, §§90.205(k), 90.209, 90.210(k)(3), part 15 §15.109, 15.107, 15.207 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); 2.1046	Mr. Y. Neuman, test engineer	December 8, 2003	4.1	Pass
Occupied bandwidth	90.209; 2.1049	Mr. Y. Neuman, test engineer	December 8, 2003	4.2	Pass
Emission mask	90.210(k)(3); 2.1051	Mr. Y. Neuman, test engineer	December 7, 8, 2003	4.3	Pass
Conducted spurious emissions	90.210; 2.1051	Mr. Y. Neuman, test engineer	December 7, 8, 2003	4.3	Pass
Radiated spurious emissions	90.210; 2.1053	Mr. Y. Neuman, test engineer	December 7, 8, 2003	4.3	Pass
Frequency stability	90.213, 2.1055	Mr. Y. Neuman, test engineer	December 9, 2003	4.4	Tested
Radiated emissions	15.109	Mr. Y. Neuman, test engineer	December 7, 22 2003	4.5	Pass
Conducted emissions	15.107	Mr. Y. Neuman, test engineer	December 7, 22, 2003	4.6	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 description

The EUT, data reader, model names IG-RS-46D9-916 and IG-RS-43D9-916, is an interrogator for electronic tags operating at 916.5 MHz, FSK modulated with 40 kHz deviation and 15625 bps data rate. The two models have the same RF board, the differences are in digital board. The IG-RS46D9-916 device has RS485 serial communication interface, the IG-RS43D9-916 model - RS232, so readers can be connected to a host.

An interrogation sequence can be initiated either by the host or by the data reader independently. When an interrogation cycle starts, the data reader transmits a header for typically 0.5 - 3 s. Then it opens a receiving window for typically 2 seconds. In this window, each tag receiving the EUT message, replies with a short message, typically 10 ms. The data reader includes standard TNC connector for external antenna, is powered by an external 24 VDC power supply and intended for outdoor installation.

The following frequencies are used or generated in the EUT: 32.768 kHz, 4 MHz, 10.7 MHz, 26.641176 MHz, 28.64062 MHz, 905.8 MHz (LO).

3.2 EUT test configuration

The EUT ports and lines description is given in Tables 3.2.1, 3.2.2, support/test equipment list is provided in Table 3.2.3, test configuration is shown in Figure 3.2.1.

Table 3.2.1

IG-RS-46D9-916 ports and lines

Port type	Port description	Connector type	Quantity	Cable type description	Cable length, m	Connected to
Power + signal	24 V DC + RS485	Terminal block TB1	1	Shielded	12	Converter
Power + signal	24 V DC + RS485	Terminal block TB2	1	Unshielded	1	Open circuit
Signal	I/O and GND	Terminal block TB3	1	Unshielded	1	Open circuit
Signal	Antenna	TNC	1	NA	NA	50 Ohm termination
Power	24 V DC	DC jack (on converter)	1	Unshielded	1.5	AC/DC adapter from converter
Power	AC	Non-detachable	1	Unshielded	1.5	AC mains from adapter



Table 3.2.2
IG-RS-43D9-916 ports and lines

Port type	Port description	Connector type	Quantity	Cable type description	Cable length, m	Connected to
Power + signal	24 V DC + RS232	Terminal block TB1	1	Shielded, splitted	12	Laptop, adapter
Power + signal	24 V DC + RS232	Terminal block TB2	1	Unshielded	1	Open circuit
Signal	I/O and GND	Terminal block TB3	1	Unshielded	1	Open circuit
Signal	Antenna	TNC	1	NA	NA	50 Ohm termination
Power	AC	Non-detachable	1	Unshielded	1.5	AC mains from adapter

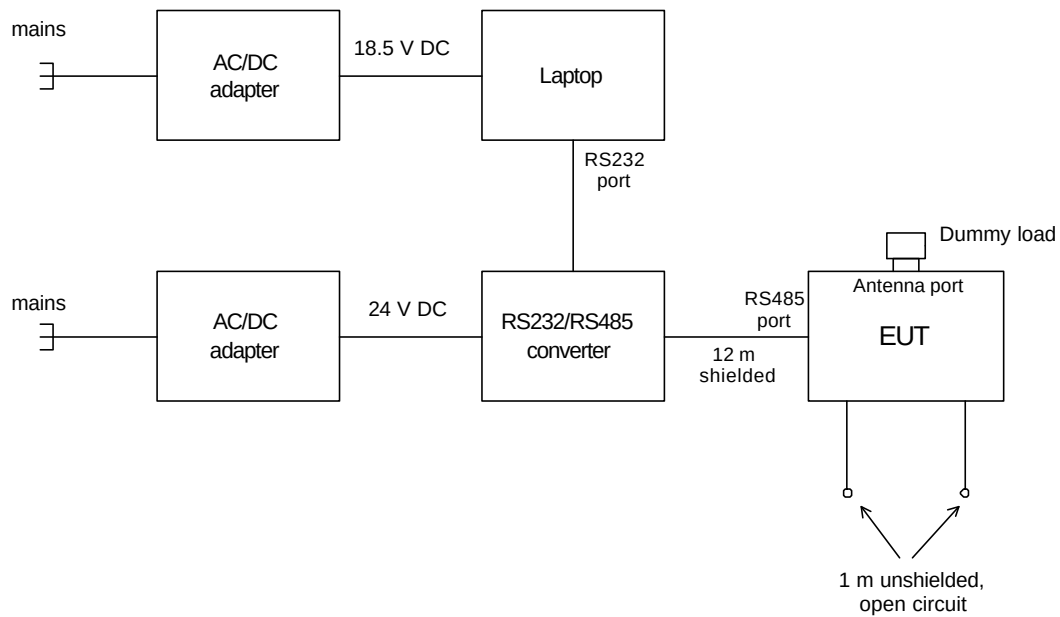
Table 3.2.3
EUT support/test equipment

Description	Manufacturer	Model number	Serial number
Laptop (IG-RS-46D9-916 setup)	Compaq	Armada V300	1J9BCXX1V442
Laptop (IG-RS-43D9-916 setup)	Toshiba	Tecra PA1221U	08638791
RS232/RS485 converter	MOXA	A51	T01AD2300252
Power supply (adapter) for EUT	AK Technology	A25B1-24MB, 24 V/1 A	A023918968
Power supply (adapter) for laptop	Compaq	ADP50-UB, 18.5 V/2.7 A	NA

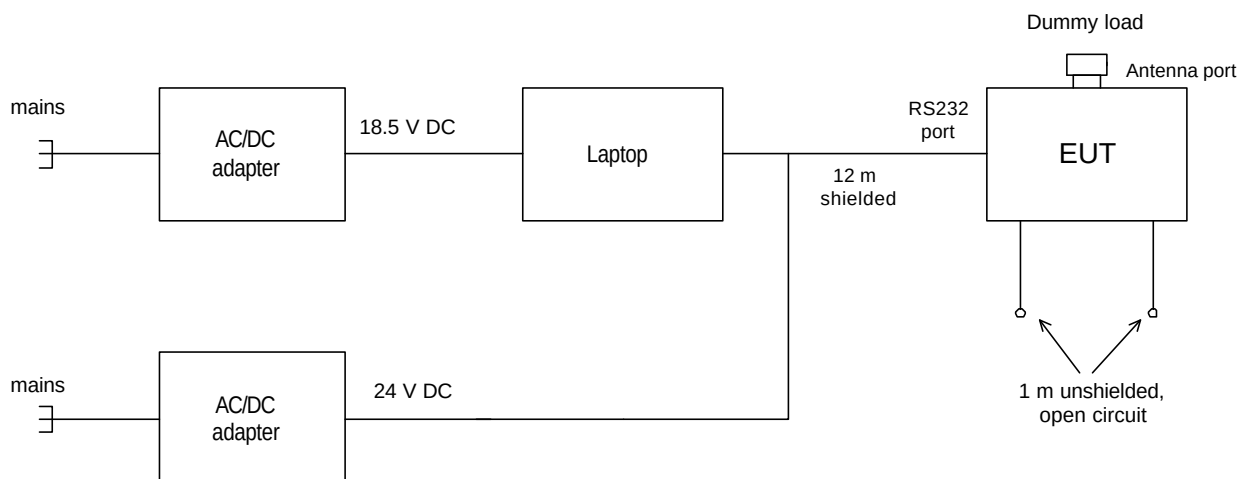


Figure 3.2.1
EUT test configuration

a) IG-RS-46D9-916 model



b) IG-RS-43D9-916 model





4 Test results

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

DATE of TEST: December 8, 2003
AMBIENT TEMPERATURE: 23°C
RELATIVE HUMIDITY: 52 %
AIR PRESSURE: 1018 hPa
MEASUREMENT UNCERTAINTY: ±4.5 dB

Carrier frequency, MHz	Peak output power, W		Verdict	Reference to plot in Appendix A
	Measured	Limit		
916.392	0.0195	30	Pass	A1

LIMITATION ON POWER

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

TEST PROCEDURE

The EUT main antenna port was connected via attenuator to spectrum analyzer and peak output power was measured.

TEST EQUIPMENT USED:

HL 1424	HL 1991	HL 2254				
---------	---------	---------	--	--	--	--



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

DATE of TEST: December 8, 2003
AMBIENT TEMPERATURE: 23°C
RELATIVE HUMIDITY: 52 %
AIR PRESSURE: 1018 hPa
MEASUREMENT UNCERTAINTY: ±2.6 dB
CARRIER FREQUENCY: 916.5 MHz

Measured 23 dB bandwidth, MHz	Authorized bandwidth, MHz	Reference to Plots in Appendix A	Verdict
0.138	12	A2	Pass

LIMIT

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

TEST PROCEDURE

The EUT RF output was connected to the spectrum analyzer, which settings are shown in the plots. Spectrum analyzer readings were corrected for external attenuation and cable loss.

TEST EQUIPMENT USED:

HL 1430	HL 1991	HL 2254			
---------	---------	---------	--	--	--



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

DATE of TEST:	December 8, 2003
AMBIENT TEMPERATURE:	23°C
RELATIVE HUMIDITY:	52 %
AIR PRESSURE:	1018 hPa
FREQUENCY RANGE:	9 kHz – 9.2 GHz
MEASUREMENT UNCERTAINTY:	±4.3 dB (conducted method) ±4.5 dB (radiated method)

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.

4.3.1 Test procedure

Conducted spurious emissions were measured at the EUT antenna terminal in the frequency range from 9 kHz up to 9.2 GHz.

The following calculated limit was applied to spurious emissions throughout the testing in transmit mode: the specified limit for attenuation $55 + 10 \log (P)$ is equivalent to -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, test results were recorded in Table 4.3.1. Emissions at the lower band edge and at the higher band edge were tested.

The full test results in transmit mode are shown in plots A3 to A15.

The test results in receive mode are depicted in plots A16 to A18.

Radiated spurious emissions were measured at 3m test distance in the anechoic chamber from 9 kHz up to 6.5 GHz and at OATS from 6.5 GHz up to 9.2 GHz:

with the loop antenna in the 9 kHz to 30 MHz range,

the biconilog - in the 30 MHz to 1000 MHz range,

the double ridged guide – in 1 GHz to 9.2 GHz range.

The EUT was set up on the 80 cm height wooden table as shown in Figures 4.3.1 and 4.3.2.

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°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

The specified limit $55 + 10 \log (P)$ was converted in 70 dB(μV/m) equivalent field strength at 3 m

$E = \sqrt{30P} / r$, where $P = -25$ dBm = 3×10^{-6} W.

$E [\text{dB}\mu\text{V/m}] = 20 \log \{10^6 \times \sqrt{(30 \times 3 \times 10^{-6}) / 3}\} = 70 \text{ dB}\mu\text{V/m}$.

The test results were recorded in Table 4.3.2 and shown in Plots A19 to A27.

The spurious emissions found in 1.0 GHz – 6.5 GHz range were retested by substitution method.

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 4.3.2.

$$\text{ERP (dBm)} = P_{\text{out gen}} (\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dBd)}$$



Table 4.3.1

Conducted spurious emissions test results

Frequency, MHz	Spurious emission level, dBm		Margin, dB	Verdict	Reference to Plots in Appendix A
	Measured	Limit			
887.885	-36.73	-25	11.73	Pass	A7
909.701	-30.91	-25	5.91	Pass	A8
921.750	-28.60	-25	3.60	Pass	A9
945.167	-38.29	-25	13.29	Pass	A10
1833.045	-53.35	-25	28.35	Pass	A12
2749.555	-36.58	-25	11.58	Pass	A14
3665.917	-46.47	-25	21.47	Pass	A15

Table 4.3.2

Radiated emissions measurement results

Frequency, MHz	Radiated measured result, dB(uV/m)	Generator P_{out} , dBm	Cable loss, dB	Antenna gain, dBd	Equivalent radiated power, dBm	Limit, dBm	Margin, dB	Verdict
1833	57.8	-44.3	0.8	4.7	-40.4	-25	15.4	Pass
2749.5	58.5	-44.5	0.9	5.5	-39.9	-25	14.9	Pass

TEST EQUIPMENT USED FOR CONDUCTED METHOD:

HL 1430	HL 1991	HL 2254				
---------	---------	---------	--	--	--	--

TEST EQUIPMENT USED IN ANECHOIC CHAMBER:

HL 0446	HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594
HL 0604	HL 1004	HL 2009				

TEST EQUIPMENT USED AT OPEN AREA TEST SITE:

HL 0038	HL 0091	HL 0287	HL 1200	HL 1424	HL 1942	HL 1984
HL 2254	HL 2259					

TEST EQUIPMENT USED AT OPEN AREA TEST SITE FOR SUBSTITUTION METHOD:

HL 0038	HL 0091	HL 0287	HL 0661	HL 1116	HL 1365	HL 1430
HL 1947	HL 1984	HL 2400				



Figure 4.3.1

Set up for radiated emissions measurement with loop antenna

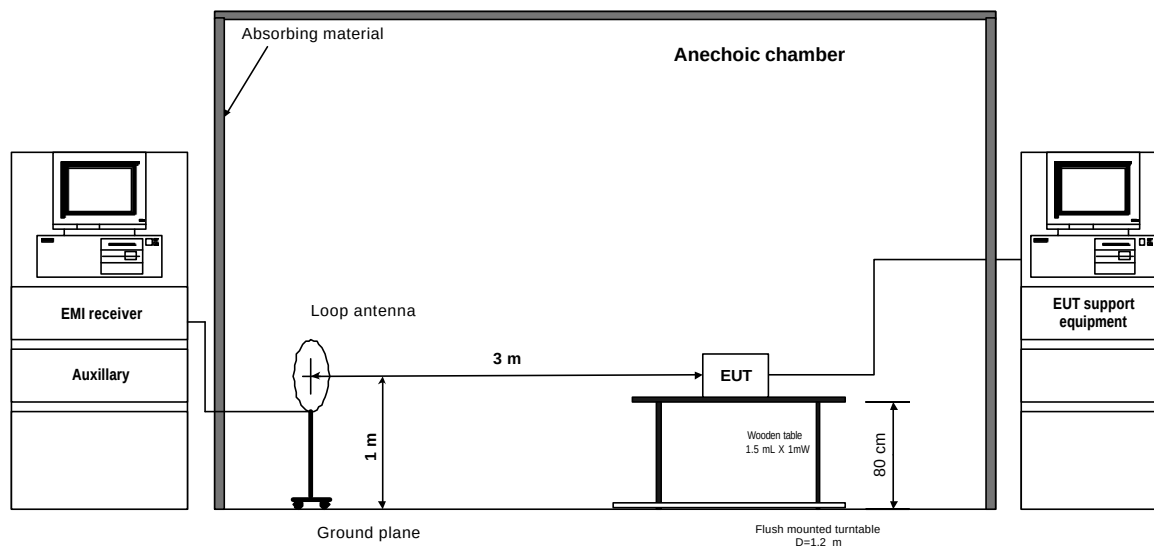
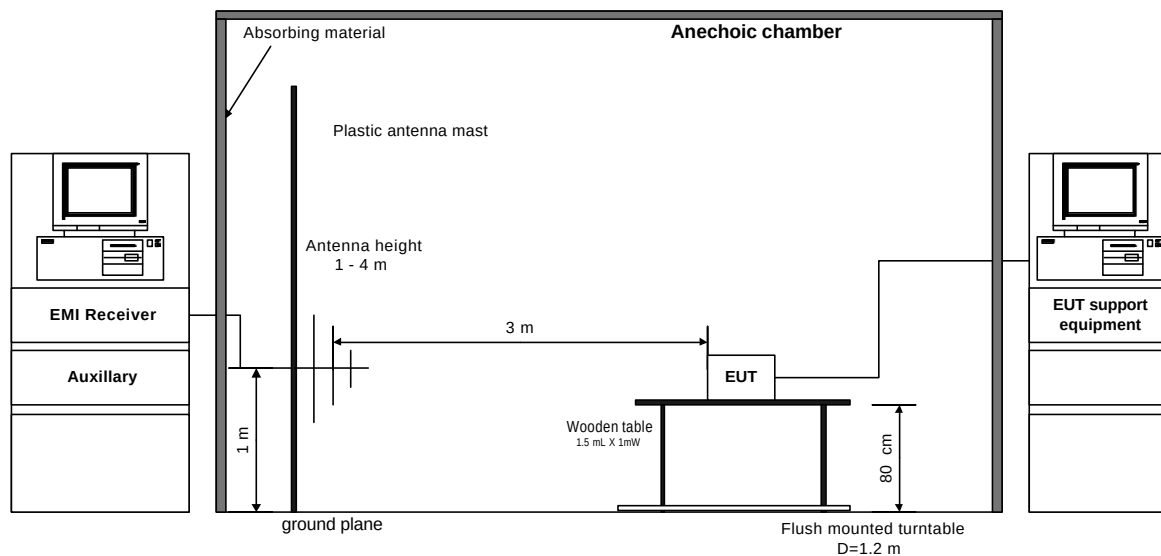


Figure 4.3.2

Set up for radiated emissions measurement with biconilog antenna





4.4 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: December 7, 22, 2003
AMBIENT TEMPERATURE: 21°C
RELATIVE HUMIDITY: 59 %
AIR PRESSURE: 1013 hPa
DISTANCE BETWEEN ANTENNA AND EUT: 3 m
THE EUT WAS TESTED AS: Table-top
FREQUENCY RANGE: 30 MHz – 5 GHz
DETECTOR TYPE: Peak
MEASUREMENT UNCERTAINTY: ± 6 dB max

For test procedure and setup refer to section 4.3, radiated emissions.

Model number: IG-RS-46D9-916, test performed in anechoic chamber

Frequency, MHz	Detector type	RBW kHz	Antenna type	Antenna polariz.	Antenna height, m	TT position (°)	Radiated emissions, dB(mV/m)	Limit, dB (mV/m)	Margin, dB	Verdict
40.000	QP	120	Biconilog	Vertical	1.0	195	33.46	40.00	6.54	Pass
48.000	QP	120	Biconilog	Vertical	1.0	116	36.72	40.00	3.28	Pass
58.075	QP	120	Biconilog	Vertical	1.1	164	34.97	40.00	5.03	Pass
248.058	QP	120	Biconilog	Horizontal	1.0	243	44.50	46.00	1.50	Pass
344.087	QP	120	Biconilog	Horizontal	2.7	206	42.46	46.00	3.54	Pass
360.083	QP	120	Biconilog	Horizontal	1.0	191	43.35	46.00	2.65	Pass
1079.965	AVRG	1000	DRG	Vertical	1.0	353	45.53	54.00	8.47	Pass
1560.000	AVRG	1000	DRG	Vertical	1.0	228	35.67	54.00	18.33	Pass

For full test results refer to plots A28-A30.

Table abbreviations:

Detector type QP- quasi-peak, AVRG – average
RBW resolution bandwidth
Antenna type Bic - biconical, LP - log periodic, DRG – double ridged guide
Antenna polariz. antenna polarization
TT position turntable position in degrees, (EUT front panel = 0°).
Margin dB below (negative if above) specification limit.

TEST EQUIPMENT USED IN THE ANECHOIC CHAMBER:

HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604
HL 1004	HL 1947	HL 1984	HL 2009			



Model number: IG-RS-43D9-916, test performed at OATS

Frequency, MHz	Detector type	RBW kHz	Antenna type	Antenna polariz.	Antenna height, m	TT position (°)	Radiated emissions, dB(mV/m)	Limit, dB (mV/m)	Margin, dB	Verdict
195.430	QP	120	Bic	Vertical	1.0	264	38.51	43.50	4.99	Pass
199.943	QP	120	Bic	Vertical	1.0	238	38.76	43.50	4.74	Pass
325.707	QP	120	LP	Vertical	1.2	319	41.71	46.00	4.29	Pass
328.075	QP	120	LP	Horizontal	1.0	44	42.49	46.00	3.51	Pass
336.074	QP	120	LP	Vertical	1.2	302	40.46	46.00	5.54	Pass
344.076	QP	120	LP	Horizontal	1.0	200	42.67	46.00	3.33	Pass
373.350	QP	120	LP	Vertical	1.0	311	45.24	46.00	0.76	Pass
466.640	QP	120	LP	Vertical	1.0	63	43.32	46.00	2.68	Pass
1267.040	AVRG	1000	DRG	Horizontal	1.0	9	31.00	54.00	23.00	Pass
1399.950	AVRG	1000	DRG	Vertical	1.0	240	35.04	54.00	18.96	Pass

Table abbreviations:

Detector type QP- quasi-peak, AVRG – average
RBW resolution bandwidth
Antenna type Bic - biconical, LP - log periodic, DRG – double ridged guide
Antenna polariz. antenna polarization
TT position turntable position in degrees, (EUT front panel = 0°).
Margin dB below (negative if above) specification limit.

LIMIT (§ 15.109)

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

TEST EQUIPMENT USED AT THE OATS:

HL 0032	HL 0034	HL 0287	HL 0415	HL 0812	HL 1942	



4.5 Frequency stability measurement according to §90.213

DATE of TEST: December 9, 2003
AMBIENT TEMPERATURE: 20°C
RELATIVE HUMIDITY: 52 %
AIR PRESSURE: 1016 hPa

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.

Frequency stability test results vs supply voltage

Voltage, V	Frequency, Hz	Displacement, Hz	Time, min
Uac=120 V	916 526 334	3647	startup
	916 524 683	1996	+2
	916 523 606	919	+5
	916 522 687	0	+10
Uac=102 V	916 525 379	2692	startup
	916 524 011	1324	+2
	916 523 106	419	+5
	916 522 352	-335	+10
Uac=138 V	916 525 942	3255	startup
	916 524 346	1659	+2
	916 523 367	680	+5
	916 522 541	-146	+10

Reference frequency: **916 522 687 Hz**

For information only: 2.5 ppm = ± 2291 Hz

TEST EQUIPMENT USED:

HL 0026	HL 0493	HL 0558	HL 1097	HL 1207		

**Frequency stability test results vs ambient temperature**

Temperature, °C	Frequency, Hz	Displacement, Hz	Time, min
t°=30°C	916 523 512	825	startup
	916 521 803	-884	+2
	916 520 491	-2196	+5
	916 519 266	-3421	+10
t°=40°C	916 519 776	-2911	startup
	916 518 177	-4510	+2
	916 516 887	-5800	+5
	916 515 674	-7013	+10
t°=50°C	916 515 725	-6962	startup
	916 514 414	-8273	+2
	916 513 347	-9340	+5
	916 512 411	-10276	+10
t°=10°C	916 524 046	1359	startup
	916 523 559	872	+2
	916 523 631	944	+5
	916 523 833	1146	+10
t°=0°C	916 535 193	12506	startup
	916 533 944	11257	+2
	916 533 028	10341	+5
	916 532 214	9527	+10
t°=-10°C	916 536 979	14292	startup
	916 536 325	13638	+2
	916 535 699	13012	+5
	916 535 247	12560	+10
t°=-20°C	916 538 512	15825	startup
	916 538 257	15570	+2
	916 538 129	15442	+5
	916 537 955	15268	+10
t°=-30°C	916 537 913	15226	startup
	916 537 860	15173	+2
	916 538 752	16065	+5
	916 538 901	16214	+10



4.6 Conducted emissions test according to §15.107

EUT MODEL NUMBER: IG-RS-46D9-916
METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.3
DATE of TEST: December 7, 2003
RELATIVE HUMIDITY: 49%
AMBIENT TEMPERATURE: 22°C
AIR PRESSURE: 1018 hPa
THE EUT WAS TESTED AS: TABLE-TOP
FREQUENCY RANGE: 150 kHz – 30 MHz
RESOLUTION BANDWIDTH: 9 kHz
MEASUREMENT UNCERTAINTY, dB
± 3.9 dB in 9 – 150 kHz
± 3.8 dB in 150 kHz – 30 MHz

EUT power lines, transmit and receive modes

Quasi-peak detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification QP limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.177	1	49.18	64.67	15.49	Pass	A31, A33
0.769	1	39.99	56.00	16.01	Pass	A31, A33
0.947	2	39.65	56.00	16.35	Pass	A32, A34
1.006	1	40.09	56.00	15.91	Pass	A31, A33
1.243	1	39.39	56.00	16.61	Pass	A31, A33
29.998	2	45.87	60.00	14.13	Pass	A32, A34

Average detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification AVRG limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.177	1	44.31	54.67	10.36	Pass	A31, A33
0.769	1	37.26	46.00	8.74	Pass	A31, A33
0.947	2	37.64	46.00	8.36	Pass	A32, A34
1.006	1	38.51	46.00	7.49	Pass	A31, A33
1.243	1	37.56	46.00	8.44	Pass	A31, A33
29.998	2	44.11	50.00	5.89	Pass	A32, A34



Laptop power lines, transmit and receive modes

Quasi-peak detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification QP limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.203	1	53.37	63.54	10.17	Pass	A35, A37
0.272	1	45.50	61.12	15.62	Pass	A35, A37
0.405	2	41.37	57.77	16.40	Pass	A36, A38
0.541	2	36.16	56.00	19.84	Pass	A36, A38
3.648	1	38.16	56.00	17.84	Pass	A35, A37
4.354	1	43.61	56.00	12.39	Pass	A35, A37

Average detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification AVRG limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.203	1	44.48	53.54	9.06	Pass	A35, A37
0.272	1	37.53	51.12	13.59	Pass	A35, A37
0.405	2	39.44	47.77	8.33	Pass	A36, A38
0.541	2	32.67	46.00	13.33	Pass	A36, A38
3.648	1	31.16	46.00	14.84	Pass	A35, A37
4.354	1	43.10	46.00	2.90	Pass	A35, A37

LIMIT

Frequency, MHz	Class B equipment, dB(mV)	
	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5	56	46
5 - 30	60	50

*The limit decreases linearly with the logarithm of frequency.

TEST PROCEDURE

The measurements were performed at mains terminals by means of LISN, connected to spectrum analyzer in the frequency range as referred to in the table above. The unused coaxial connector of the LISN was terminated with 50 Ω . The measurements were made with quasi-peak and average detectors as referred to in the tables. The position of the EUT cables was varied to determine maximum emission level.

TEST EQUIPMENT USED:

HL 0447	HL 0495	HL 0521	HL 0787	HL 1003	HL 1503	
---------	---------	---------	---------	---------	---------	--



Conducted emissions test according to §15.107 (continued)

EUT MODEL NUMBER: IG-RS-43D9-916
METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.3
DATE of TEST: December 22, 2003
RELATIVE HUMIDITY: 38%
AMBIENT TEMPERATURE: 25°C
AIR PRESSURE: 1012 hPa
THE EUT WAS TESTED AS: TABLE-TOP
FREQUENCY RANGE: 150 kHz – 30 MHz
RESOLUTION BANDWIDTH: 9 kHz
MEASUREMENT UNCERTAINTY, dB
± 3.9 dB in 9 – 150 kHz
± 3.8 dB in 150 kHz – 30 MHz

EUT power lines, transmit and receive modes

Quasi-peak detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification QP limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.177	2	49.27	64.68	15.41	Pass	A40
0.236	1	42.40	62.27	19.87	Pass	A39
0.472	1	42.86	56.53	13.67	Pass	A39
0.532	2	43.99	56.00	12.01	Pass	A40
0.828	2	43.43	56.00	12.57	Pass	A40
0.887	2	44.20	56.00	11.80	Pass	A40
0.943	1	42.52	56.00	13.48	Pass	A39
1.242	2	43.37	56.00	12.63	Pass	A40
5.189	1	45.39	60.00	14.61	Pass	A39
5.261	2	44.72	60.00	15.28	Pass	A40

Average detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification AVRG limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.177	2	44.45	54.68	10.23	Pass	A40
0.236	1	40.36	52.27	11.91	Pass	A39
0.472	1	41.84	46.53	4.69	Pass	A39
0.532	2	41.95	46.00	4.05	Pass	A40
0.828	2	41.85	46.00	4.15	Pass	A40
0.887	2	42.32	46.00	3.68	Pass	A40
0.943	1	40.90	46.00	5.10	Pass	A39
1.242	2	41.68	46.00	4.32	Pass	A40
5.189	1	42.81	50.00	7.19	Pass	A39
5.261	2	40.85	50.00	9.15	Pass	A40



Laptop power lines, transmit and receive modes

Quasi-peak detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification QP limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.163	1	46.48	65.34	18.86	Pass	A41
0.203	2	49.71	63.52	13.81	Pass	A42
0.268	2	44.09	61.23	17.14	Pass	A42
0.403	1	42.75	57.80	15.05	Pass	A41
0.470	1	35.68	56.56	20.88	Pass	A41
0.540	2	36.84	56.00	19.16	Pass	A42

Average detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification AVRG limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.163	1	16.38	55.34	38.96	Pass	A41
0.203	2	41.30	53.52	12.22	Pass	A42
0.268	2	37.79	51.23	13.44	Pass	A42
0.403	1	41.25	47.80	6.55	Pass	A41
0.470	1	33.34	46.56	13.22	Pass	A41
0.540	2	35.58	46.00	10.42	Pass	A42

LIMIT

Frequency, MHz	Class B equipment, dB(mV)	
	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5	56	46
5 - 30	60	50

*The limit decreases linearly with the logarithm of frequency.

TEST PROCEDURE

The measurements were performed at mains terminals by means of LISN, connected to spectrum analyzer in the frequency range as referred to in the table above. The unused coaxial connector of the LISN was terminated with 50 Ω. The measurements were made with quasi-peak and average detectors as referred to in the tables. The position of the EUT cables was varied to determine maximum emission level.

TEST EQUIPMENT USED:

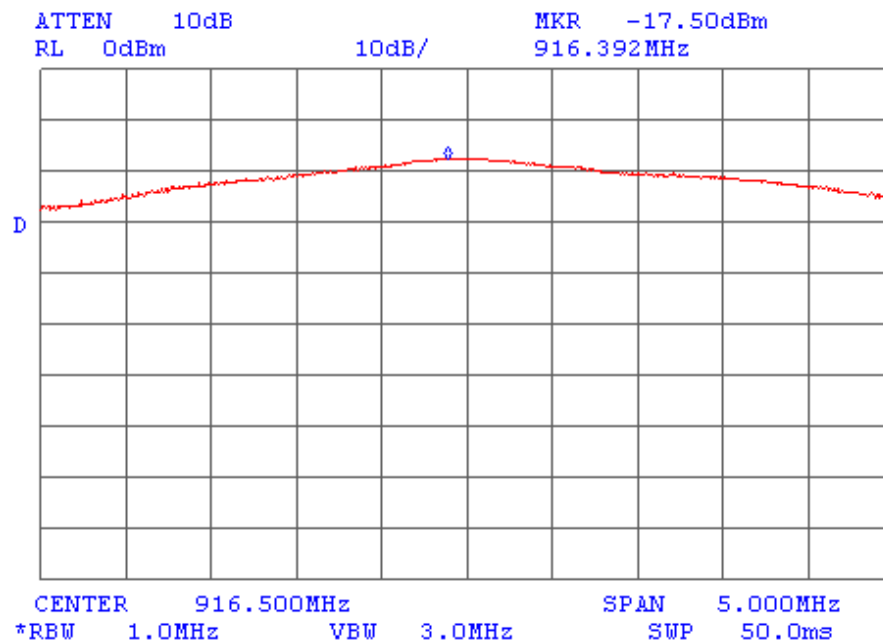
HL 0163	HL 0787	HL 1430	HL 1502	HL 1510		
---------	---------	---------	---------	---------	--	--



Appendix A Plots

Plot A 1

Output power measurement result



External attenuation (attenuator + cable loss) 30.4 dB
Output power=-17.5 dBm+30.4 dB = 12.9 dBm = 19.5 mW

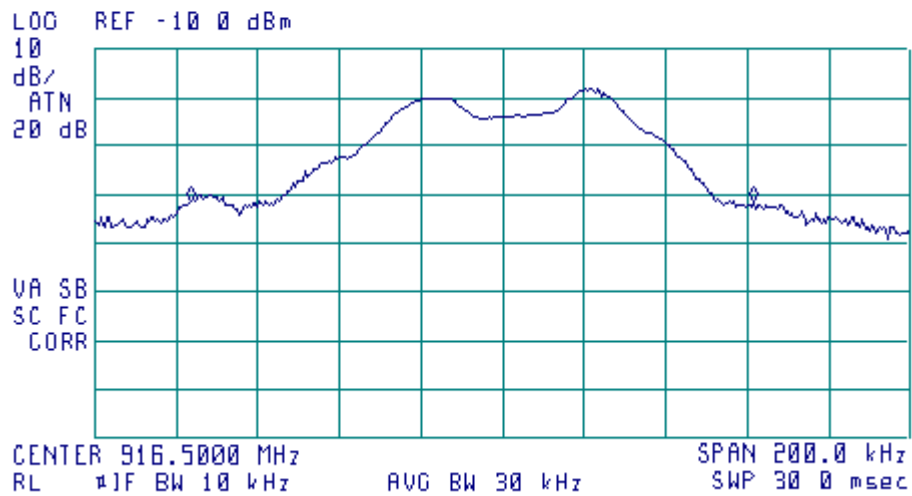


Plot A 2

23 dB bandwidth measurement result

14:05:33 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKRΔ 138.0 kHz
-.05 dB



Limit=12 MHz

Note: Measurement was performed in continuous transmission mode

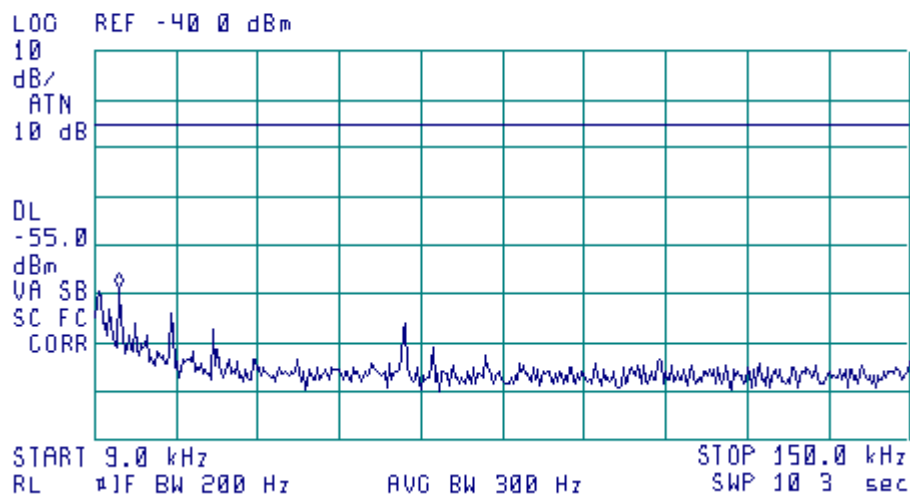


Plot A 3

Conducted spurious emission measurements in Tx mode from 9 kHz to 150 kHz

13:42:30 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 13.2 kHz
-88.58 dBm



All spurious emissions were found more than 30 dB below the limit

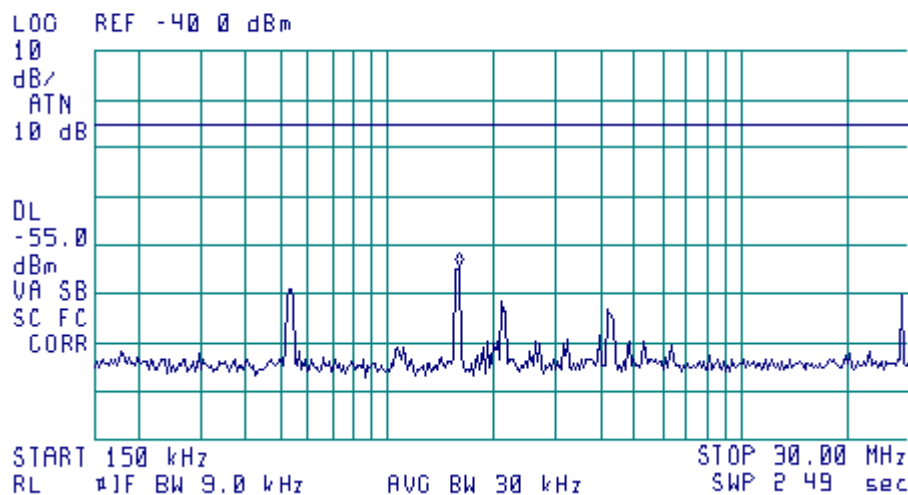


Plot A 4

Conducted spurious emission measurements in Tx mode from 150 kHz to 30 MHz

13:38:06 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 1.62 MHz
-84.44 dBm



All spurious emissions were found more than 25 dB below the limit

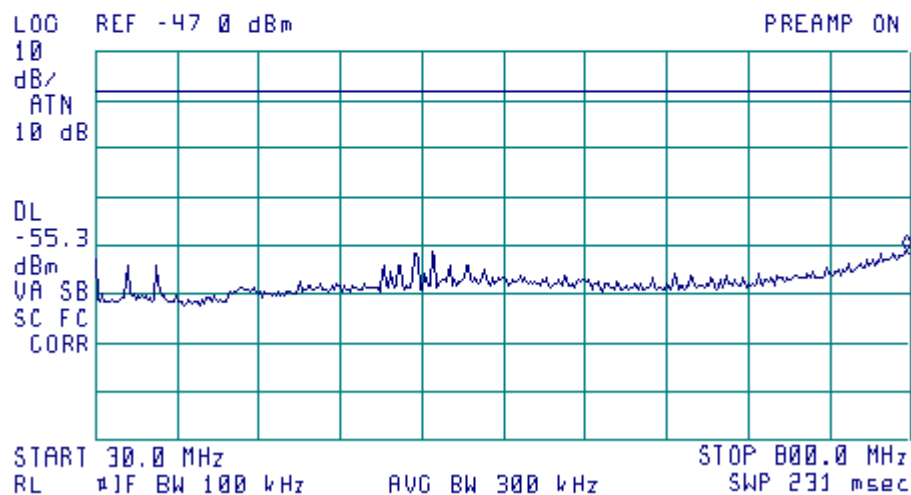


Plot A 5

Conducted spurious emission measurements in Tx mode from 30 MHz to 800 MHz

13:31:27 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 796.2 MHz
-87.86 dBm



All spurious emissions were found more than 30 dB below the limit

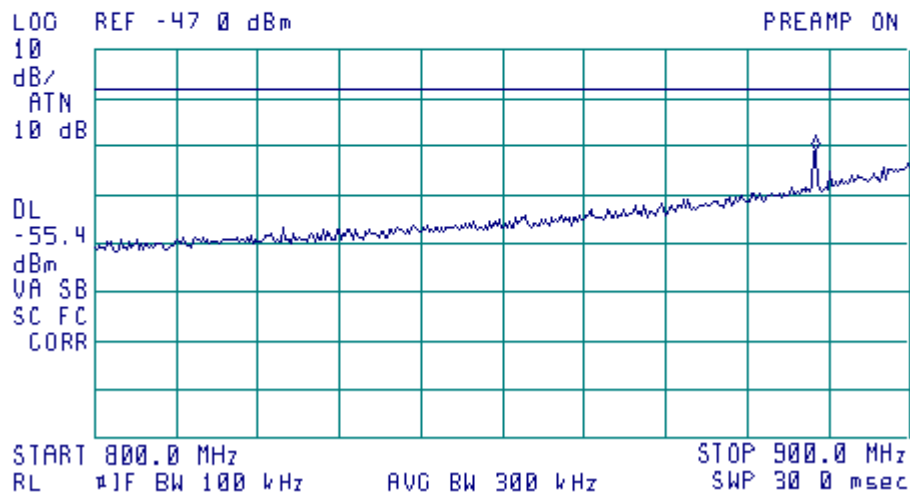


Plot A 6

Conducted spurious emission measurements in Tx mode from 800 MHz to 900 MHz

13:25:25 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 888.3 MHz
-67.88 dBm



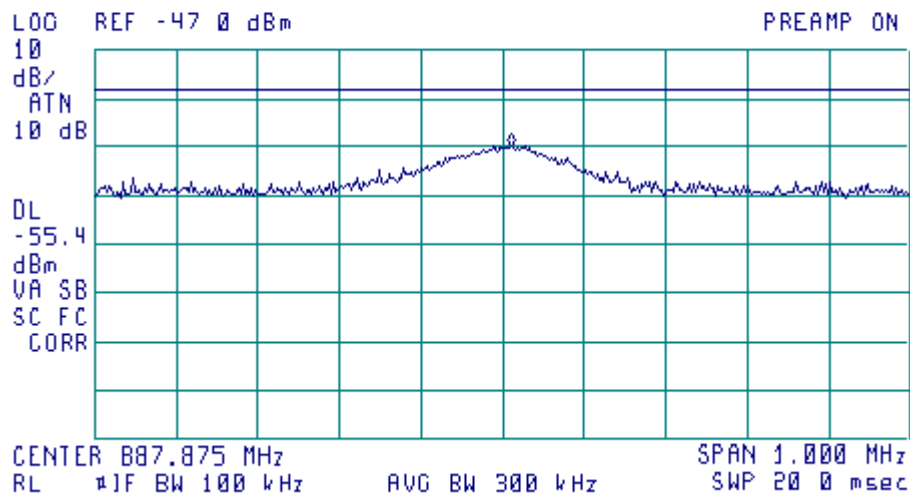


Plot A 7

Conducted spurious emission measurements in Tx mode

13:26:55 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 887.885 MHz
-67.13 dBm



External attenuation (attenuator + cable loss) is 30.4 dB
 $P = -67.13 \text{ dBm} + 30.4 \text{ dB} = -36.73 \text{ dBm}$
Limit=-25 dBm
Verdict: PASS

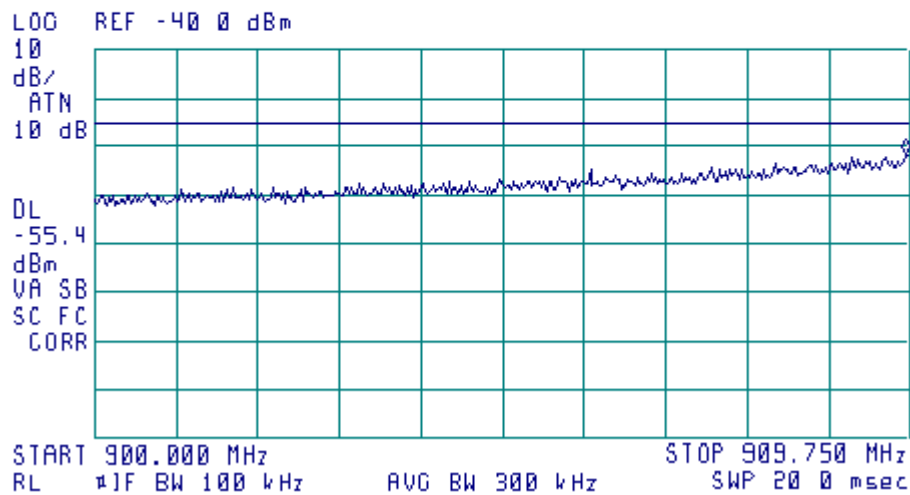


Plot A 8

Conducted spurious emission measurements in Tx mode from 900 MHz to 909.75 MHz (band edges)

14:19:53 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 909.701 MHz
-61.31 dBm



External attenuation (attenuator + cable loss) is 30.4 dB
 $P = -61.31 \text{ dBm} + 30.4 \text{ dB} = -30.91 \text{ dBm}$
Limit = -25 dBm
Verdict: PASS

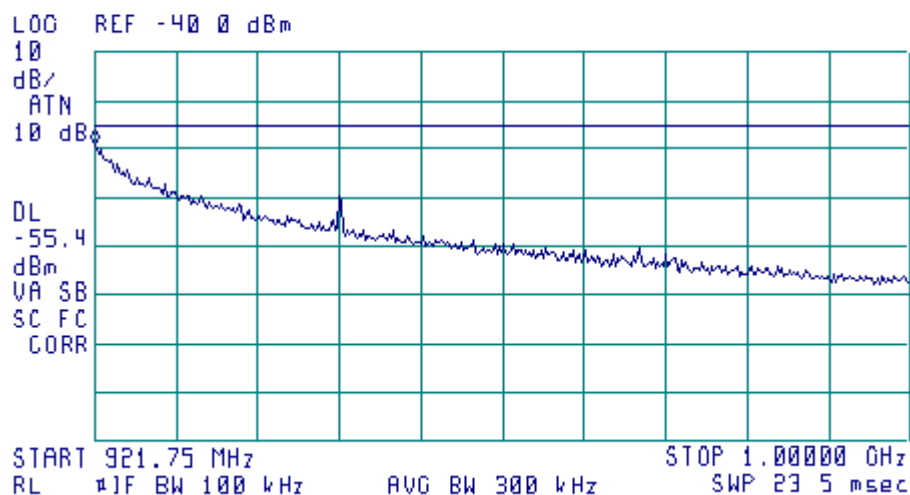


Plot A 9

Conducted spurious emission measurements in Tx mode from 921.75 MHz to 1000 MHz (band edges)

14:23:41 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 921.75 MHz
-59.00 dBm



External attenuation (attenuator + cable loss) is 30.4 dB
 $P = -59 \text{ dBm} + 30.4 \text{ dB} = -28.6 \text{ dBm}$
Limit=-25 dBm
Verdict: PASS

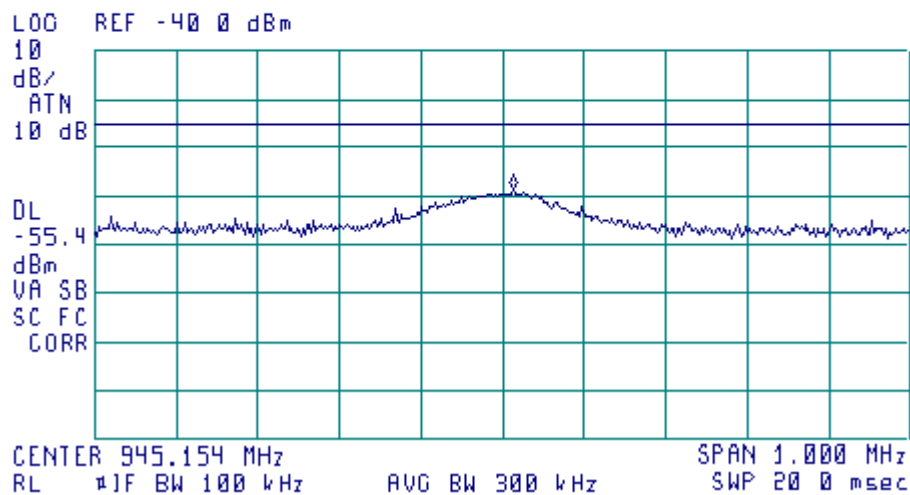


Plot A 10

Conducted spurious emission measurements in Tx mode

14:50:28 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 945.167 MHz
-68.69 dBm



External attenuation (attenuator + cable loss) is 30.4 dB
 $P = -68.69 \text{ dBm} + 30.4 \text{ dB} = -38.29 \text{ dBm}$
Limit=-25 dBm
Verdict: PASS

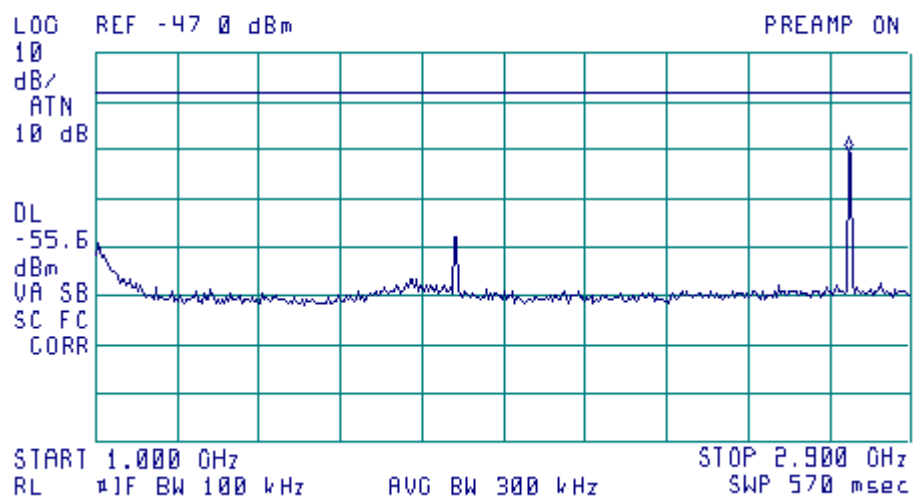


Plot A 11

Conducted spurious emission measurements in Tx mode from 1000 MHz to 2.900 GHz

12:21:54 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.753 GHz
-67.55 dBm



External attenuation (attenuator + cable loss) is 30.6 dB

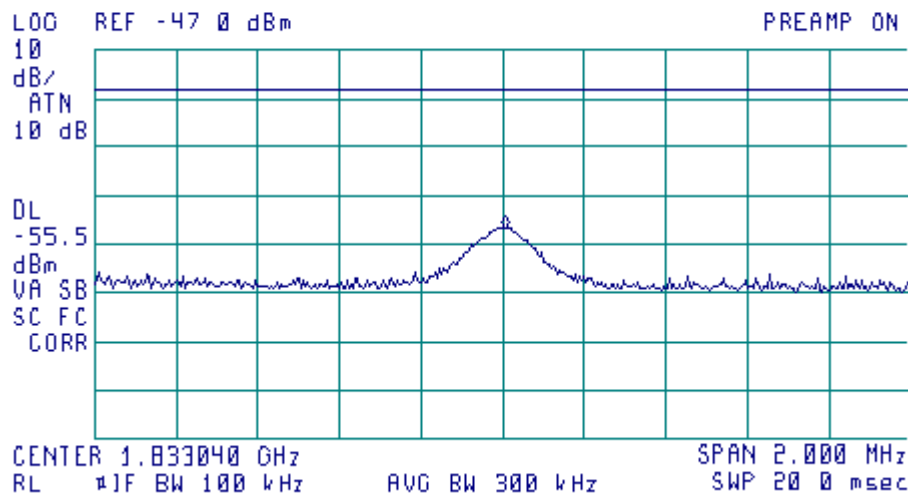


Plot A 12

Conducted spurious emission measurements in Tx mode, 2nd harmonic of fundamental

12:28:29 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 1.833045 GHz
-83.85 dBm



External attenuation (attenuator + cable loss) is 30.5 dB

$P = -83.85 \text{ dBm} + 30.5 \text{ dB} = -53.35 \text{ dBm}$

Limit=-25 dBm

Verdict: PASS

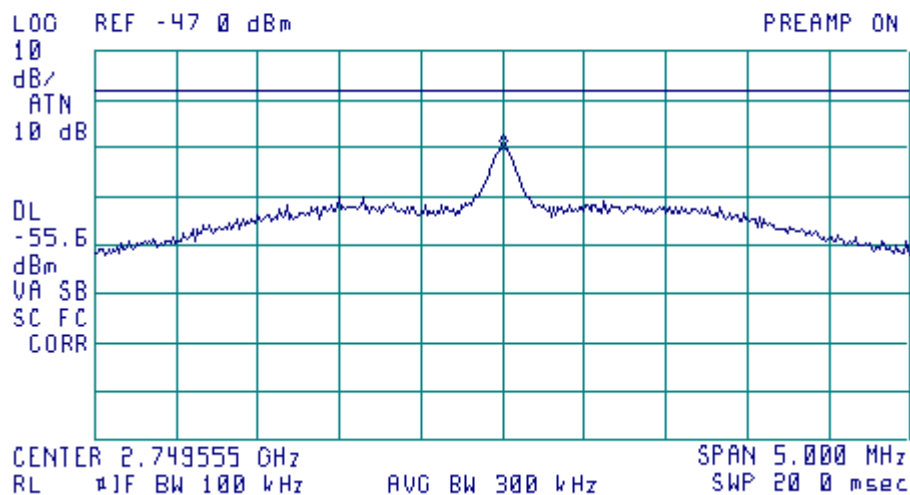


Plot A 13

Conducted spurious emission measurements in Tx mode, 3rd harmonic of fundamental

12:33:16 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.749555 GHz
-67.18 dBm

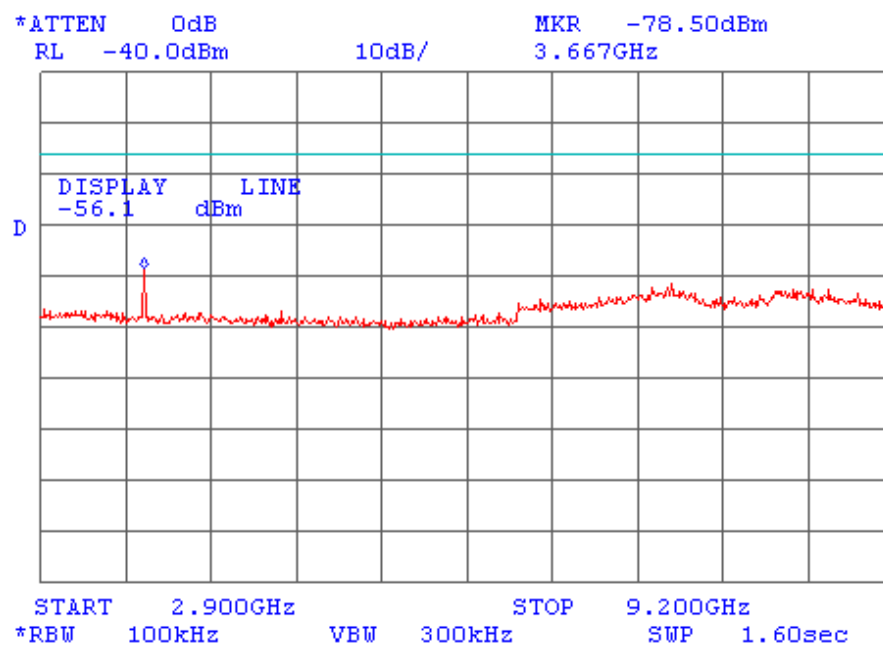


External attenuation (attenuator + cable loss) is 30.6 dB
 $P = -67.18 \text{ dBm} + 30.6 \text{ dB} = -36.58 \text{ dBm}$
Limit = -25 dBm
verdict: PASS



Plot A 14

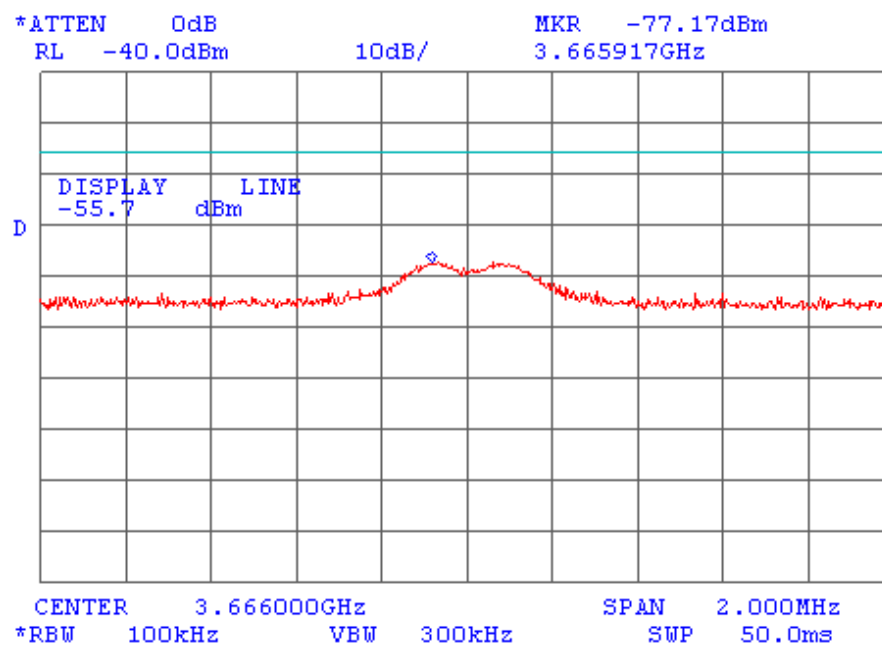
Conducted spurious emission measurements in Tx mode from 2.900 GHz to 9.200 GHz





Plot A 15

Conducted spurious emission measurements in Tx mode, 4th harmonic of fundamental



External attenuation (attenuator + cable loss) is 30.7 dB
 $P = -77.17 \text{ dBm} + 30.7 \text{ dB} = -46.47 \text{ dBm}$
Limit = -25 dBm
Verdict: PASS

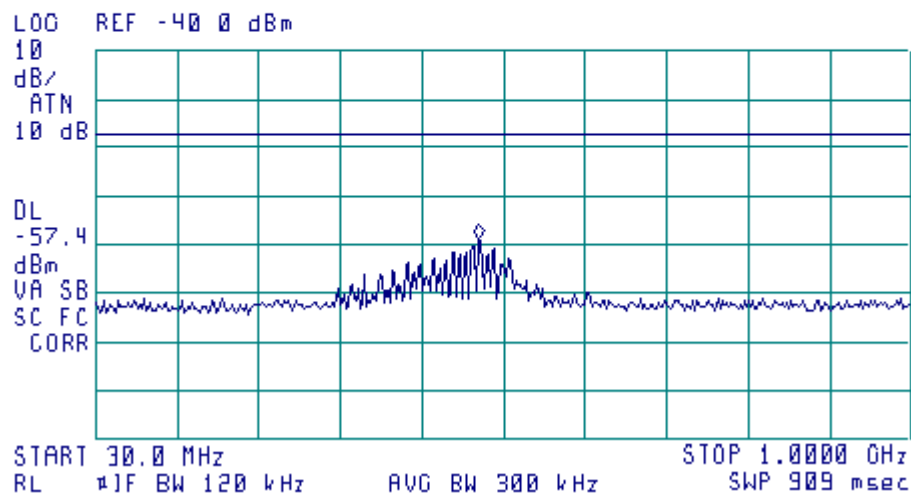


Plot A 16

Conducted spurious emission measurements in Rx mode from 30 MHz to 1000 MHz

15:05:18 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 485.9 MHz
-78.78 dBm



Limit = 2 nW = -57 dBm

Cable loss 0.4 dB

All spurious emissions found more than 20 dB below the limit

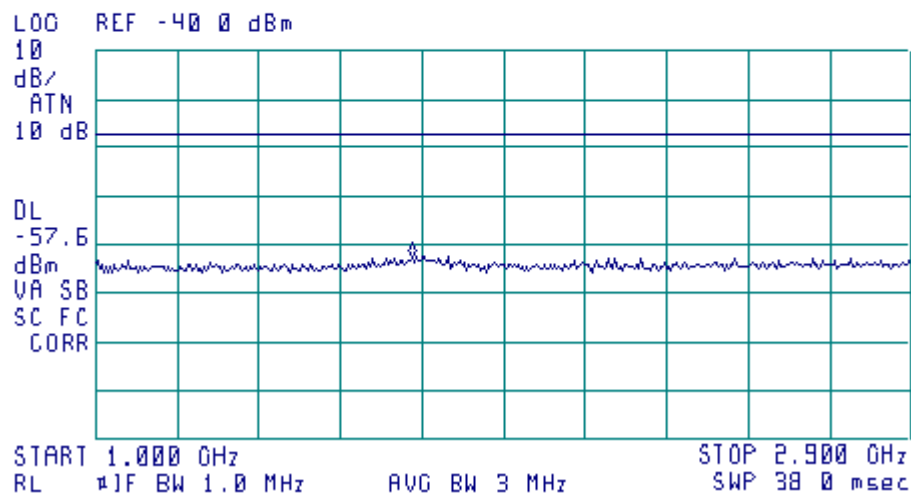


Plot A 17

Conducted spurious emission measurements in Rx mode from 1.000 GHz to 2.900 GHz

15:07:34 DEC 08, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 1.736 GHz
-82.47 dBm



Limit=2 nW=-57 dBm

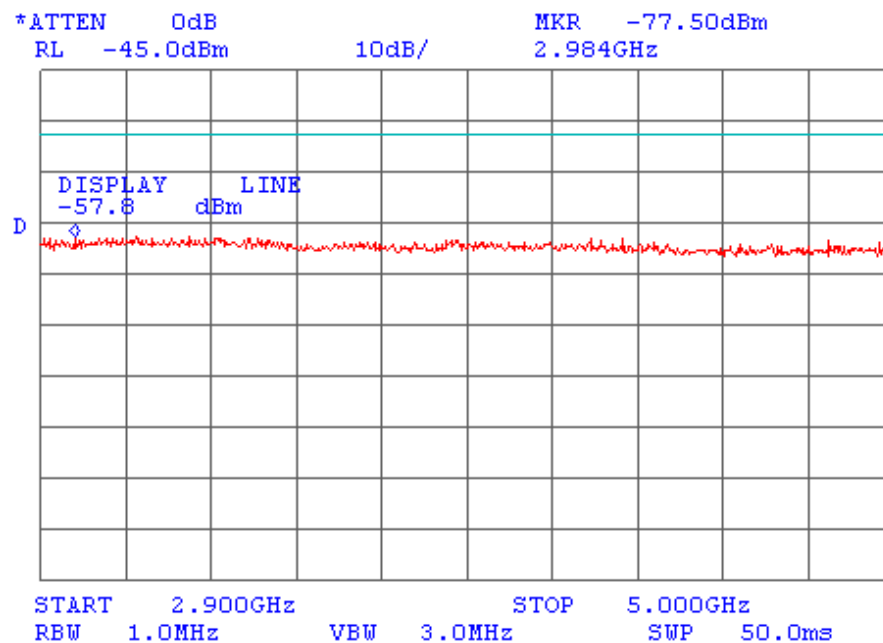
Cable loss 0.6 dB

No spurious emissions were found



Plot A 18

Conducted spurious emission measurements in Rx mode from 2.900 GHz to 5.000 GHz



Limit=2 nW=-57 dBm

Cable loss 0.8 dB

No spurious emissions were found

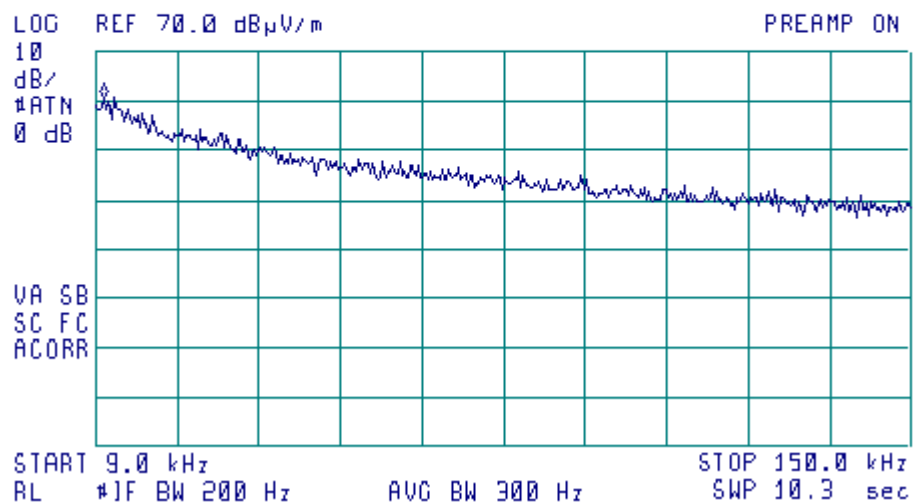


Plot A 19

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

13:58:29 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKA 10.4 kHz
60.65 dB μ V/m



No spurious emissions were found.

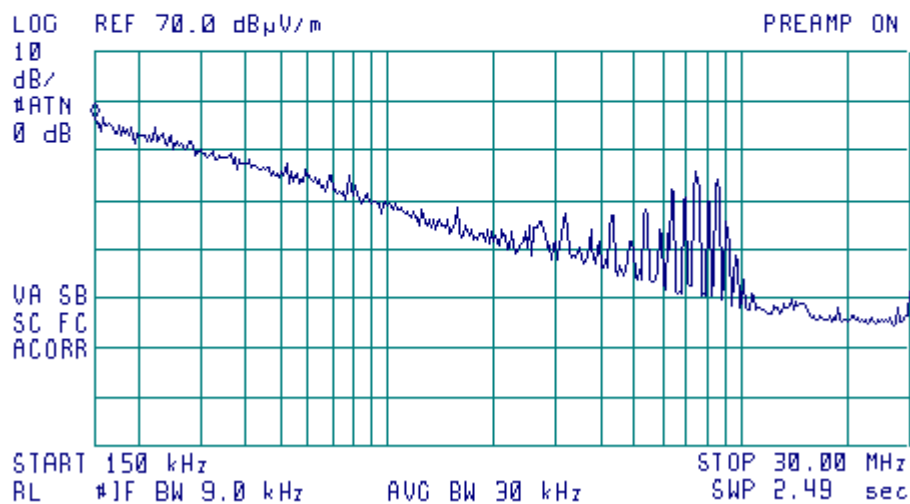


Plot A 20

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

13:46:48 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKA 150 kHz
56.58 dB μ V/m



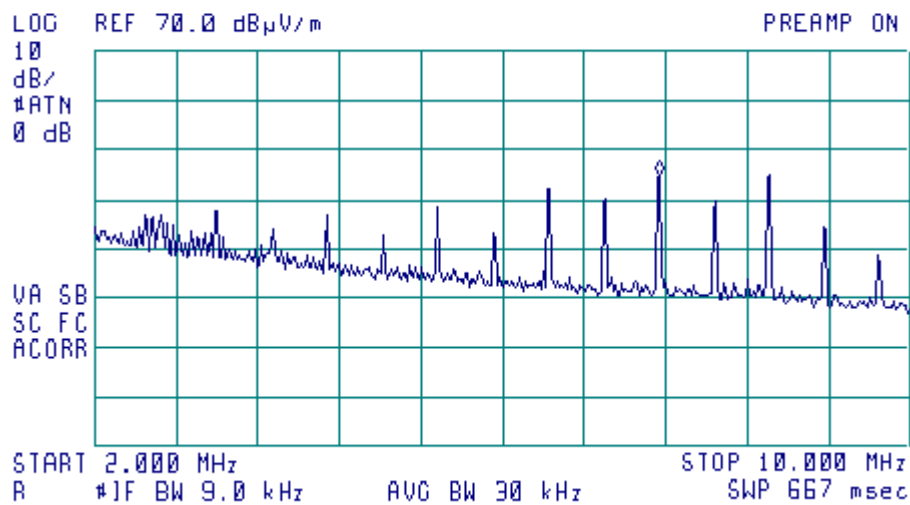


Plot A 21

Radiated spurious emission measurements in Tx mode in the anechoic chamber from 2 MHz to 10 MHz

13:53:35 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 7.540 MHz
45.12 dB μ V/m



All found spurious emissions are more than 20 dB below the limit.

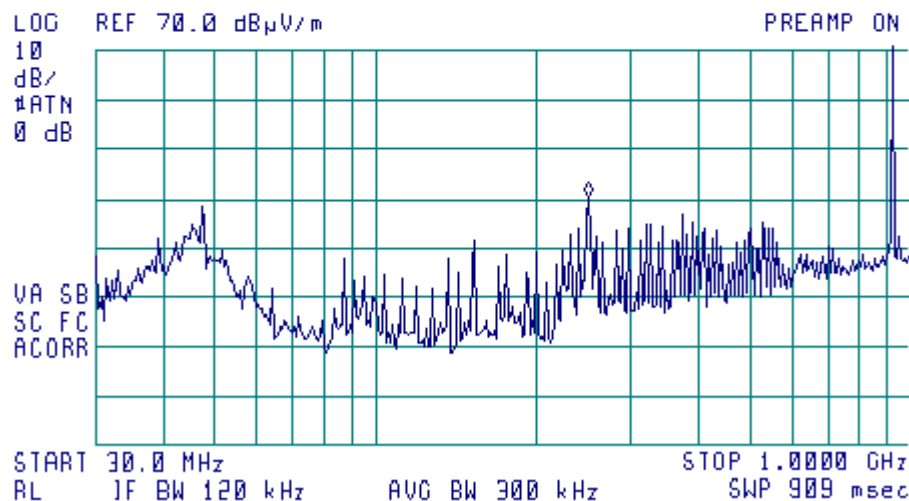


Plot A 22

Radiated spurious emission measurements in Tx mode in the anechoic chamber from 30 MHz to 1000 MHz

11:11:19 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 248.5 MHz
40.33 dB μ V/m



Limit: -25 dBm ERP {70 dB(μ V/m)}

All spurious emissions were found at least 30 dB below the limit.

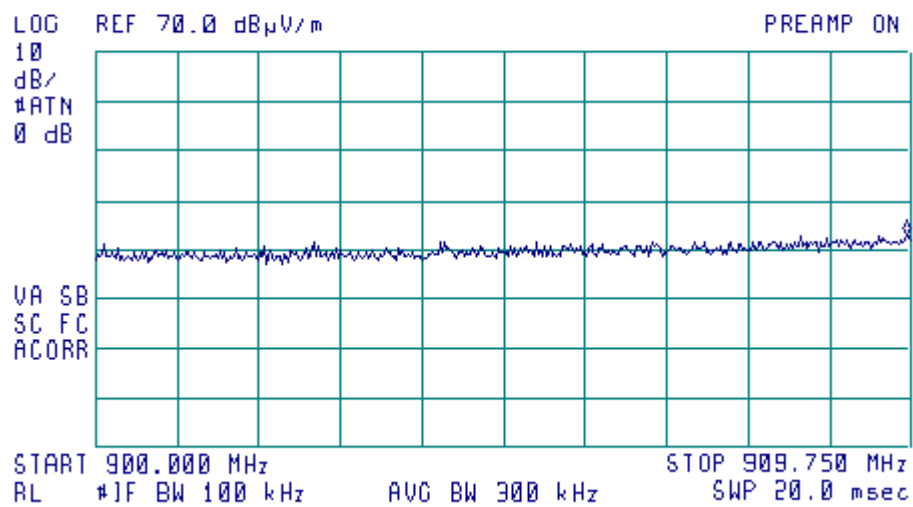


Plot A 23

Radiated spurious emission measurements in Tx mode in the anechoic chamber

14:28:26 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 909.701 MHz
32.90 dB μ V/m



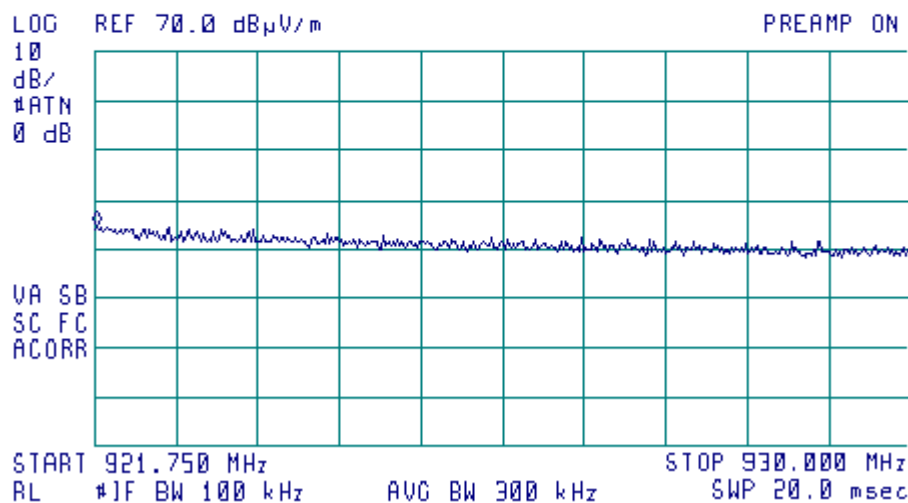


Plot A 24

Radiated spurious emission measurements in Tx mode in the anechoic chamber

14:30:29 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 921.771 MHz
34.00 dB μ V/m



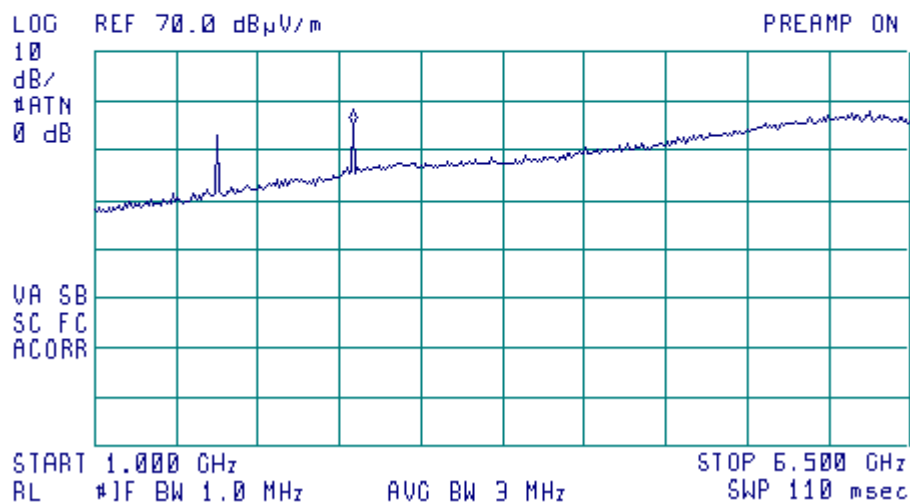


Plot A 25

Radiated spurious emission measurements in Tx mode in the anechoic chamber from 1 GHz to 6.5 GHz

13:21:18 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.756 GHz
55.24 dB μ V/m

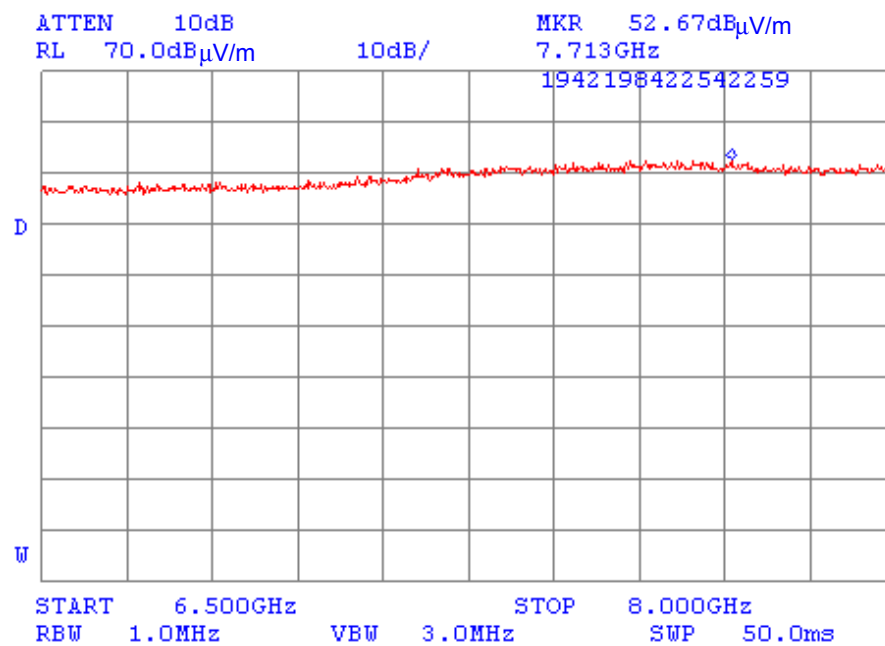


No spurious emissions were found except the 2nd and 3rd harmonics of fundamental.
Tested by substitution method at OATS, for test results refer to Table 4.3.2.



Plot A 26

Radiated spurious emission measurements in Tx mode at the OATS from 6.5 GHz to 8 GHz

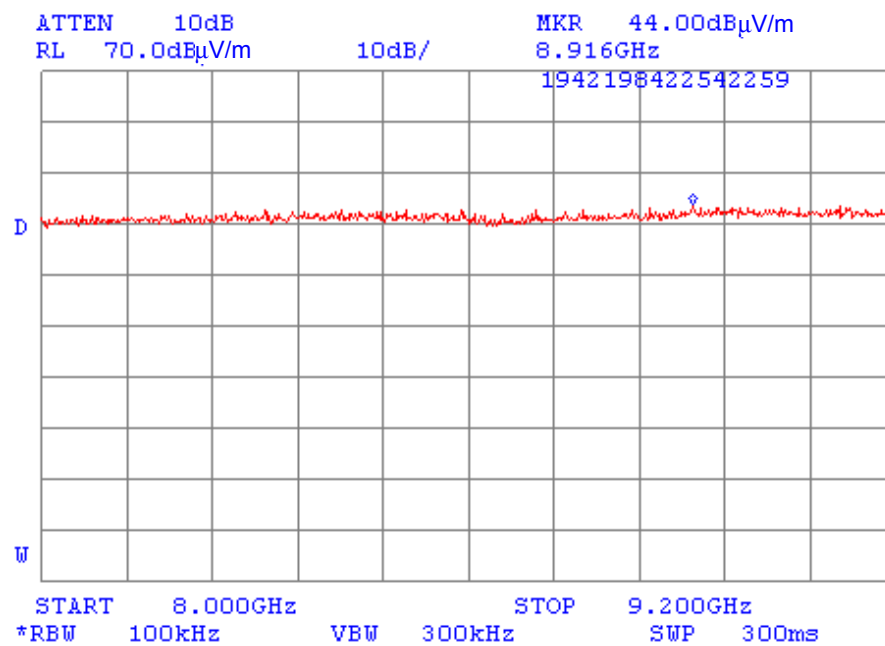


No spurious emissions were found.



Plot A 27

Radiated spurious emission measurements in Tx mode at the OATS from 8 GHz to 9.2 GHz



No spurious emissions were found.

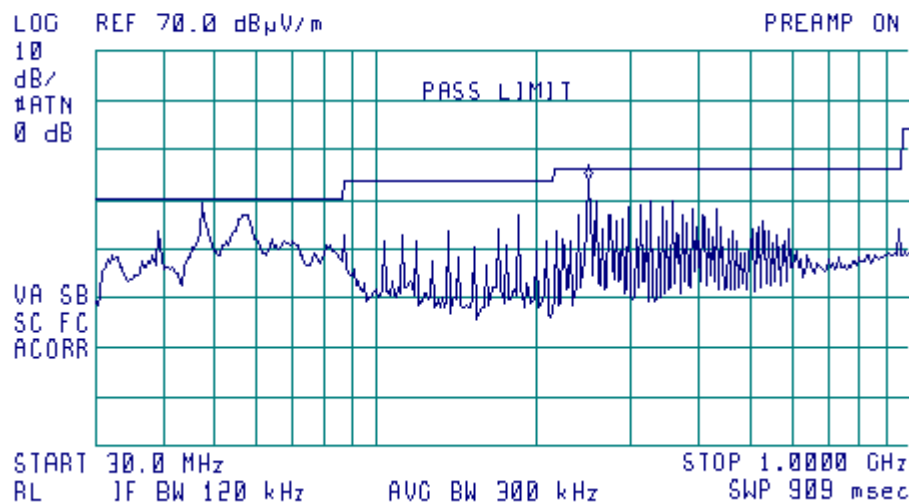


Plot A 28

Radiated emission measurements in the anechoic chamber from 30 MHz to 1000 MHz,
test distance 3 m, vertical & horizontal antenna polarization, model number IG-RS-46D9-916

11:50:21 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 248.5 MHz
44.11 dB μ V/m



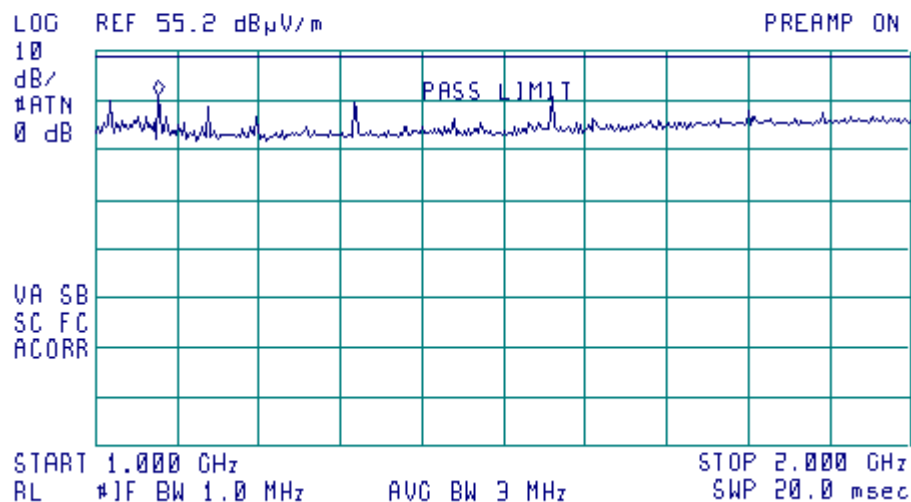


Plot A 29

Radiated emission measurements in the anechoic chamber from 1 GHz to 2 GHz,
test distance 3 m, vertical & horizontal antenna polarization, model number IG-RS-46D9-916

11:58:16 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 1.078 GHz
46.27 dB μ V/m



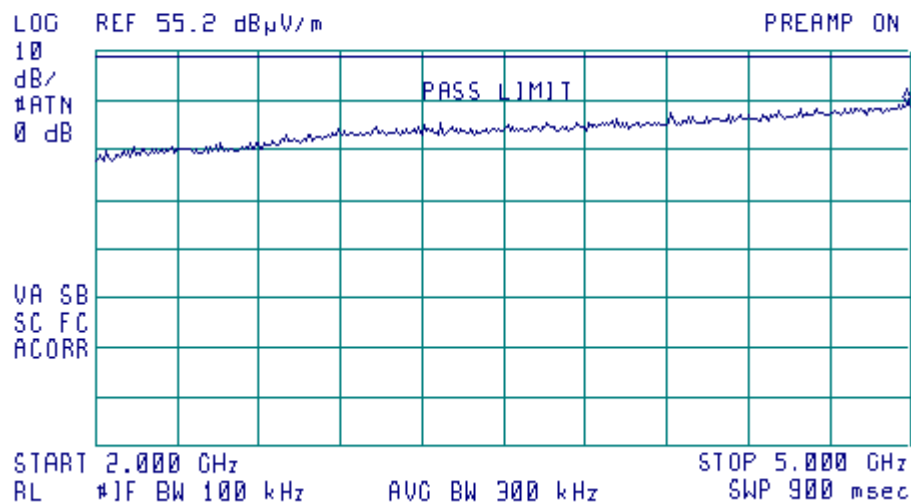


Plot A 30

Radiated emission measurements in the anechoic chamber from 2 GHz to 5 GHz,
test distance 3 m, vertical & horizontal antenna polarization, model number IG-RS-46D9-916

12:52:09 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 4.985 GHz
44.57 dB μ V/m



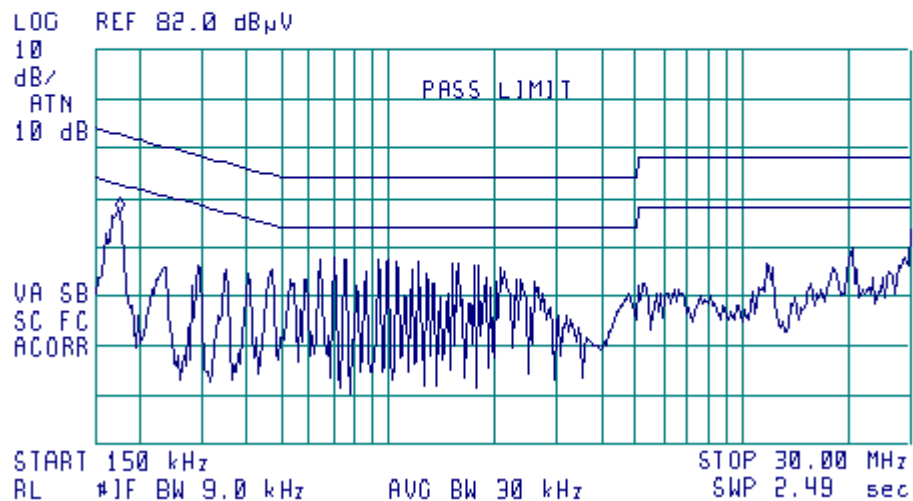


Plot A 31

Conducted emission measurements test results at the EUT AC first line,
model IG-RS-46D9-916 in receive mode

15:26:57 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKA 100 kHz
49.35 dB μ V



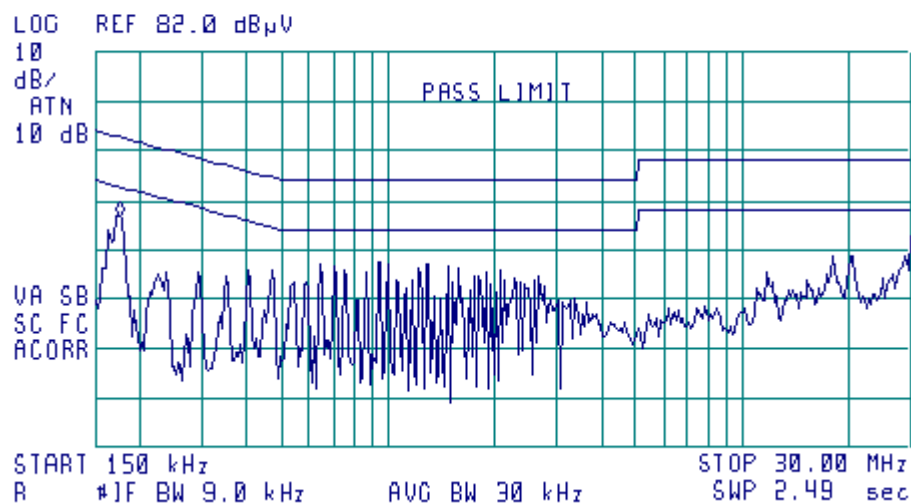


Plot A 32

Conducted emission measurements test results at the EUT AC second line,
model IG-RS-46D9-916 in receive mode

15:41:27 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKA 100 kHz
48.77 dBμV



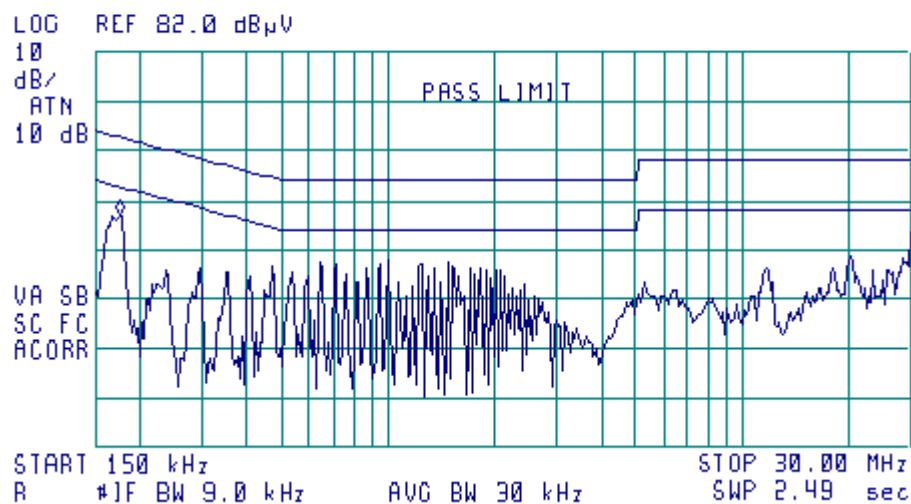


Plot A 33

Conducted emission measurements test results at the EUT AC first line,
model IG-RS-46D9-916 in transmit mode

15:58:32 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKA 100 kHz
49.12 dBμV



The same results as in receive mode

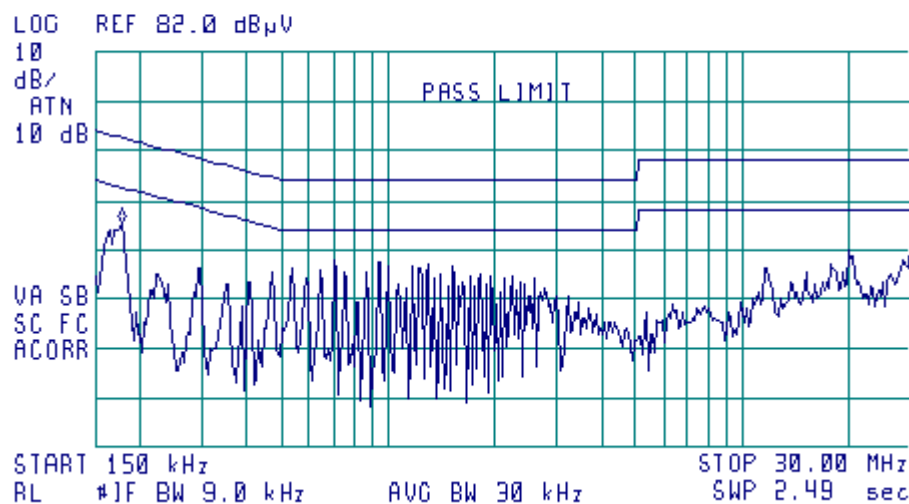


Plot A 34

Conducted emission measurements test results at the EUT AC second line,
model IG-RS-46D9-916 in transmit mode

15:50:59 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKA 100 kHz
47.45 dBμV



The same results as in receive mode

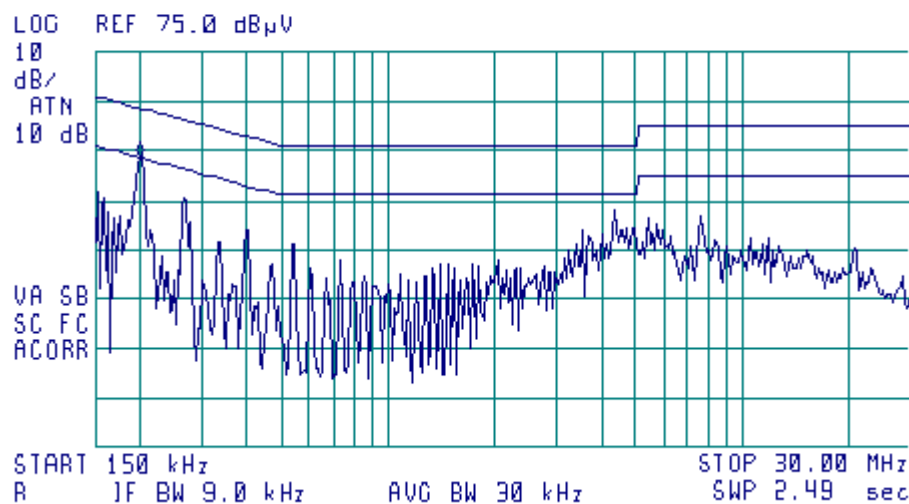


Plot A 35

Conducted emission measurements test results at the laptop AC first line,
model IG-RS-46D9-916 in receive mode

16:26:57 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKA 200 kHz
53.94 dBμV



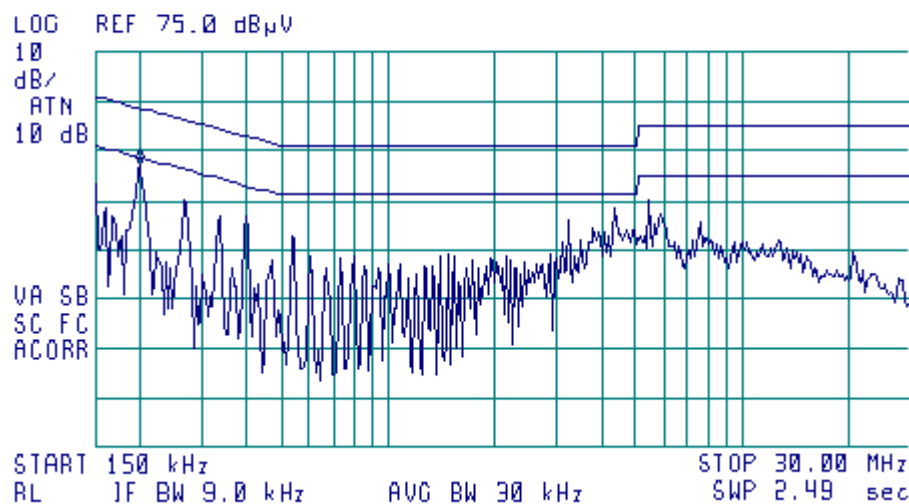


Plot A 36

Conducted emission measurements test results at the laptop AC second line,
model IG-RS-46D9-916 in receive mode

16:35:36 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 200 kHz
52.51 dB μ V



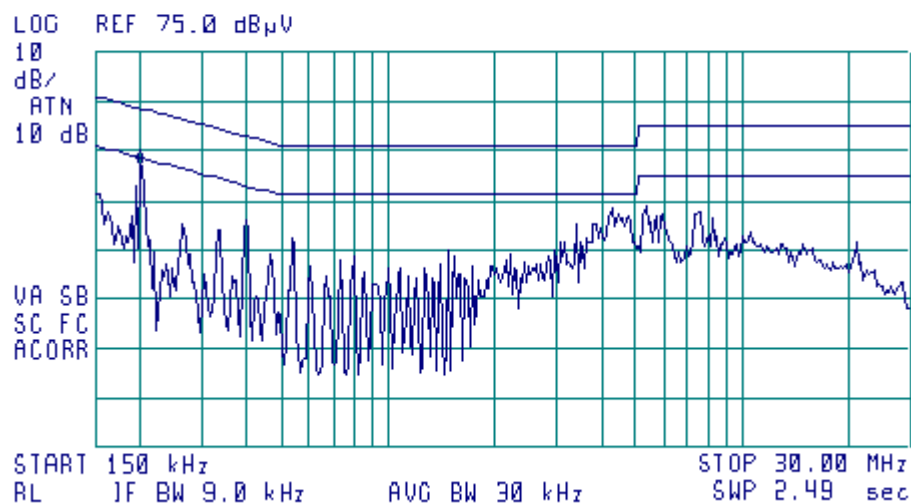


Plot A 37

Conducted emission measurements test results at the laptop AC first line,
model IG-RS-46D9-916 in transmit mode

16:45:31 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 200 kHz
52.24 dBμV



The same results as in receive mode

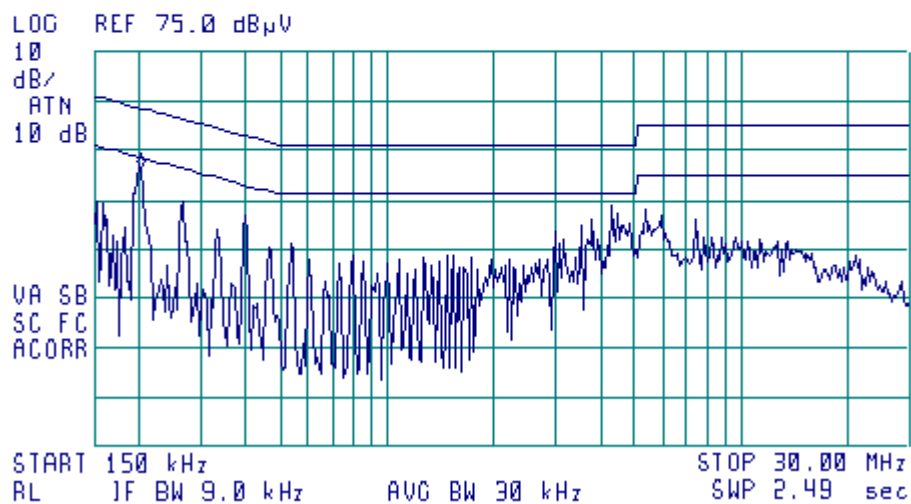


Plot A 38

Conducted emission measurements test results at the laptop AC second line,
model IG-RS-46D9-916 in transmit mode

16:43:14 DEC 07, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 200 kHz
51.56 dBμV



The same results as in receive mode

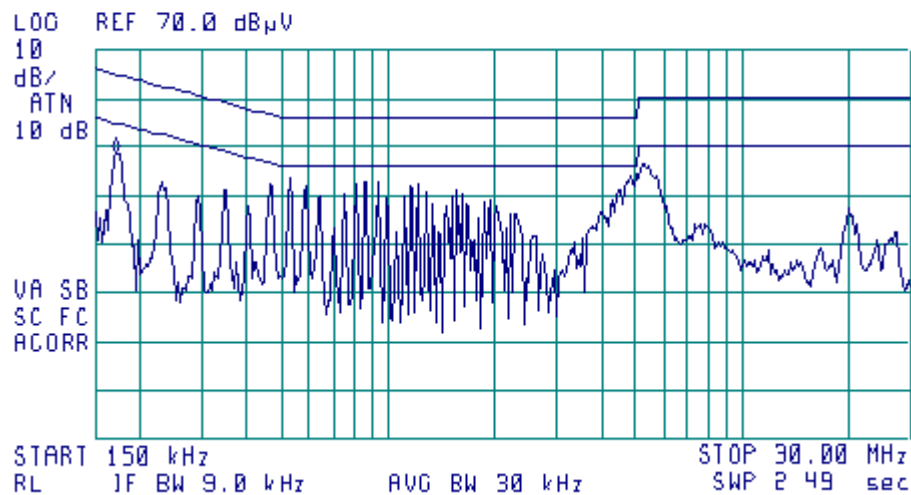


Plot A 39

Conducted emission measurements test results at the EUT AC first line,
model IG-RS-43D9-916 in transmit and receive mode



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 170 kHz
4B 87 dB μ V



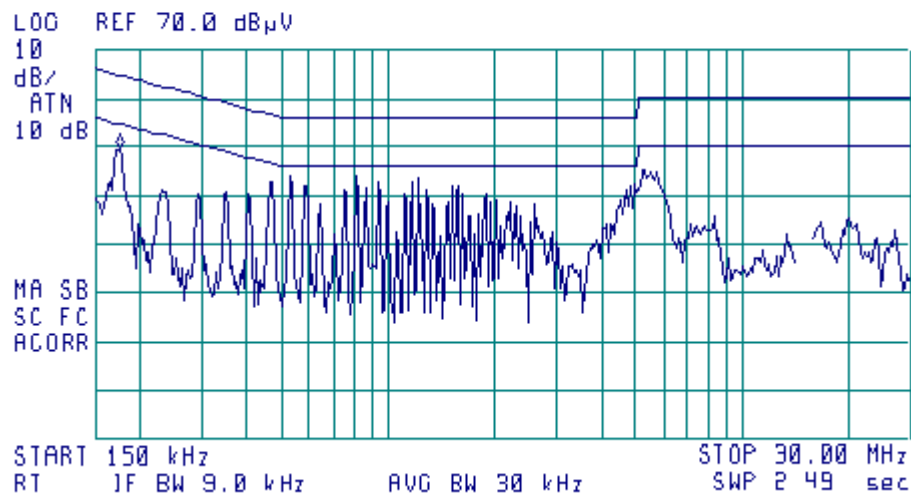


Plot A 40

Conducted emission measurements test results at the EUT AC second line,
model IG-RS-43D9-916 in transmit and receive mode



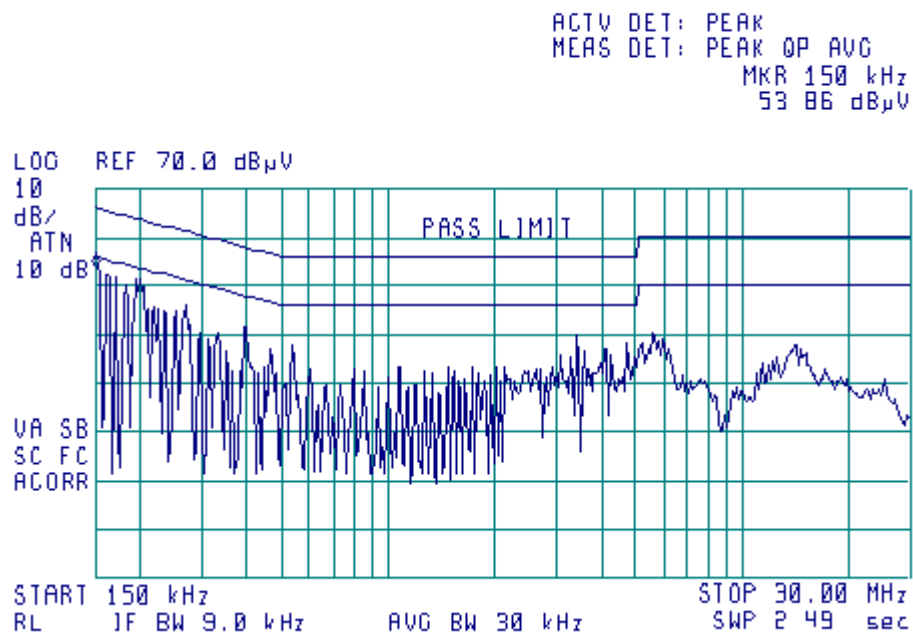
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 100 kHz
49 43 dB μ V





Plot A 41

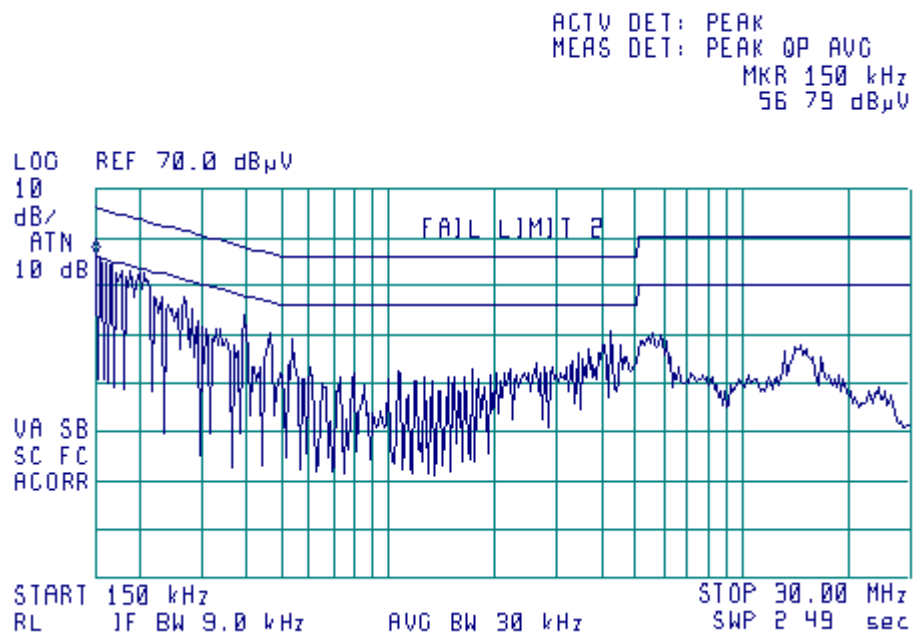
Conducted emission measurements test results at the laptop AC first line,
model IG-RS-43D9-916 in transmit and receive mode





Plot A 42

Conducted emission measurements test results at the laptop AC second line,
model IG-RS-43D9-916 in transmit and receive mode





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	4/04
0034	Log periodic antenna, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	1988	1/05
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
0163	LISN FCC/VDE/MIL -STD	Electro-Metrics	ANS-25/2	1314	10/04
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	12/04
0446	Active loop antenna, 10 kHz-30 MHz	Electro-Mechanics	6502	2857	10/04
0447	LISN, 16/2, 300 V RMS	Hermon Labs	LISN 16-1	447	11/04
0465	Anechoic chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	10/05 check
0493	Oven temperature	Thermotron	S-1.2 Mini-Max	4016	9/04
0495	Autotransformer 0-255V, 10A	Variac	EAB VARIAC	495	3/04
0521	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/04
0558	Multimeter digital	Fluke	76	0904	10/04
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	2/04 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
0661	Generator Swept Signal, 10MHz to 40GHz+ 10dBm	Hewlett Packard	83640B	0266	9/04
0787	Transient limiter	Hewlett Packard	11947A-8ZE	3107A01877	11/04
0812	Cable, coax, RG-214, 11.5 m, N-type connectors	Hermon Labs	C214-11	148	12/04
1003	Cable coaxial, M17/164, 10 m	Hermon Labs	C17164-10	161	11/04
1004	Cable, coaxial ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/04



HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ year
		Name	Model No.	Serial No.	
1097	Attenuator, 50 Ohm, 2 W, DC to 8 GHz, 20 dB	Midwest Microwave	0793-20-NN-07	1097	1/05
1116	Antenna horn, 1-18 GHz	Hermon Labs	A1-18	186	3/04
1200	Quadruplexer, 1-12 GHz	Elettronica S.p.A. - Roma	UE 84	0240	4/04 check
1207	One phase voltage regulator, 2 kVA, 0-250V	Hermon Labs	TDGC-2	NA	6/04 check
1365	Cable coaxial, RG-214, 5 m	Hermon Labs	C214-5	1365	4/04
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/04
1430	EMI receiver system, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3807A00262	9/04
1502	Cable RF, 6 m	Belden	M17/167 MIL-C-17	1502	12/04 check
1503	Cable RF, 6 m	Belden	M17/167 MIL-C-17	1503	9/04 check
1510	Cable RF, 8 m	Belden	M17/167 MIL-C-17	1510	12/04
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
1984	Antenna, double ridged waveguide horn, 1-18 GHz, 300 W, N-type	EMC Test Systems	3115	9911-5964	3/04
1991	Attenuator, DC – 18 GHz, 30 dB, 2 W	Midwest Microwave	ATT 0290-30-SMA-02	NA	11/04
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	12/04
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	11/04
2400	Cable 40 GHz, 1.5 m, green	Rhophase Microwave Ltd.	KPS-1503A-1500-KPS	X2946	6/04



Appendix C Antenna factors and cable loss

Correction factor
Line impedance stabilization network
Model ANS-25/2
Electro-Metrics

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

Correction factor
Line impedance stabilization network
Model LISN 16 - 1
Hermon Laboratories

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.



Antenna factor
Biconical antenna
Electro-Metrics, model BIA-25/30
Ser.No.3577, HL 0032

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(μ V) to convert it into field intensity in dB(μ V/m).

Antenna factor
Log periodic antenna
Electro-Metrics, model LPA-25/30
Ser.No.1988, HL 0034

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(μ V) to convert it into field intensity in dB(μ V/m).



**Antenna factor
Active loop antenna
Model 6502
S/N 2857, HL 0446**

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(μ V) to convert it into field intensity in dB(μ V/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(μ V) to convert it into field intensity in dB(μ V/m).



Antenna factor
Double ridged guide antenna
Hermon Laboratories, 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(μ V) to convert it into field intensity in dB(μ V/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(μ V) to convert it into field intensity in dB(μ V/m).



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	



Cable loss
Cable coaxial, M17/164, model: C17164-10, s/n 161, HL 1003

No.	Frequency, MHz	Cable loss, dB	Tolerance, dB	Measurement uncertainty, dB
1	30	0.41	12.5	±0.12
2	50	0.52		
3	100	0.75		
4	300	1.45		
5	500	2.01		
6	800	2.71		
7	1000	3.14		
8	1200	3.56		
9	1400	3.93		
10	1600	4.31		
11	1800	4.63		
12	2000	4.97		
13	2200	5.32		
14	2400	5.65		
15	2600	6.01	12.5	±0.12
16	2800	6.42		
17	3000	6.76		
18	3300	7.12		
19	3600	7.53		
20	3900	7.95		±0.17
21	4200	8.32		
22	4500	8.72		
23	4800	9.14		
24	5100	9.59		
25	5400	10.00		
26	5700	10.49		
27	6000	11.07		
28	6500	11.80		

**Cable loss**

Cable Coaxial, GORE A2P01POL118, 2.3 m, model:GORE-3, HL 0589
+ Cable Coaxial, ANDREW PSWJ4, 6m, model: ANDREW-6, HL 1004

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	30	0.33	6.5	±0.12
2	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		
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	2800	3.21	6.5	±0.12
17	3000	3.32		
18	3300	3.47		±0.17
19	3600	3.62		
20	3900	3.84		
21	4200	3.92		
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		



Cable loss
Cable coaxial, RG-214, 5m, model: C214-5, HL 1365

No.	Frequency, MHz	Measured, dB	Measured uncertainty dB
1	1000	0.41	±0.12
2	1200	0.44	
3	1400	0.48	
4	1600	0.52	
5	1800	0.55	
6	2000	0.58	
7	2200	0.61	
8	2400	0.64	±0.17
9	2600	0.67	
10	2800	0.7	
11	3000	0.73	
12	3300	0.79	
13	3600	0.84	
14	3900	0.94	
15	4200	1.22	



Cable loss
Cable coaxial, 6 m, model: M17/167 MIL-C-17, HL 1502

Frequency, MHz	Cable loss, dB
0.1	0.02
1	0.07
3	0.15
5	0.17
10	0.26
30	0.43
50	0.57
80	0.72
100	0.81
300	1.48
500	2.00
800	2.70
1000	3.09

Cable loss
Cable M17/167 MIL-C-17, HL 1510

No.	Frequency, MHz	Cable loss, dB
1	0.1	0.05
2	1	0.09
3	3	0.16
4	5	0.18
5	10	0.27
6	30	0.44
7	50	0.58
8	80	0.69
9	100	0.82
10	300	1.48
11	500	2.01
12	800	2.65
13	1000	3.12

**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



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



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		



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	0.64	8.70	1.07	24.00	1.90
1.80	0.67	8.90	1.11	24.50	1.81
1.90	0.69	9.10	1.09	25.00	1.98
2.00	0.71	9.30	1.14	25.50	1.91
2.10	0.73	9.50	1.12	26.00	2.02
2.20	0.75	9.70	1.15	26.50	1.92
2.30	0.77	9.90	1.16	27.00	1.97
2.40	0.79	10.10	1.16	28.00	2.02
2.50	0.81	10.30	1.19	29.00	1.95
2.60	0.83	10.50	1.14	30.00	1.94
2.70	0.85	10.70	1.19	31.00	2.11
2.80	0.87	10.90	1.17	32.00	2.17
2.90	0.89	11.10	1.13	33.00	2.27
3.10	0.91	11.30	1.20	34.00	2.27
3.30	0.93	11.50	1.13	35.00	2.29
3.50	0.95	11.70	1.20	36.00	2.35
3.70	0.97	11.90	1.18	37.00	2.37
3.90	0.99	12.10	1.14	38.00	2.40
4.10	1.01	12.40	1.19	39.00	2.57
4.30	1.03	13.00	1.34	40.00	2.36
4.50	1.05	13.50	1.33		
4.70	1.07	14.00	1.48		
4.90	1.09	14.50	1.45		

**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).

Address: PO Box 23, Binyamina 30500, Israel.

Telephone: +972 4628 8001

Fax: +972 4628 8277

e-mail: mail@hermonlabs.com

website: www.hermonlabs.com

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

Abbreviations and acronyms

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

ASK	amplitude shift keying
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
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
LO	local oscillator
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
RF	radio frequency
Rx	receiver
rms	root mean square
s	second
Tx	transmitter
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.