HERMON LABORATORIES

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Electrical

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ELECTROMAGNETIC EMISSIONS TEST REPORT

according to 47CFR Part 15, §15.247 and subpart B

for

Tadiran Telematics Ltd.

EQUIPMENT UNDER TEST:

Rode-side communication system, RSC-900 Reader and Tag, model RSC-900 rev.B

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1 Project information

Description of equipment under test

Test items	:Road side communication system
Manufacturer	:Tadiiran Telematics Ltd.
Equipment serial number	:543
Types (Models)	:RSC-900 rev.B
Equipment FCC code[1]	:DSS

Applicant information

Applicant's responsible person	:Slava Snitkovsky, project manager
Company	:Tadiran Telematics Ltd.
Address	:P.O. Box 1911
Postal code	:58117
City	:Holon
Country	:Israel
Telephone number	:+972 3 5575781
Telefax number	:+972 3 5575783

Test performance

Project Number:	:14963
Location	:Hermon Laboratories
Receipt date	:January 14, 2002
Test started	:January 15, 2002
Test completed	:March 10, 2002
Purpose of test	Apparatus compliance verification in accordance with emission requirements
Test specification(s)	47CFR Part 15, §15.247 and subpart B

[1] FCC Equipment codes – see Appendix D

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2 Summary of tests

The tests listed in the table below were performed. The EUT was found complying with the limits of 47CFR Part 15, §15.247 and subpart B.

Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
Transmitter characteristics, §15.247								
Frequency hopping systems								
Occupied bandwidth of hopping channels	(a)(1) (i)	**C**				Mrs. E. Pitt, test engineer	January 15, 2002	
Hopping channel frequency separation	(a)(1)	**C**				Mrs. E. Pitt, test engineer	January 15, 2002	
Number of hopping channels	(a)(1) (i – iii)	**C**				Mrs. E. Pitt, test engineer	January 15, 2002	
Average time of occupancy	(a)(1) (i – iii)	**C**				Mrs. E. Pitt, test engineer	January 15, 2002	
Maximum peak output power	b(2)	**C**				Mrs. E. Pitt, test engineer	January 15, 2002	
Exposure compliance requirements	b(4)	**C**						
Spurious emissions (conducted)	c	**C**				Mrs. E. Pitt, test engineer	January 15, 2002	
Spurious emissions (radiated)	c			NT				
Spurious emissions (radiated) in restricted bands	15.209, 15.205(a,c)	**C**				Mr. M. Feldman, test engineer	March 10, 2002	
Unintentional radiation, §15.107, §15.109								
Conducted emissions	15.107	**C**				Mrs. E. Pitt, test engineer	March 27, 2001	
Radiated emissions	15.109	**C**				Mr. M. Feldman, test engineer	March 10, 2002	

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Parameter		Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
General conditions under Part 15									
The Intentional radiator operates in 904.2-925.8 MHz frequency range.		15.247	**C**						
The hopping sequence meets the requirement specified in the definition of a frequency hopping spread spectrum system		15.247, a(1)	**C**				For an example of a hopping sequence see Appendix D		
Each of the hopping channels is used equally on average		15.247 a(1)	**C**						
The associated receiver complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal		15.247 a(1)	**C**						
The EUT is designed to be capable of operating as a true frequency hopping system		15.247(g)	**C**						
The EUT does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters		15.247(h)	**C**						
Examined frequencies:		15.31(m)	**C**						
Near the top	924.0 MHz and 925.8 MHz								
Near the middle	915 MHz								
Near the bottom	904.2 MHz and 904.8 MHz								
The intentional radiator has permanently attached antenna or antenna that uses a unique coupling to the intentional radiator.		15.203				**NA**			
The intentional radiator has a standard connector and must be professionally installed. To demonstrate that professional installation is required, the following three points must be addressed: (a) the application (or intended use) of the EUT; (b) the installation requirements of the EUT, and (c) the method by which the EUT will be marketed.		15.203	**C**						
No antenna other than that furnished by the responsible party can be used with the device.		15.203	**C**						
Antenna technical characteristics, as referred to in “Transmitter description” table in the test report		15.204	**C**						

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Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
Tag								
Unintentional radiation, part 15, subpart B								
Conducted emissions	15.107				**NA**	**See Note 2**		
Radiated emissions	15.109				**NA**	**See Note 2**		

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

Note 2. Tag (digital device) was exempt from the specific technical standards and other requirements contained in Part 15 according to 15.103 (a).

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

Test report approved by: Mr. M. Nikishin, EMC group leader

Mr. A. Usoskin, QA manager

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3 EUT description

3.1 General description

The EUT, RSC-900 rev.B, is a frequency hopping short range communication system which operates in frequency range 904.2 – 925.8 MHz. The EUT consists of two units: a frequency hopping transceiver (reader) and a digital back scattering tag. The system provides bi-directional data transmission by transmitting RF hopping signal from the reader, the tag receives it and stores upon request or provides information requested by the reader by modulating the carrier. The tag has no RF part and provides on-off key modulation of carrier by means of a switching internal antenna. The tag also has an internal GPS receiver.
The reader is powered from 20 V DC power supply.

3.2 EUT test configuration

The EUT ports and lines description is given in Table 3.2.1 and test configuration is shown in Figure 3.2.1.
The highest frequency generated by the EUT is 20 MHz.

Table 3.2.1 EUT ports and lines

Port type	Port description	Indoor/ outdoor cable	Connector type	Quantity	Cable type description	Cable length, m	Connected to
Power + signal **(reader)**	control	outdoor	BINDER, 24 pin, male	1	shielded	25	20VDC to power supply; others – open circuit
RF signal **(reader)**	antenna	outdoor	N-type-f	1	coax	0.3	Tx antenna
RF signal **(reader)**	antenna	outdoor	N-type-f	1	coax	3	Rx antenna

3.2.1 Changes made in EUT

To withstand the standard requirements the following changes were made in the EUT during the testing:

1) one ferrite bead manufactured by Fair-Rite, p/n 0431164951, was installed at the wires from P1 connector;
2) one ferrite bead manufactured by Fair-Rite, p/n 0431164181, was installed at the wires from P6, P7 and P8 connectors;
3) RFEU card was shielded.

It is manufacturer responsibility to implement the changes in the production version of the EUT. In any case the test report applies to the tested items only.

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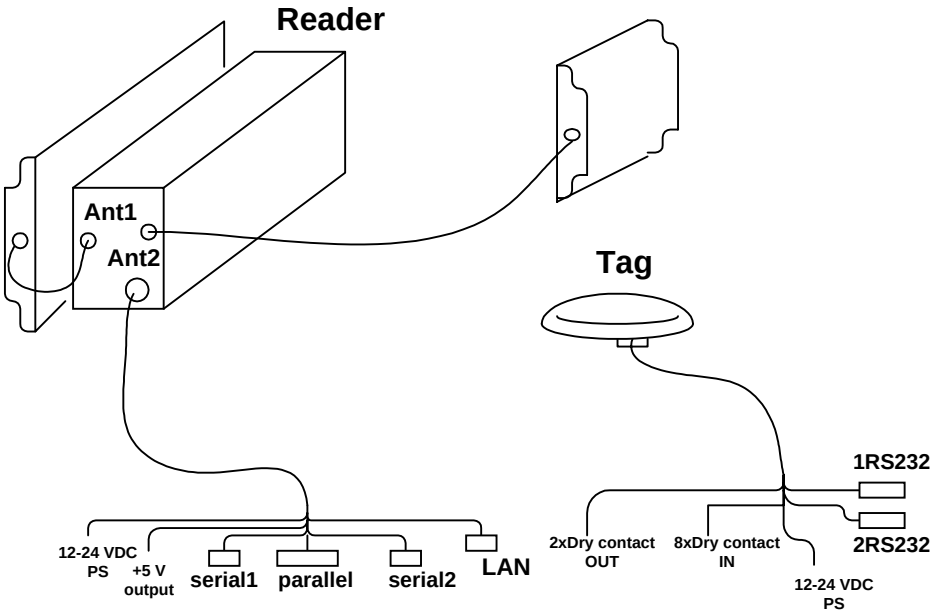
Figure 3.2.1 EUT test configuration



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3.3 Transmitter description

Type of equipment						
X	Stand-alone (Equipment with or without its own control provisions)					
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)					
	Plug-in card (Equipment intended for a variety of host systems)					
	Other:					
Operating frequency range	904.2 – 925.8 MHz					
Spread spectrum technique used						
X	Frequency hopping (FHSS)					
	Direct sequence (DSSS)					
	Combined					
Spread spectrum parameters*						
DSSS	chip sequence length (bits)					
	spectrum width (MHz)					
FHSS	total number of hops (units)	37				
	dwell time (milliseconds)	350				
	bandwidth per hop (MHz)	0.42				
	max. separation of hops (MHz)	0.6				
Transmitter aggregate data rate (bits per second)		150 000				
Normal test signal						
Maximum rated output power						
At transmitter permanent external 50 Ω rf output connector (dBm)		24 dBm				
Effective radiated power (for equipment with integral antenna) (dBm)						
Is transmitter output power variable?	X	No				
		Yes		continuous variable		
				stepped variable		
				stepsize (dB):.....		
				minimum RF power (dBm):.....		
				maximum RF power (dBm):.....		
Transmitter power source						
	Battery	**Nominal rated voltage (VDC)**				
	Nickel Cadmium					
	Lithium					
	Other					
X	**DC**	**Nominal rated voltage (VDC)**	20			
	AC mains	**Nominal rated voltage (VAC)**				
Is there common power source for transmitter and receiver			**X**	yes		no

Antenna technical characteristics (both, Tx and Rx)						
			Type	**Manufacturer**	**Model number**	**Gain**
Integral		with temporary RF connector				
		without temporary RF connector				
External			NA	Tadiran Telematics	NA	3 dBi

External antenna connection			
X	standard connector**		unique coupling

* If more than 1 variant of any spectrum parameter may be used, provide all variations of these parameters.
** Please refer to User Manual for justification of professional installation.

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4 Test results

4.1 Occupied bandwidth of hopping channels and channel carrier frequencies separation according to § 15.247(a)(1)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.7
DATE:	January 15, 2002
RELATIVE HUMIDITY:	44 %
AMBIENT TEMPERATURE:	20 °C
OPERATING FREQUENCY RANGE	902-928 MHz
MODULATION TECHNIQUE	FHSS

Carrier frequency, MHz	Measured 20 dB bandwidth, kHz	Reference to Plot in Appendix A
904.8	409	A1
915.0	379	A2
924.0	379	A3
Measurement uncertainty, ppm	± 0.21	

Frequency range	Channel carrier frequency separation, kHz	Reference to Plot in Appendix A
904.2 – 925.8	600	A4
Measurement uncertainty, ppm	± 0.21	

TEST EQUIPMENT USED:

0057	0410	1430				

LIMIT

Operating frequency range, MHz	Allowed bandwidth	Channel carrier frequency separation (minimum)
902-928	≤ 500 kHz @ 20 dBc	25 kHz or 20 dB bandwidth, which is greater
2400-2483.5; 5275-5850	≤ 1 MHz @ 20 dBc	
2400-2483.5	> 1 MHz @ 20 dBc	

TEST PROCEDURE
The EUT RF output was connected to the spectrum analyzer, which settings are shown in the plots.
The measurements were performed in normal mode of operation for carrier (channel) frequency at low and high edges and at the middle of the frequency band.

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4.2 Number of hopping channels according to § 15.247(a)(1)

METHOD OF MEASUREMENT ANSI 63.4 §13.1.7
DATE: January 15, 2002
RELATIVE HUMIDITY: 44 %
AMBIENT TEMPERATURE: 20 °C
OPERATING FREQUENCY RANGE 902-928 MHz
MODULATION TECHNIQUE FHSS

Occupied frequency range	Measured 20 dB BW, kHz	Number of channels	Reference to Plot in Appendix A
904.2 – 925.8	409	37	A4
Measurement uncertainty, dB		NA	

TEST EQUIPMENT USED:

0057	0410	1430				

LIMIT

Operating frequency range, MHz	20 dB bandwidth	Number of frequencies
902-928	< 250 kHz	≥ 50
	≥ 250 kHz	≥ 25
2400-2483.5; 5275-5850	≤ 1 MHz	≥ 75
2400-2483.5	> 1 MHz	≥ 15 non-overlapping channels with total span ≥ 75 MHz

TEST PROCEDURE
The EUT RF output was connected to the spectrum analyzer, which settings are shown in the plots.

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4.3 Average time of hopping frequency occupancy according to § 15.247(a)(1), (f)

METHOD OF MEASUREMENT	ANSI 63.4 §13.1.7
DATE:	January 15, 2002
RELATIVE HUMIDITY:	44 %
AMBIENT TEMPERATURE:	20 °C
OPERATING FREQUENCY RANGE	902-928 MHz
MODULATION TECHNIQUE	FHSS

Carrier frequency, MHz	Time period between two successive transmissions, s	Tx ON, s	Average time of occupancy, s	Reference to Plot in Appendix A
915	5.7	0.175	0.35	A5, A6
Measurement uncertainty, ppm		± 0.21		

TEST EQUIPMENT USED:

0057	0410	1430				

LIMIT

Operating frequency range, MHz	Number of frequencies	Average time of occupancy
902-928	≥ 50	≤ 0.4 s within 20 s period
	≥ 25	≤ 0.4 s within 10 s period
2400-2483.5; 5275-5850	≥ 75	≤ 0.4 s within 30 s period
2400-2483.5	≥ 15 non-overlapping channels with total span ≥ 75 MHz	≤ 0.4 s within the time required to hop through all channels

TEST PROCEDURE
The EUT RF output was connected via attenuator to spectrum analyzer, which settings are shown in the plots.

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4.4 Maximum peak output power test according to §15.247 (b)(1), (b)(2), (b)(3)

METHOD OF MEASUREMENTS ANSI 63.4 §13.1.4
DATE: January 15, 2002
RELATIVE HUMIDITY: 44 %
AMBIENT TEMPERATURE: 20 °C
OPERATING FREQUENCY RANGE 902-928 MHz
MODULATION TECHNIQUE FHSS

Carrier frequency, MHz	Peak output power, dBm	Limit, dBm	Margin, dB	Reference to Plots in Appendix A
904.5	23.64	24	0.36	A7
915.0	23.51	24	0.49	A8
925.8	23.22	24	0.78	A9
Measurement uncertainty, dB		+0.36/-0.38 dB		

TEST EQUIPMENT USED:

0057	0410	1430				

LIMIT

Operating frequency range, MHz	Number of hopping channels	Maximum peak output power*, W
902-928 (hopping)	≥ 50	1
	< 50	0.25
2400-2483.5 (hopping)	≥ 75	1
	other admissible	0.125
5275-5850 (hopping)	any admissible	1
902-928; 2400-2483.5; 5275-5850 (direct sequence)	NA	1

* Notes to table
1. If transmitting antennas of directional gain greater than 6 dB are used, the peak output power shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 6 dBi with the following exceptions:
   a) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi;
   b) Systems operating in the 5725-5850 MHz band, that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power;
   c) Fixed, point-to-point operation as used in paragraphs a) and b) of Notes, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information.

   For more details see 15.247 (b)(3).

TEST PROCEDURE
The EUT RF output was connected via attenuator to spectrum analyzer, which settings are shown in the plots.

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4.5 Exposure limit according to §15.247(b)(4) and §1.1310

Limit for power density for general population/uncontrolled exposure is 0.6 mW/cm^2.

The power density $P\ (mW/cm^2) = \dfrac{P_T}{4\pi r^2}$, where

P_T is the maximum equivalent isotropically radiated power (EIRP).
In our case P_T is 23.64 dBm + 3 dBi (antenna gain) = 26.64 dBm = 461.3 mW.

$$0.6\ (mW/cm^2) = 461.3\ mW / 4\pi r^2$$

The minimum safe distance “r”, where RF exposure does not exceed FCC permissible limit, is 7.8 cm.

$$r = sqrt(P_T / (Px4\pi)) = sqrt(26.64 / (0.6 \times 4 \times 3.14)) = 7.8\ (cm).$$

Hence, no safety hazard exists for human being.

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4.6 Out of band conducted emissions test according to §15.247(c)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.5
DATE:	January 15, 2002
RELATIVE HUMIDITY:	44 %
AMBIENT TEMPERATURE:	20 °C
RATED RF OUTPUT POWER	23.6 dBm
OPERATING FREQUENCY RANGE	902-928 MHz
MODULATION TECHNIQUE	FHSS
FREQUENCY RANGE*	9 kHz – 9.5 GHz

* The frequency spectrum was investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Frequency range, MHz	Measurement bandwidth, kHz	Spurious emission level, dBm	Reference to Plots in Appendix A
0.009 – 0.15	**1**	**-33.99**	**A10**
0.15 - 1	**30**	**-45.25**	**A11**
1 – 30	**100**	**-56**	**A12**
30 – 500	**100**	**-38**	**A13**
500 – 900	**100**	**-23.49**	**A14**
902	**100**	**-14**	**A15**
928	**100**	**-11.4**	**A16**
930 – 1200	**100**	**-19.97**	**A17**
1200 – 2000	**100**	**-37.26**	**A18**
2000 – 4000	**100**	**-50.8**	**A19**
4000 – 8000	**100**	**-57.1**	**A20**
8000 – 10000	**1000**	**-61.8**	**A21**
Measurement uncertainty		± 2.5 dB	

TEST EQUIPMENT USED:

0025	0057	0410	1200	1430	1940	

LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

TEST PROCEDURE
The EUT RF output was connected via attenuator to spectrum analyzer, which settings are shown in the plots.

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4.7 Radiated emissions which fall in restricted bands test according to §15.247(c) and § 15.205, §15.209(a)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4/ §13.1.5
DATE:	March 10, 2002
RELATIVE HUMIDITY:	51 %
AMBIENT TEMPERATURE:	24 °C
RATED RF OUTPUT POWER	23.6 dBm
TEST DISTANCE	3 m
OPERATING FREQUENCY RANGE	902-928 MHz
MODULATION TECHNIQUE	FHSS
FREQUENCY RANGE*	9 kHz – 9.5 GHz
ANTENNA USED	Loop (9 kHz – 30 MHz), biconilog (30 – 1000 MHz), double ridged guide horn (1 – 9.5 GHz)

*The frequency spectrum was investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

a) F carrier: 904.2 MHz

Peak value, RBW = VBW = 1 MHz

Frequency, MHz	Antenna polarization	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB
2712	H	66	74	8
3616.8	H	73	74	1
4521	H	68	74	6
5425	H	68	74	6
6329	H	65	74	9
Measurement uncertainty, dB		+5.73 dB/-5.57 dB		

Average in 100 ms value, RBW = 1 MHz; VBW = 10 Hz

Frequency, MHz	Antenna polarization	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB
2712	H	36	54	18
3616.8	V	46	54	8
4521	H	38	54	16
5425	H	38	54	16
6329	H	52	54	2
Measurement uncertainty, dB		+5.73 dB/-5.57 dB		

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b) F carrier: 915 MHz

Peak detector, RBW = 200 Hz, VBW = 300 Hz (9 – 150 kHz);
Peak detector, RBW = 9 kHz, VBW = 30 kHz (150 kHz – 30 MHz);
Quasi-peak detector, RBW = 120 kHz, VBW = 300 kHz (30 – 1000 MHz);

Frequency, MHz	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB	Reference to Plots in Appendix A
0.009 – 0.15	all spurious emissions were found more than 30 dB below the limit			A22
0.15 - 30	all spurious emissions were found more than 20 dB below the limit			A23
116.924	45.62	54	8.38	A24
133.685	44.28	54	9.72	A24
143.997	43.51	54	10.49	A24
150.340	50.94	54	3.06	A24
200.454	46.81	54	7.19	A25
Measurement uncertainty, dB		+5.73 dB/-5.57 dB		

Peak value, RBW = VBW = 1 MHz

Frequency, MHz	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB
2745	68	74	6
3660	70	74	4
4575	69	74	5
5490	67	74	7
6405	65	74	9
Measurement uncertainty, dB		+5.73 dB/-5.57 dB	

Average in 100 ms value, RBW = 1 MHz; VBW = 10 Hz

Frequency, MHz	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB
2745	39	54	15
3660	45	54	9
4575	38	54	16
5490	38	54	16
6405	47	54	7
Measurement uncertainty, dB		+5.73 dB/-5.57 dB	

Notes to table:
Test results were obtained throughout the testing with antenna in horizontal polarization.

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c) F carrier: 925.8 MHz

Peak value, RBW = VBW = 1 MHz

Frequency, MHz	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB
2777.4	72	74	2
3703.2	69	74	5
4629	69.2	74	4.8
7406.4	<54	74	>20
Measurement uncertainty, dB		+5.73 dB/-5.57 dB	

Average in 100 ms value, RBW = 1 MHz; VBW = 10 Hz

Frequency, MHz	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB
2777.4	42	54	12
3703.2	42	54	12
4629	41	54	13
7406.4	<34	54	>20
Measurement uncertainty, dB		+5.73 dB/-5.57 dB	

Notes to table:
Test results were obtained throughout the testing with antenna in horizontal polarization.

Table abbreviations:
Margin = dB below (negative if above) specification limit.
RBW = resolution bandwidth;
VBW = video bandwidth.

TEST EQUIPMENT USED:

0041	0465	0521	0554	0589	0604	1004
1424	1915	1942				

LIMIT

Radiated emissions, which fall in the restricted bands, must comply with §15.209(a) limits.

TEST PROCEDURE

The test was performed with transmitter operating at central frequency in 9 kHz to 1000 MHz frequency range, and at 3 carrier frequencies F_{max} = 925.8 MHz, F_{min} = 904.2 MHz, F_{cent} = 915 MHz in 1 GHz to 9.5 GHz range.

9 kHz – 30 MHz frequency range. The EUT was placed on a wooden 80 cm height turntable. 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 – 9.5 GHz frequency range. The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

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4.8 Unintentional conducted emissions test according to §15.107

METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.3
DATE: March 27, 2001
RELATIVE HUMIDITY: 51%
AMBIENT TEMPERATURE: 23°C
THE EUT WAS TESTED AS: TABLE-TOP
DETECTOR USED: QUASI-PEAK
FREQUECNY RANGE: 450 kHz – 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Phase

Frequency, MHz	Measured emissions, peak detector, dB (μV)	Measured emissions, quasi-peak detector, dB (μV)	Specification limit, dB (μV)	Margin, dB	Pass/ Fail
0.479545	53.36	46.71	48	1.29	**Pass**
0.509640	50.80	44.53	48	3.47	**Pass**
0.518828	50.07	43.73	48	4.27	**Pass**
2.351810	43.12	38.55	48	9.45	**Pass**
Measurement uncertainty		± 2.5 dB			

The "Pass" decision was made without Hermon Labs uncertainty.

Table calculations and abbreviations:
- Measured conducted emissions = EMI meter reading (dBμV) + cable loss (dB) + LISN correction factor (dB).
- Margin = dB below (negative if above) specification limit.

TEST EQUIPMENT USED:

HL 0163	HL 0787	HL 1425	HL 1566			

LIMIT

Frequency, MHz	Class A Equipment, dB(μV)	Class B equipment, dB(μV)
0.45 – 1.705	60.0	48
1.705 - 30	69.5	48

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 detector as referred to in the table.
The position of the EUT cables was varied to determine maximum emission level.

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4.9 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT: ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
TEST PERFROMED IN: ANECHOIC CHAMBER
AMBIENT TEMPERATURE: 24°C
DISTANCE BETWEEN ANTENNA AND EUT: 3 m
THE EUT WAS TESTED AS: TABLE-TOP
FREQUECNY RANGE: 30 MHz – 1 GHz
DETECTOR TYPE: QUASI-PEAK
RESOLUTION BANDWIDTH: 120 kHz

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

The limits for class A unintentional radiated emissions were used while testing the equipment in Tx mode, refer to paragraph 4.7 and Plots A24, A25.

LIMIT (§ 15.109)

Frequency, MHz	**Class A equipment @ 3 m (calc) dB(µV/m)**	**Class B equipment @ 3 m dB(µV/m)**
30 - 88	49.5	40
88 - 216	54.0	43.5
216 - 960	56.9	46
960 - 5000	60.0	54

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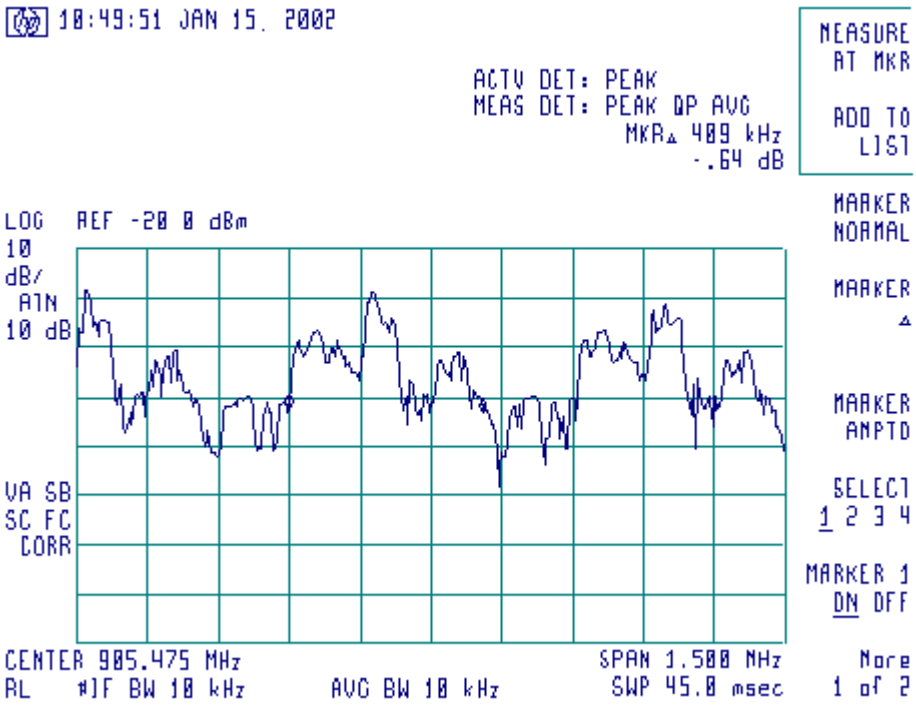
Appendix A Plots

Plot A1
Occupied bandwidth measurements
Carrier frequency 904.8 MHz



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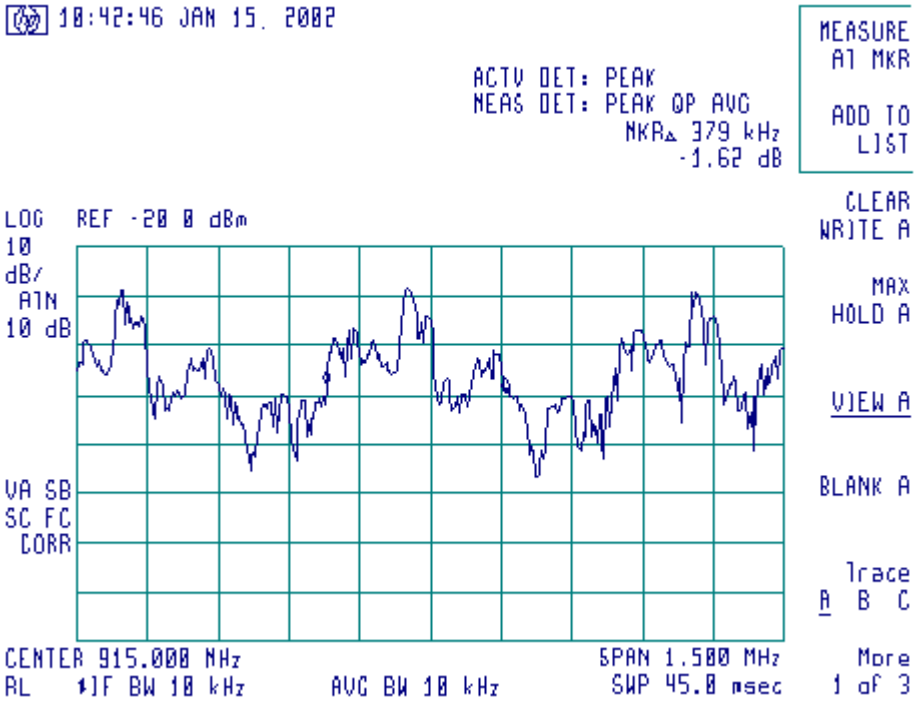
Plot A2
Occupied bandwidth measurements
Carrier frequency 915 MHz



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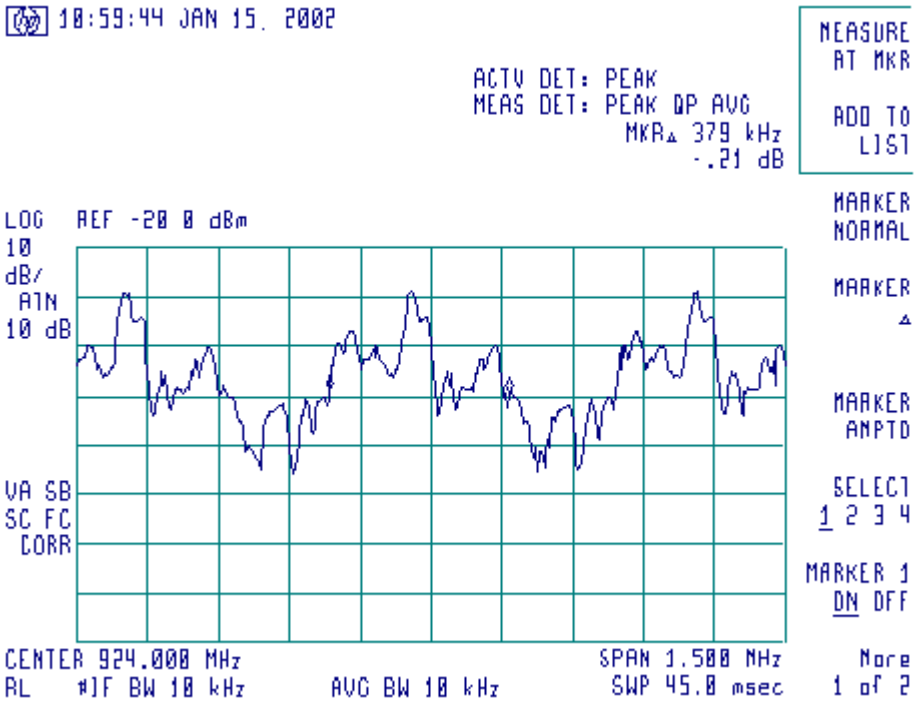
Plot A3
Occupied bandwidth measurements
Carrier frequency 924 MHz



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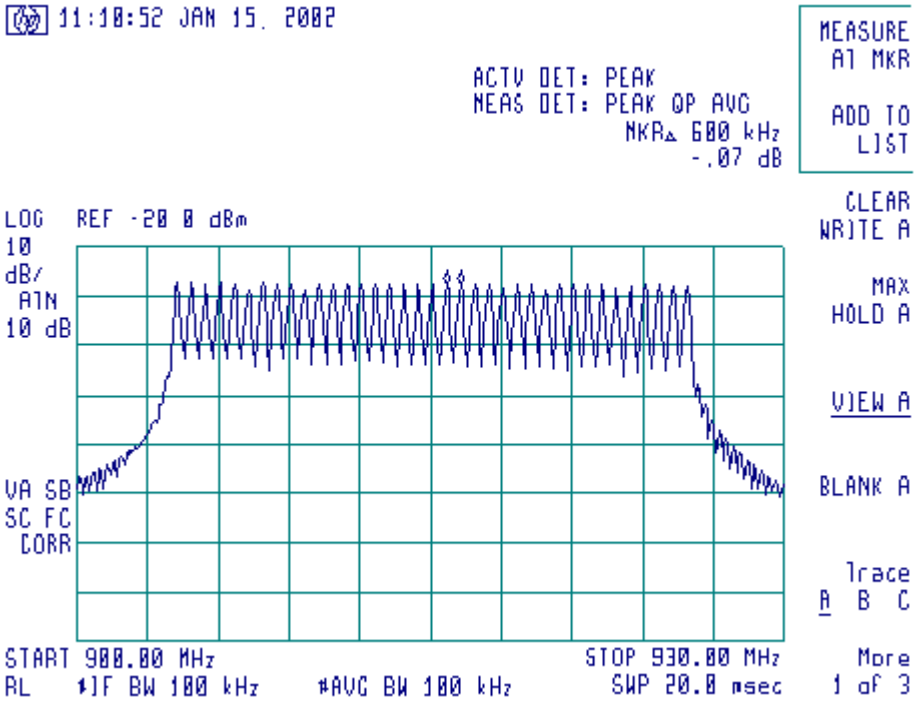
Plot A4
Channel carrier frequencies separation measurements,
Number of hopping channels

Notes **EXT ATT=50.3dB**



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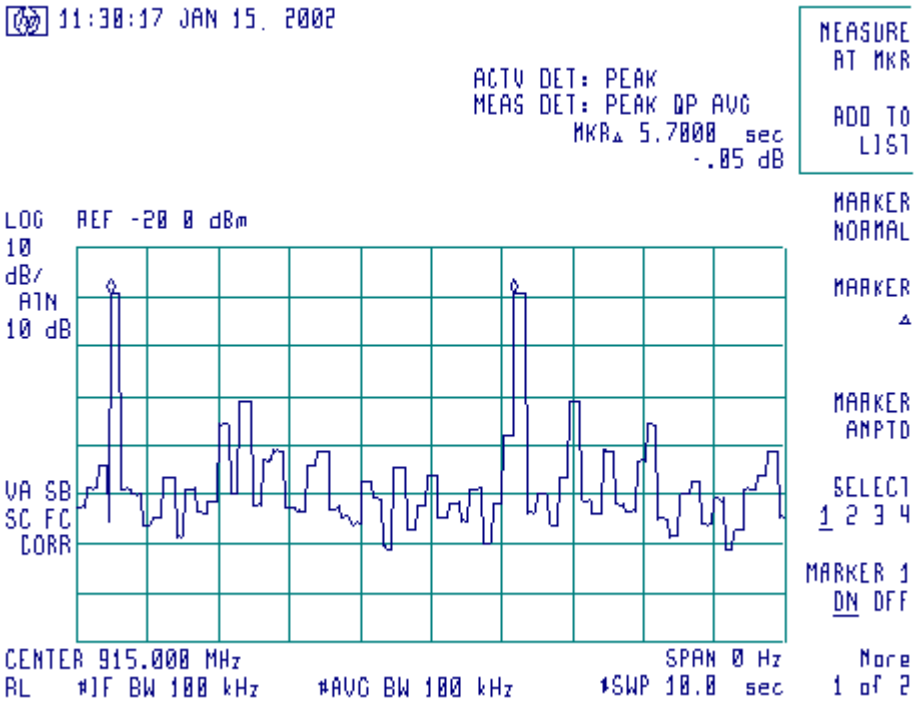
Plot A5
Time period between two successive transmissions

Notes **EXT ATT=50.3dB**



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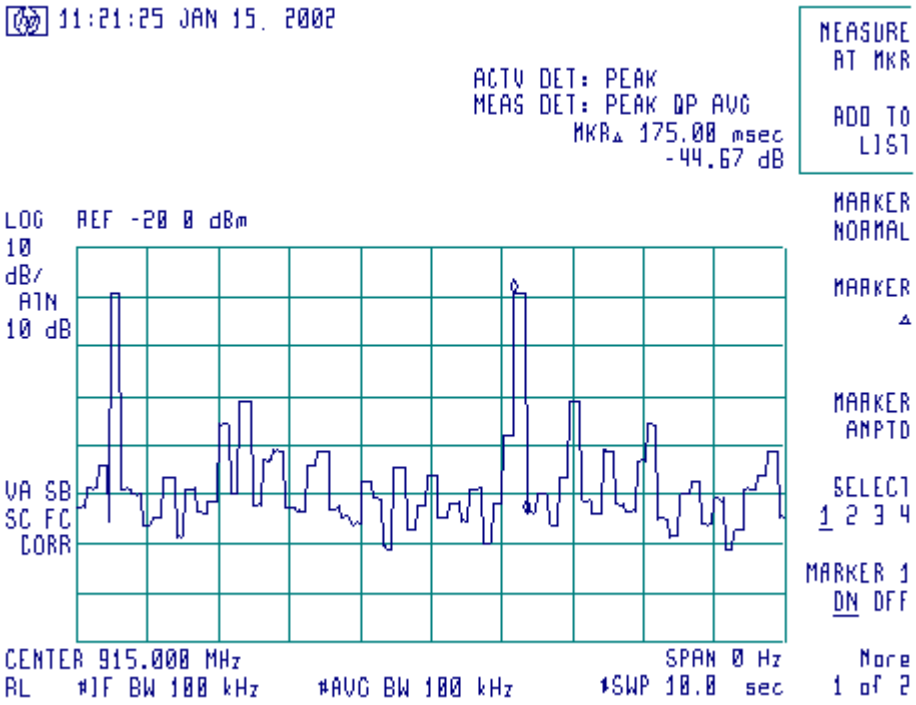
Plot A6
One transmission duration

Notes **EXT ATT=50.3dB**



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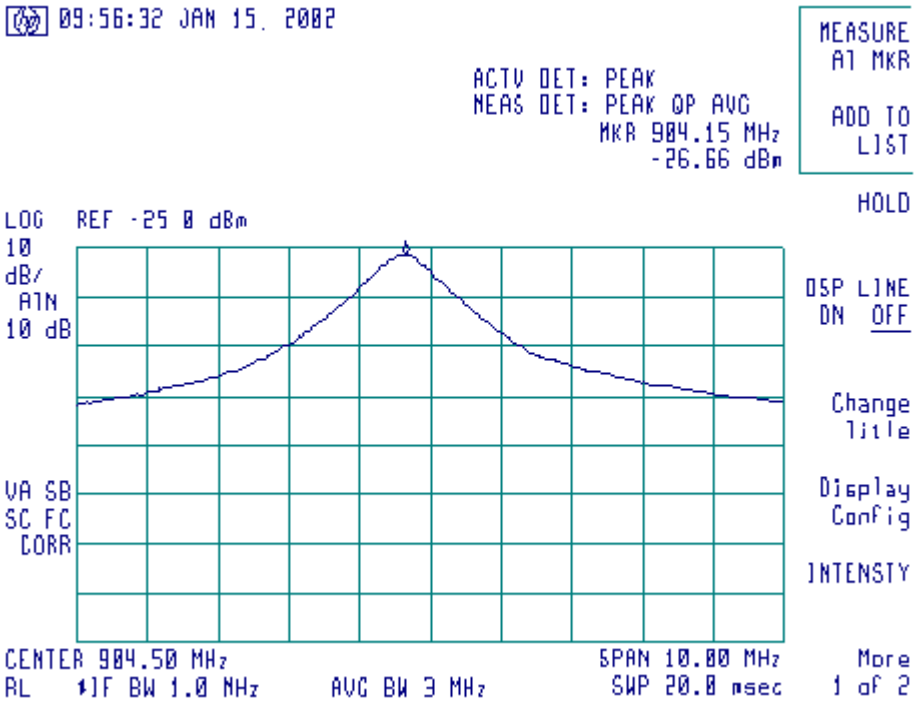
Plot A7
Maximum peak output power measurements
Carrier frequency 904.5 MHz

Notes **EXT ATT=50.3dB**



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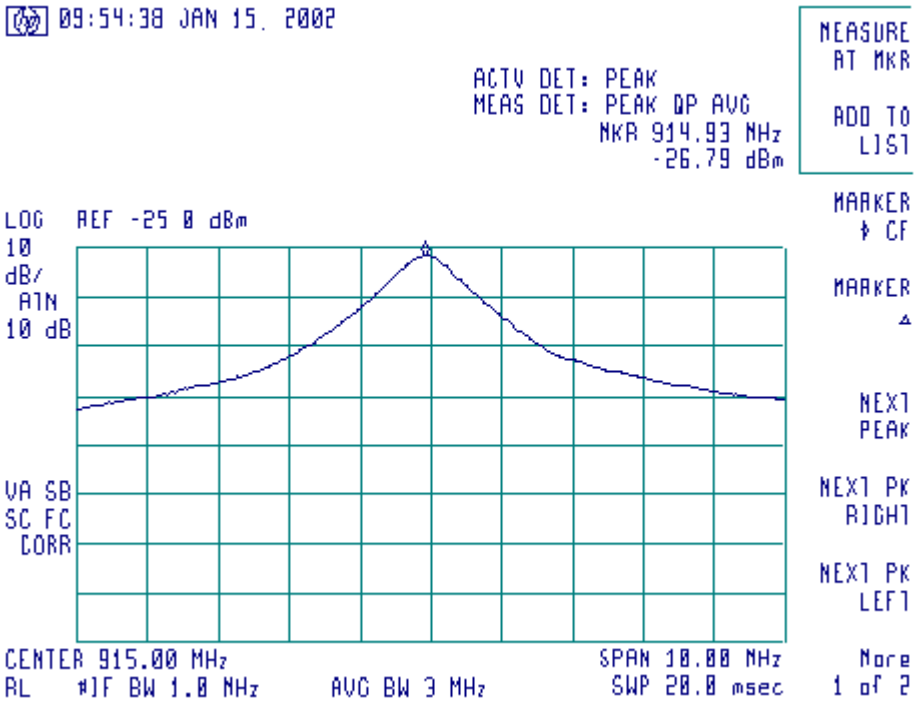
Plot A8
Maximum peak output power measurements
Carrier frequency 915 MHz

Notes **EXT ATT=50.3dB**



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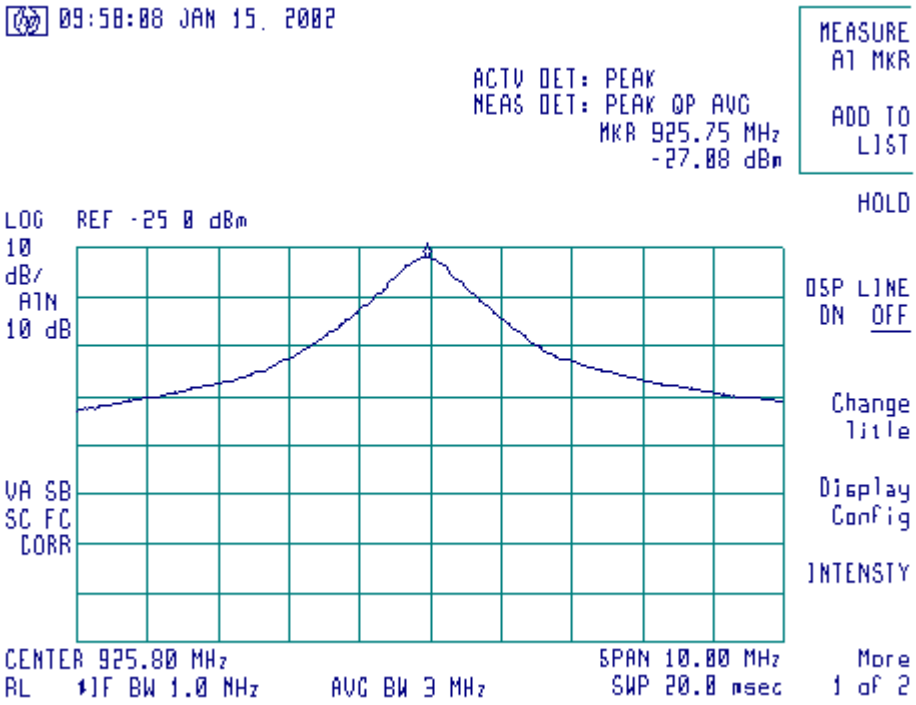
Plot A9
Maximum peak output power measurements
Carrier frequency 925.8 MHz

Notes **EXT ATT=50.3dB**



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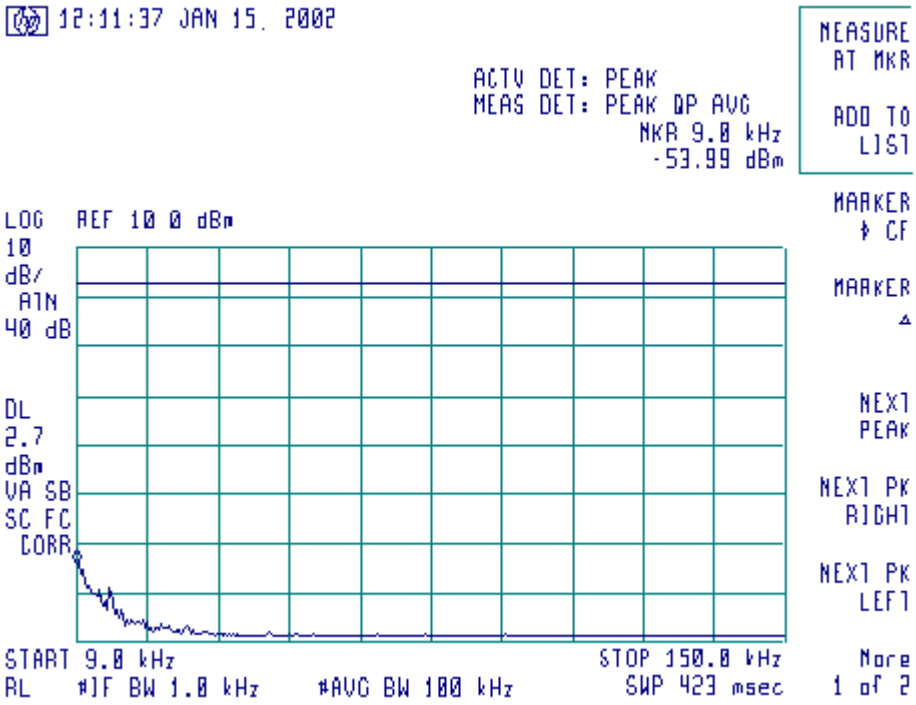
Plot A10
Conducted spurious emission measurements
9 kHz – 150 kHz frequency range

Notes **Without EXT ATT**



Correction factor (CF) = 10 log (100/1) = 20 dB

P = P_{SA} + CF = -53.99 + 20 = -33.99 dBm

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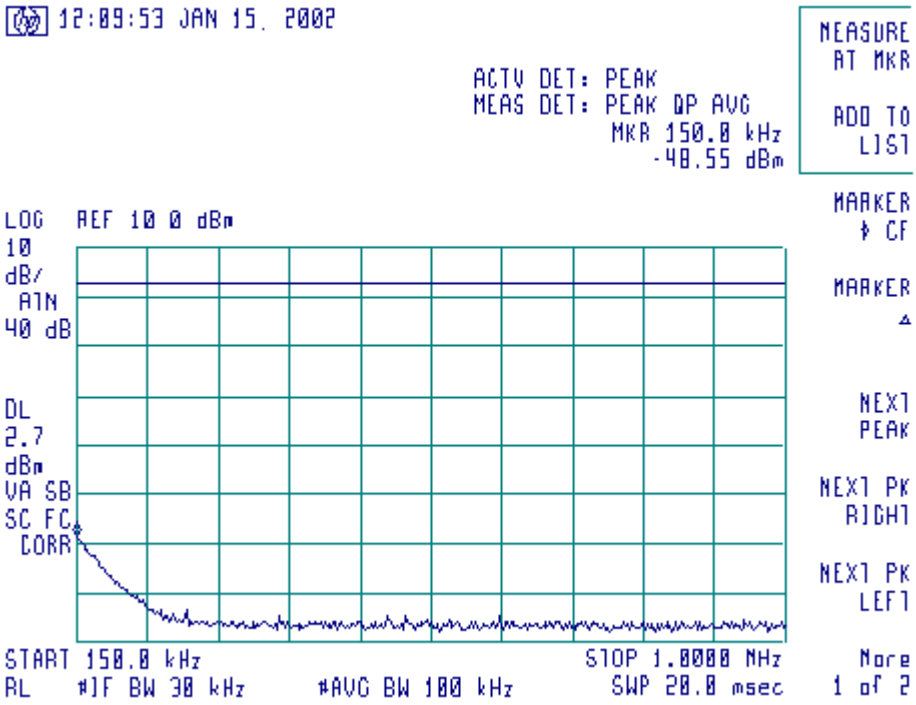
Plot A11
Conducted spurious emission measurements
150 kHz – 1 MHz frequency range

Notes **Without EXT ATT**



Correction factor (CF) = 10 log (100/30) = 3.3 dB

P = P_{SA} + CF = -48.55 + 3.3 = -45.25 dBm

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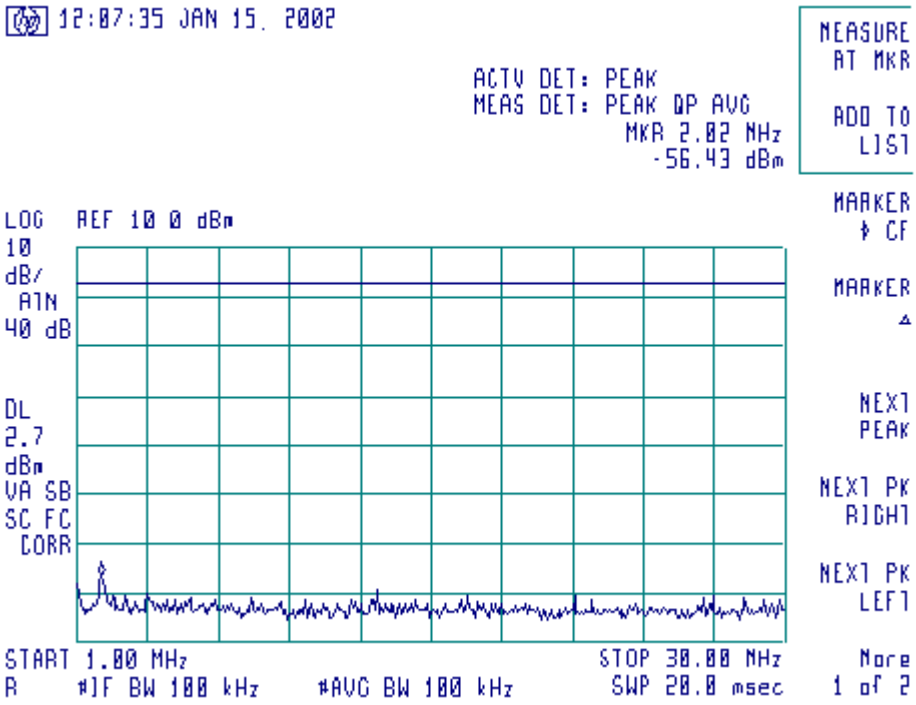
Plot A12
Conducted spurious emission measurements
1 MHz – 30 MHz frequency range

Notes **Without EXT ATT**



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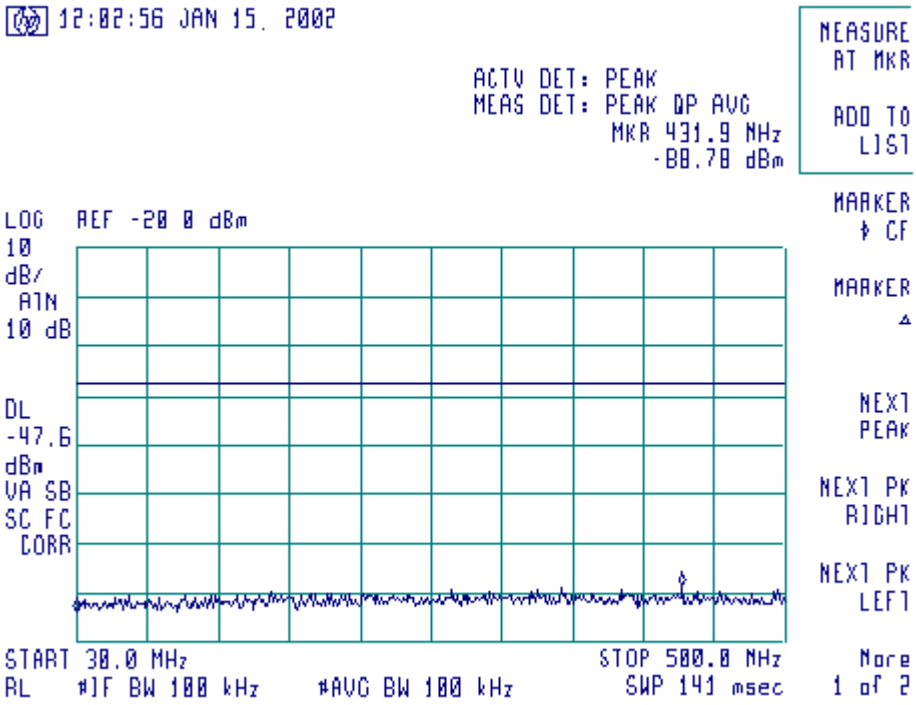
Plot A13
Conducted spurious emission measurements
30 MHz – 500 MHz frequency range

Notes **EXT ATT=50.3dB**



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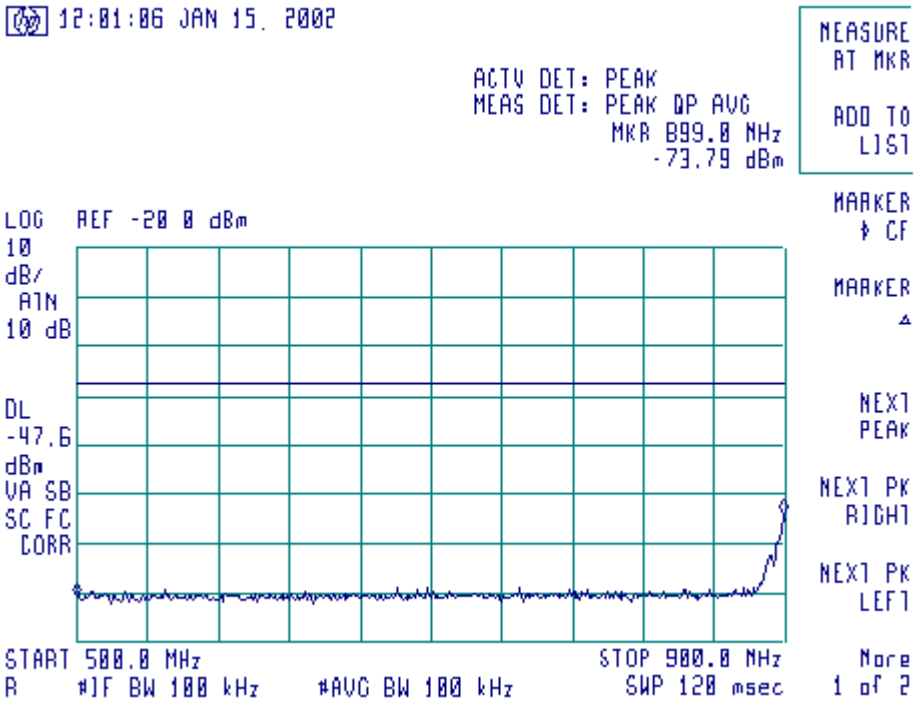
Plot A14
Conducted spurious emission measurements
500 MHz – 900 MHz frequency range

Notes **EXT ATT=50.3dB**



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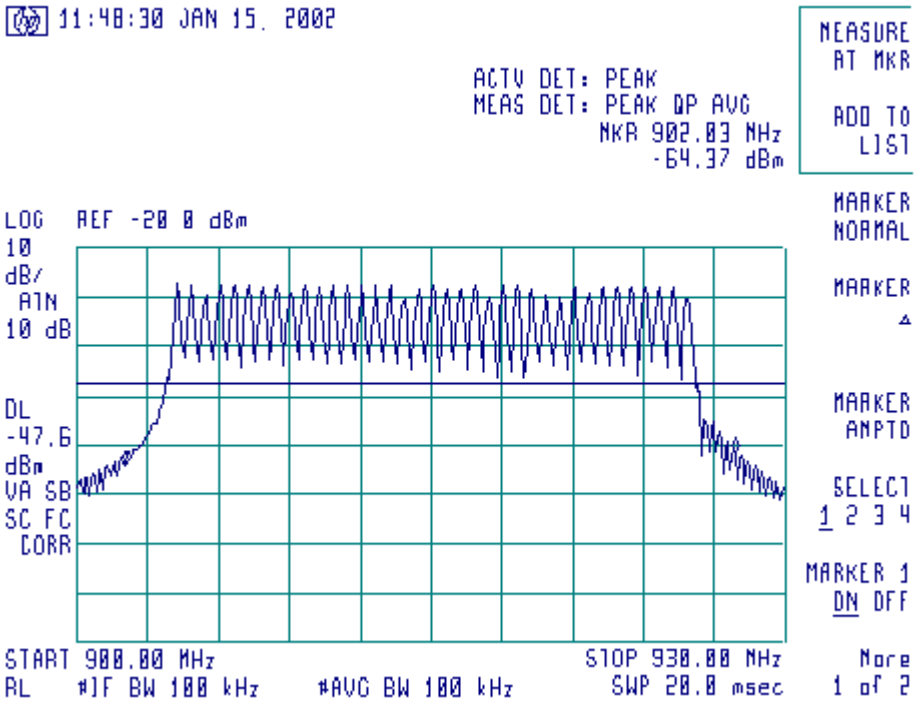
Plot A15
Conducted spurious emission measurements
900 MHz – 930 MHz frequency range

Notes **EXT ATT=50.3dB**



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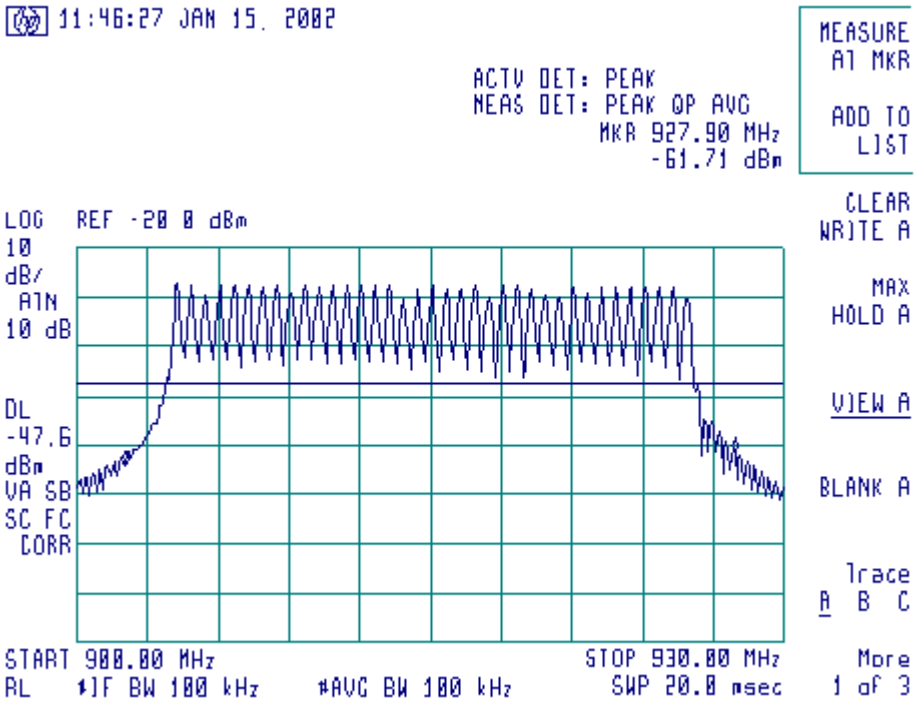
Plot A16
Conducted spurious emission measurements
900 MHz – 930 MHz frequency range

Notes **EXT ATT=50.3dB**



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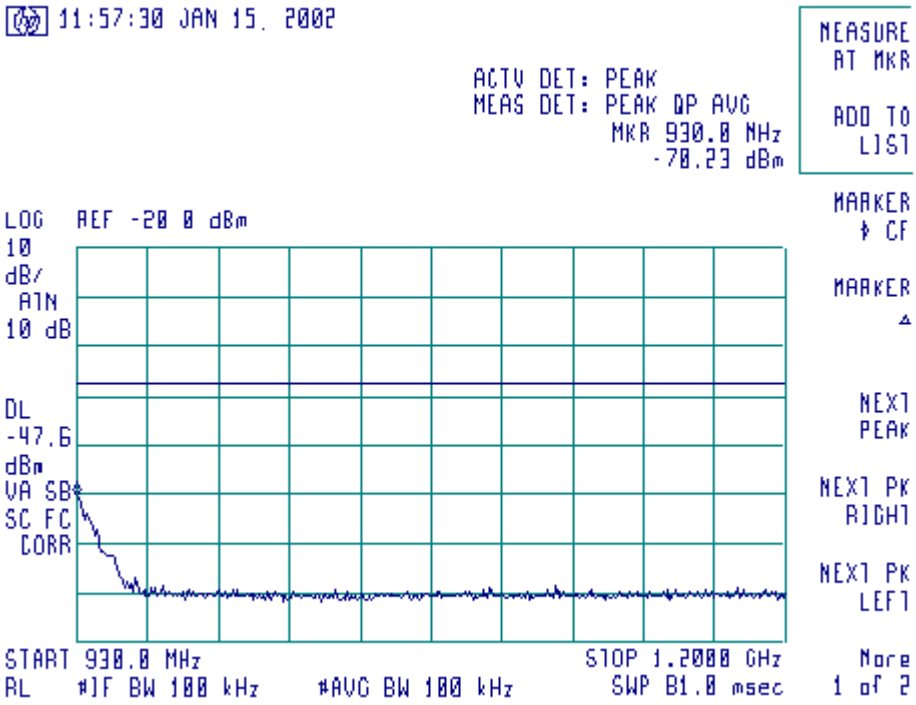
Plot A17
Conducted spurious emission measurements
930 MHz – 1200 MHz frequency range

Notes **EXT ATT=50.3dB**



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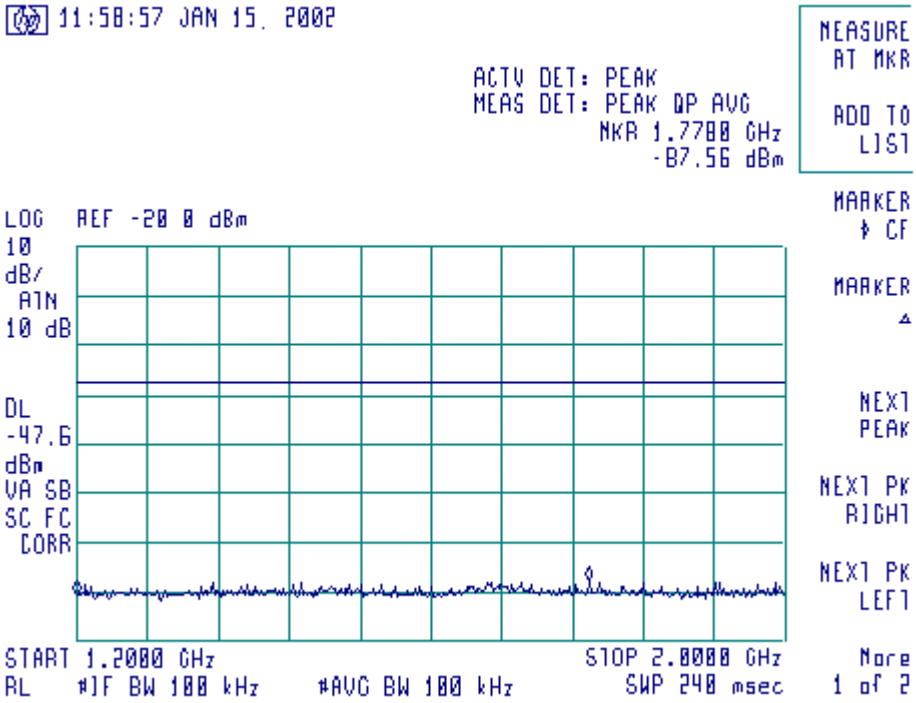
Plot A18
Conducted spurious emission measurements
1200 MHz – 2000 MHz frequency range

Notes **EXT ATT=50.3dB**



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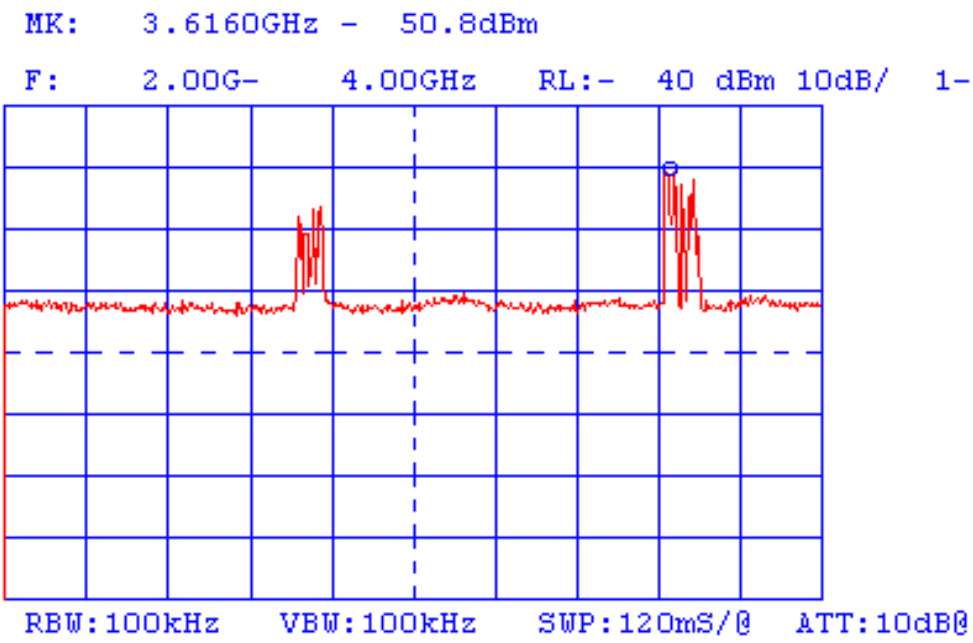
Plot A19
Conducted spurious emission measurements
2000 MHz – 4000 MHz frequency range

Notes **Without EXT ATT**



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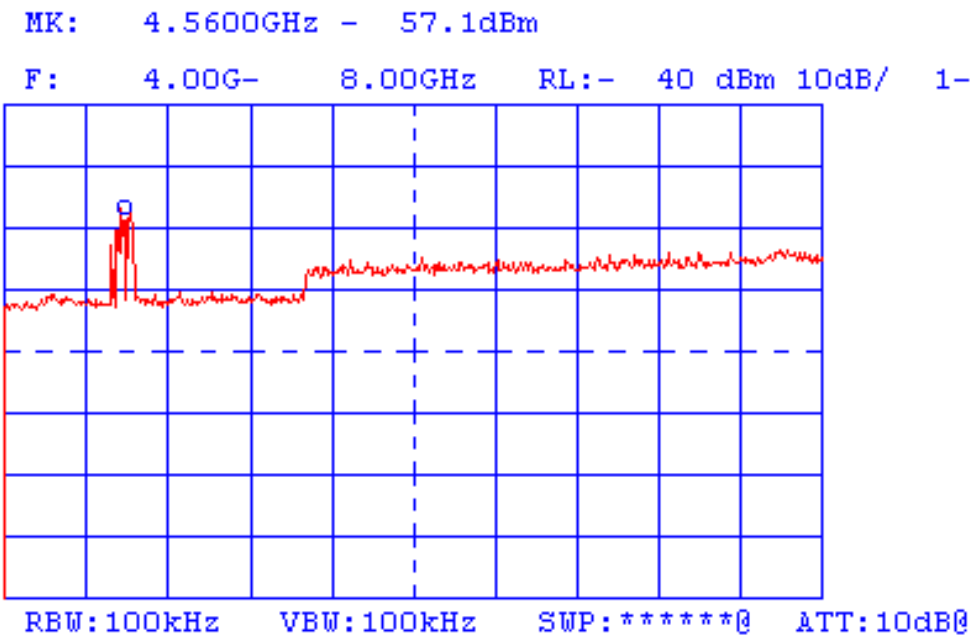
Plot A20
Conducted spurious emission measurements
4000 MHz – 8000 MHz frequency range

Notes **Without EXT ATT**



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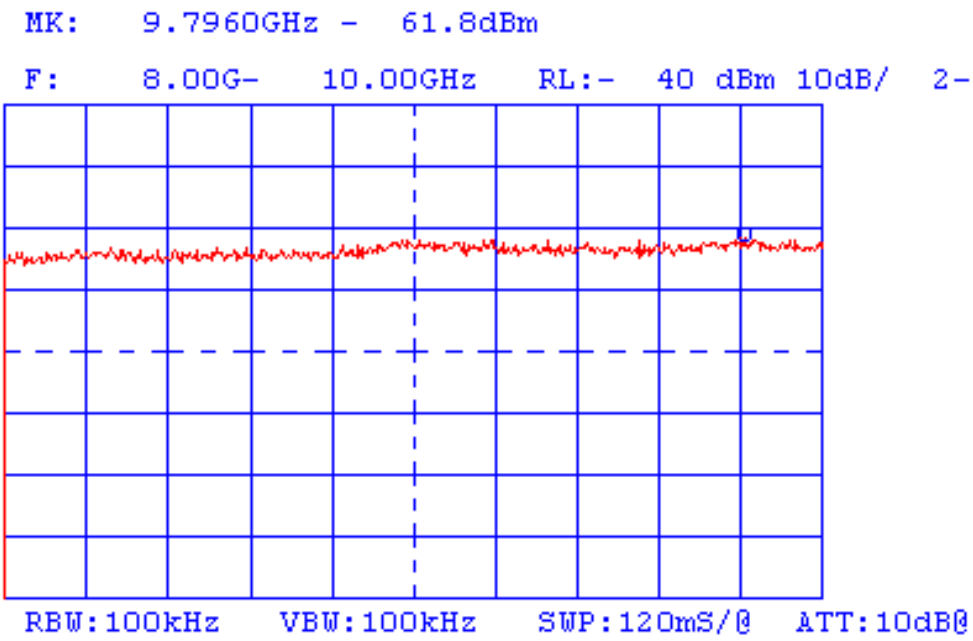
Plot A21
Conducted spurious emission measurements
8000 MHz – 10000 MHz frequency range

Notes **Without EXT ATT**



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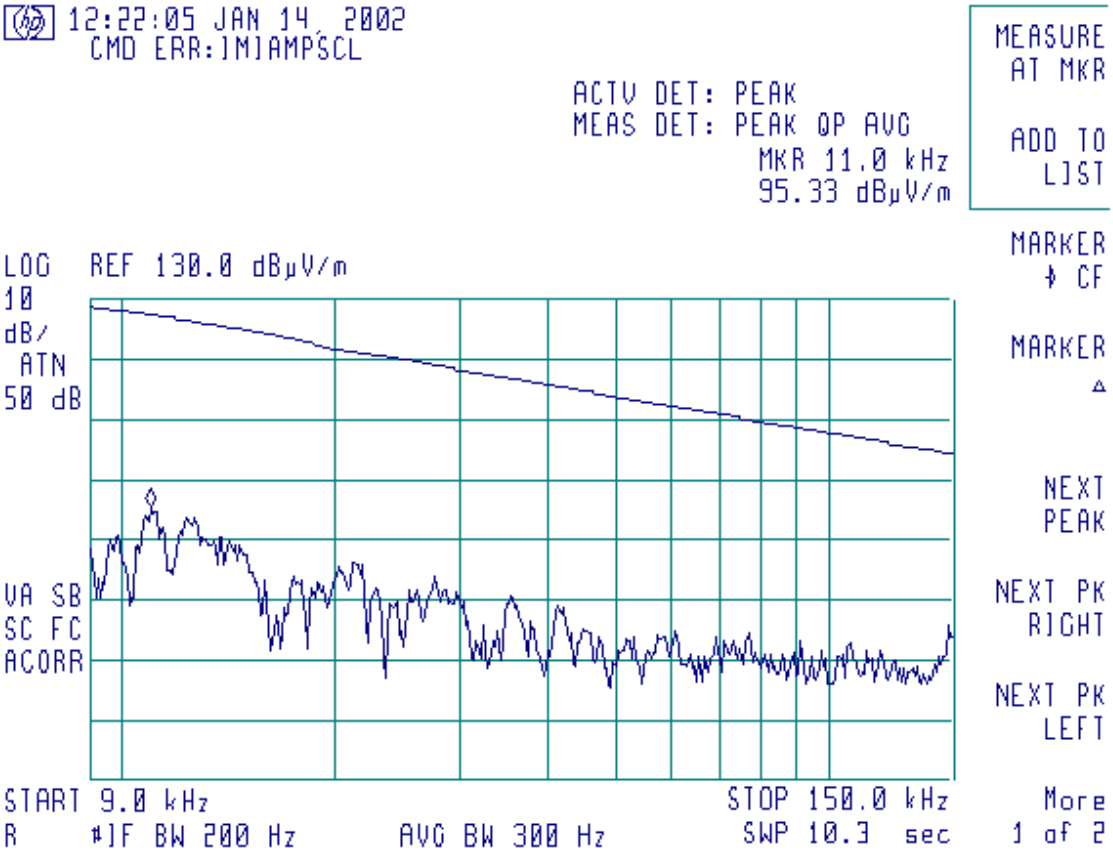
Plot A22
Radiated spurious emission measurements
9 kHz – 150 kHz frequency range



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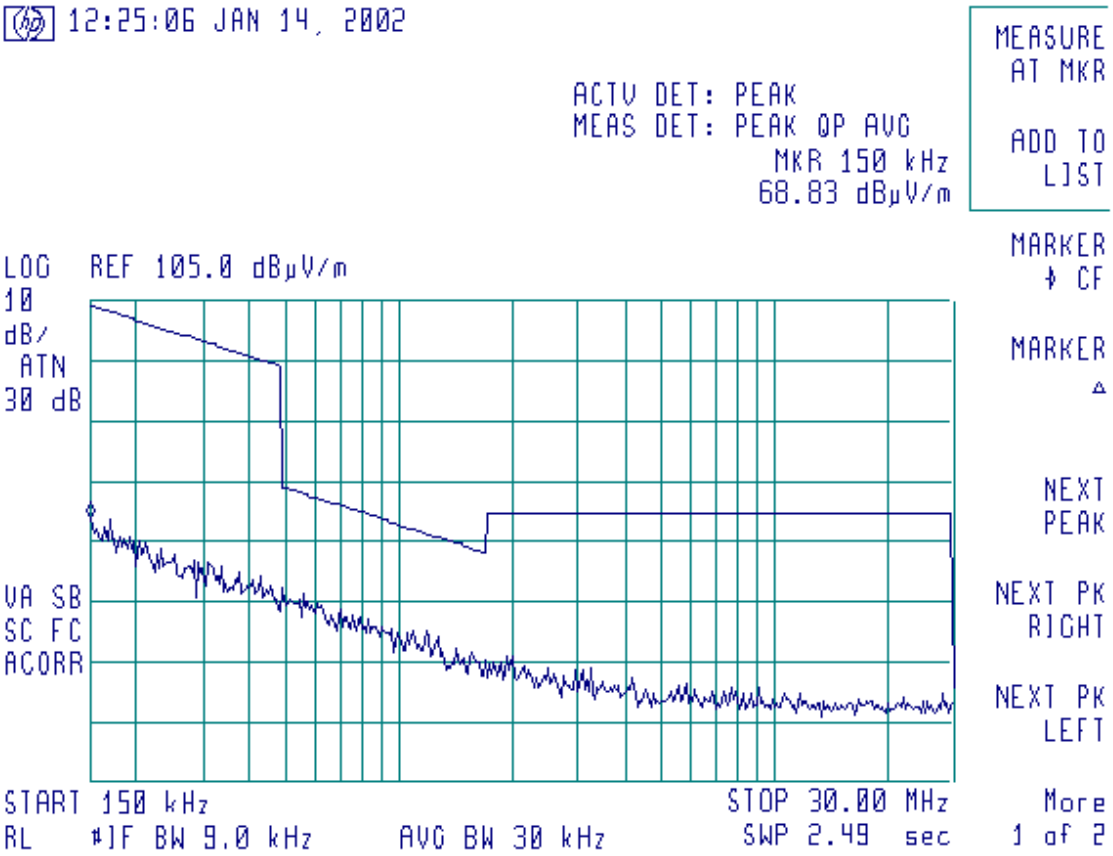
Plot A23
Radiated spurious emission measurements
150 kHz – 30 MHz frequency range



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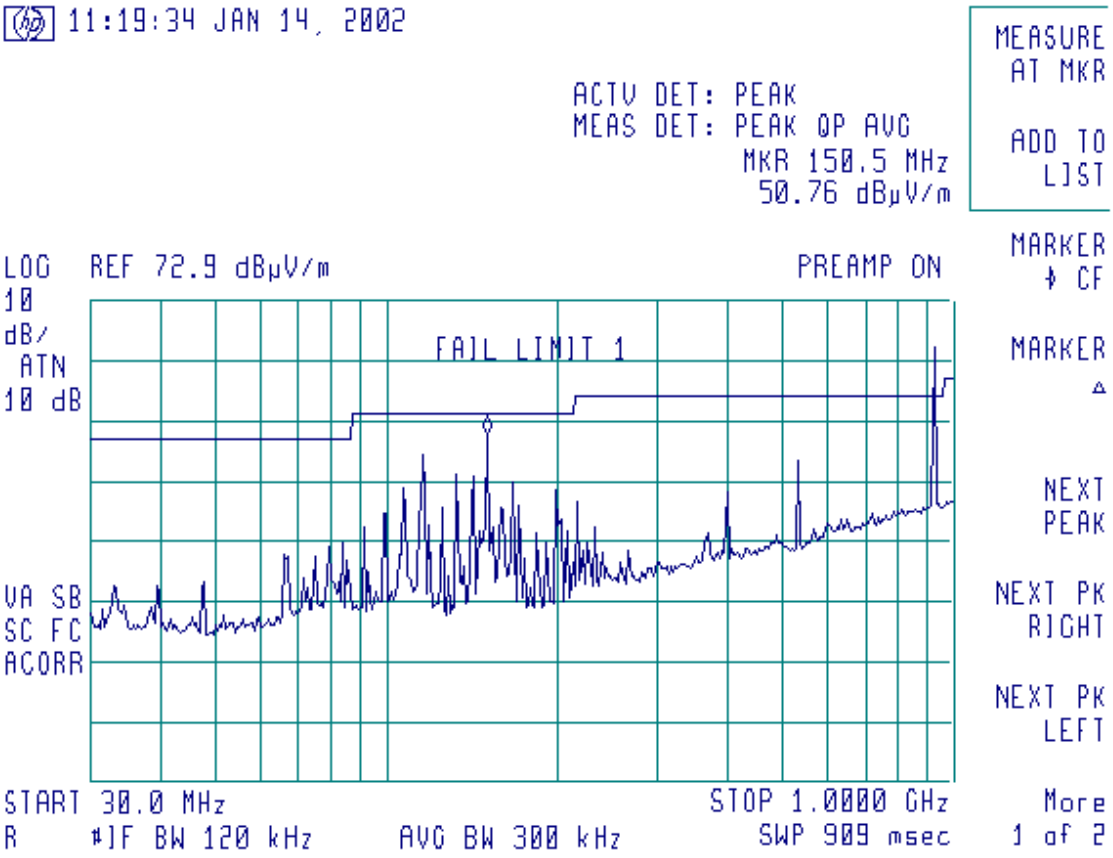
Plot A24
Radiated spurious emission measurements
30 MHz – 1000 MHz frequency range
vertical polarization



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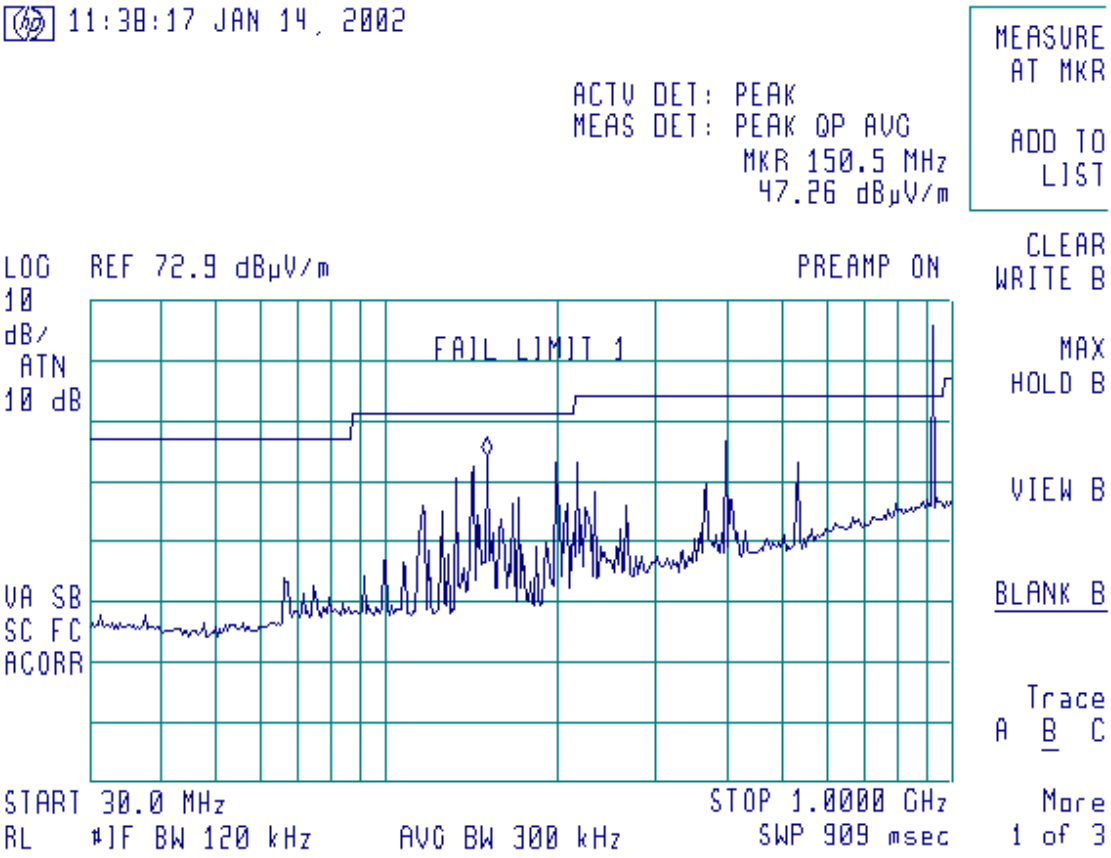
Plot A25
Radiated spurious emission measurements
30 MHz – 1000 MHz frequency range
horizontal polarization



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Appendix B Example of hopping frequency

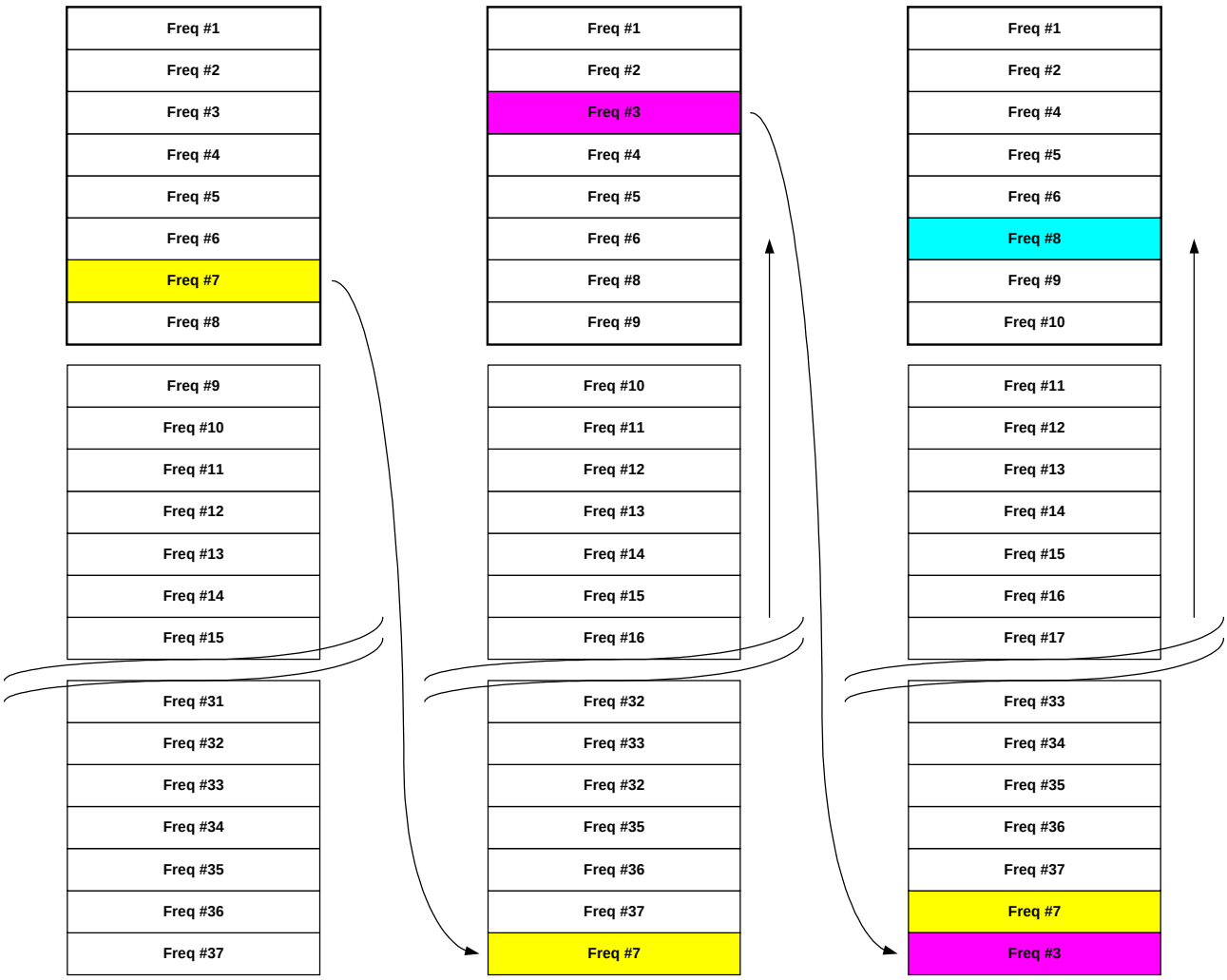
Algorithm

The hopping sequence is based on a frequency table of 37 frequencies: starts at 904.2MHz and ends at 925.8MHz with channel spacing of 600KHz.

One sequence is chosen quasi-randomly from the first 8 frequencies in the table.

After 32 transmissions, this frequency is dropped at the bottom of the 37-frequency list and the whole list is pushed 1 step upward.

Again, one sequence is chosen quasi-randomly from the first new 8 frequencies in the table and the sequence starts again.



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Appendix C Test equipment used for tests

HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ year
		Name	Model No.	Serial No.	
0025	Spectrum analyzer, 10 kHz-23 GHz	Anritsu	MS-710C	5837	10/02
0041	Double ridged guide antenna, 1-18 GHz	Electro-Metrics	RGA 50/60	2811	3/03
0057	Attenuator, 50 Ohm, 2W, 0-18 GHz, 30 dB	Hewlett Packard	8492A	NA	3/03
0163	LISN FCC/VDE/MIL -STD	Electro-Metrics	ANS-25/2	1314	10/02
0410	Cable, Coax, Microwave, DC-18 GHz, N-N, 1 m	Gore	PFP01P01039.4	9338767	9/02
0465	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	11/02 check
0521	Spectrum Analyzer with RF filter section (EMI Receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/02
0554	Amplifier, 2 – 18 GHz RF	Miteq	AFD-4	4300	12/02
0589	Cable Coaxial, GORE A2POL118.2, 3m	Hermon Labs	GORE-3	589	12/02
0604	Antenna Biconilog Log-Periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	01/03
0787	Transient limiter	Hewlett Packard	11947A-8ZE	3107A01877	11/02
1004	Cable coaxial, ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/02
1200	Quadruplexer	Elettronica	UE 84	0240	4/02 check
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/02
1425	EMI Receiver System, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3710A00222	9/02
1430	EMI Receiver System, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3807A00262	9/02
1566	Cable RF, 2 m	Huber-Suhner	Sucoflex 104PE	13094/4PE	12/02
1915	Active receiving loop antenna, 1 kHz – 30 MHz	EMC test systems	6507	1457	06/02
1940	Cable 40 GHz, 1.5 m, blue	Rhophase Microwave Ltd.	KPS-1503A-1500-KPS	T4663	10/02
1942	Cable 18 GHz, 4 m, blue	Rhophase Microwave Ltd	SPS-1803A-4000-NPS	T4658	10/02

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Appendix D General information

Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private EMC, Safety and Telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47) and by Industry Canada for electromagnetic emissions (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, Telecommunications, Safety standards, and by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for Electromagnetic Compatibility, Product Safety, Telecommunications Testing and Environmental Simulation (for exact scope please refer to Certificate No. 839.01).

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

Abbreviations and acronyms

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

AC	alternating current
AE	auxiliary equipment
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
LISN	line impedance stabilization network
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
RF	radio frequency
RE	radiated emission
rms	root mean square
s	second
V	volt
W	width

Specification references

47CFR part 15: 2001	Radio Frequency Devices
ANSI C63.2:96	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4:92	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.