

TEST REPORT

ACCORDING TO: FCC CFR 47 PART 90 §90.217(b) AND PART 15 SUBPART B

FOR:

Miltel Communications Ltd
Remote data collection
transmitter
Model:Speed TxP

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 shall not be reproduced in any form except in full with the written approval of Hermon Laboratories Ltd.

Table of contents

1	Applicant information	3
2	Equipment under test attributes	3
3	Manufacturer information	3
4	Test details	3
5	Tests summary	4
6	EUT description	5
6.1	General information	5
6.2	Ports and lines	5
6.3	Support and test equipment	5
6.4	Operating frequencies	5
6.5	Changes made in the EUT	5
6.6	Test configuration	6
6.7	Transmitter characteristics	7
7	Transmitter tests according to 47CFR part 90 requirements	8
7.1	Effective radiated power of carrier	8
7.2	Occupied bandwidth test	14
7.3	Frequency stability test	19
7.4	Band edge emission	21
7.5	Radiated spurious emission measurements	29
8	Emission tests according to 47CFR part 15 subpart B requirements	52
8.1	Radiated emission measurements	52
9	APPENDIX A Test equipment and ancillaries used for tests	56
10	APPENDIX B Test facility description	57
11	APPENDIX C Specification references	57
12	APPENDIX D Test equipment correction factors	58
13	APPENDIX E Measurement uncertainties	68
14	APPENDIX F Abbreviations and acronyms	69

1 Applicant information

Client name: Miltel Communications Ltd
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Telephone: +972 3737 1333
Fax: +972 3737 1331
E-mail: erez1@miltelcom.com
Contact name: Mr. Erez Sharabi

2 Equipment under test attributes

Product name: Remote data collection device
Product type: Transmitter
Model(s): Speed TxP
Receipt date 3/12/2007

3 Manufacturer information

Manufacturer name: Miltel Communications Ltd
Address: 7 Gush-Etzion, 4th floor, Givat-Shmuel 54030, Israel
Telephone: +972 3737 1333
Fax: +972 3737 1331
E-Mail: erez1@miltelcom.com
Contact name: Mr. Erez Sharabi

4 Test details

Project ID: 17797
Location: Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30550, Israel
Test started: 3/12/2007
Test completed: 3/25/07
Test specification(s): 47CFR part 90, §§90.217(b); part 15 , subpart B

5 Tests summary

Test	Status
Transmitter characteristics	
Section 90.205, Maximum output power	Pass
Section 90.209, Occupied bandwidth	Pass
Section 90.213, Frequency stability	Tested with no limit
Section 90.214, Transient frequency behaviour	Not required
Section 90.217, Band edge emission	Pass
Section 90.217, Radiated spurious emissions	Pass
Section 2.1091, RF radiation exposure evaluation	Not required
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Not required
Section 15.109, Radiated emission	Pass
Section 15.111, Conducted emission at receiver antenna port	Not required

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested.

The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mr. P. Kagan, test engineer	March 25, 2007	
Reviewed by:	Ms. N. Averin, certification engineer	August 7, 2007	
Approved by:	Mr. M. Nikishin, EMC and radio group leader	August 7, 2007	

6 EUT description

6.1 General information

The unit is a data collection device operating in 450 -470 MHz range that connects to various analog and/or digital sensors.

6.2 Ports and lines

Port type	Port description	Connected		Connector type	Qty.	Cable type	Cable length
		From	To				
Signal	To clk	EUT	Open circuit	NA	1	unshielded	1.5 m
Control	RS232	EUT	PC via adapter	Plug-in	1	unshielded	1.5 m

6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
PC	Unknown	Unknown	106599
Monitor	Acer	39eL	917850L006
Keyboard	Cherry	RS6000M	8595L43
Mouse	eMachines	MO15K	19C3925

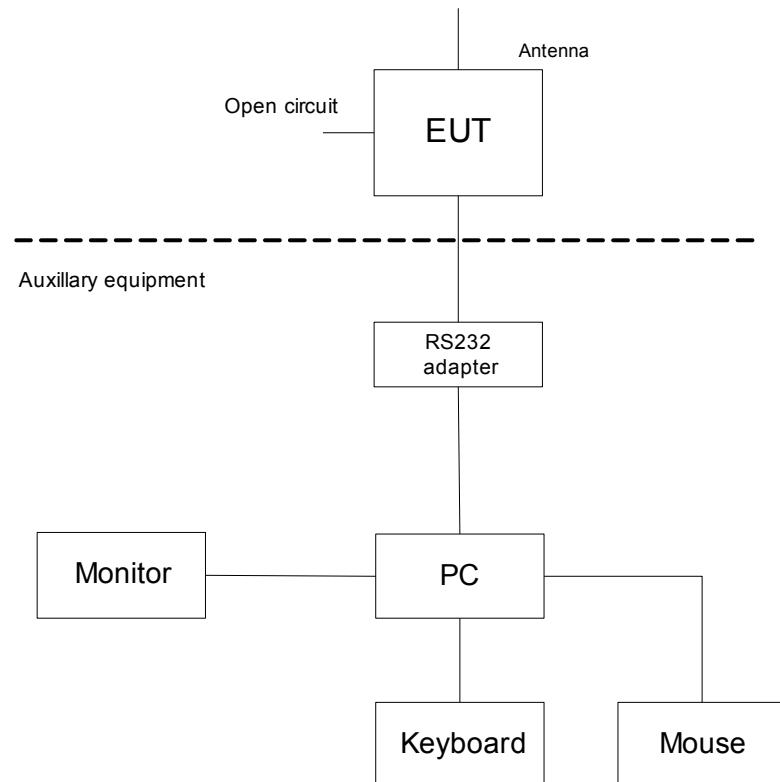
6.4 Operating frequencies

Source	Frequency, MHz		
Clocks	0.0318	8	25
Transmitter	450.05 – 469.95		

6.5 Changes made in the EUT

No changes were implemented.

6.6 Test configuration



6.7 Transmitter characteristics

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)		
Intended use	Condition of use		
fixed	Always at a distance more than 2 m from all people		
X mobile	Always at a distance more than 20 cm from all people		
portable	May operate at a distance closer than 20 cm to human body		
Assigned frequency range	450-470 MHz		
Operating frequency range	450.05 – 469.95 MHz		
RF channel spacing	12.5 kHz		
Maximum rated output power	At transmitter 50 Ω RF output connector		dBm
	Effective radiated power (for equipment with no RF connector)		20.65 dBm
Is transmitter output power variable?	X	No	
		continuous variable	
		stepped variable with stepsize	dB
		minimum RF power	dBm
		maximum RF power	dBm
Antenna connection			
unique coupling	standard connector	X integral	with temporary RF connector
		X	without temporary RF connector
Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Monopole	Miltel	2.1	0 dBi
Transmitter 99% power bandwidth	11 kHz		
Transmitter aggregate data rate/s	600 baud		
Transmitter aggregate symbol (baud) rate/s	600 baud		
Type of modulation	FSK		
Type of multiplexing	NA		
Modulating test signal (baseband)	PRBS		
Transmitter duty cycle supplied for test	100%		
Transmitter power source			
X Battery	Nominal rated voltage	3.6 VDC	Battery type
DC	Nominal rated voltage	VDC	Lithium
AC mains	Nominal rated voltage	VAC	Frequency
			Hz

Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:05:37 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

7 Transmitter tests according to 47CFR part 90 requirements

7.1 Effective radiated power of carrier

7.1.1 General

This test was performed to measure effective radiated power emanated by transmitter at carrier frequency. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Effective radiated power limit

Assigned frequency band, MHz	ERP		Equivalent field strength limit @ 3m, dB(μ V/m)*
	mW	dBm	
450-470	120	20.8	118.2

* - Equivalent field strength limit was calculated from maximum allowed ERP as follows: $E = \sqrt{30 \times P \times 1.64} / r$, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

7.1.2 Test procedure for field strength measurements

- 7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and the performance check was conducted.
- 7.1.2.2 The field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was swept throughout the range, specified in Table 7.1.2, in both vertical and horizontal polarizations.
- 7.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.
- 7.1.3 Test procedure for substitution ERP measurements
- 7.1.3.1 The test equipment was set up as shown in Figure 7.1.2 and energized.
- 7.1.3.2 RF signal generator was set to the EUT carrier frequency and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.
- 7.1.3.3 The test antenna height was swept throughout the specified in Table 7.1.2 range to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.
- 7.1.3.4 The ERP was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.
- 7.1.3.5 The above procedure was performed in both horizontal and vertical polarizations of the test antenna.
- 7.1.3.6 The worst test results (the lowest margins) were recorded in Table 7.1.3 and shown in the associated plots.

Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance		Verdict:
Date & Time:	3/25/2007 3:05:37 PM		PASS
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Figure 7.1.1 Setup for carrier field strength measurements

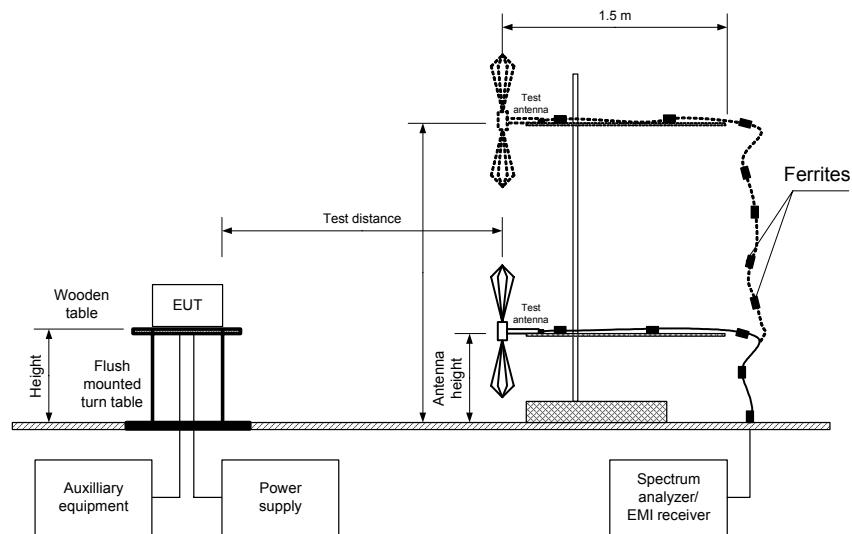
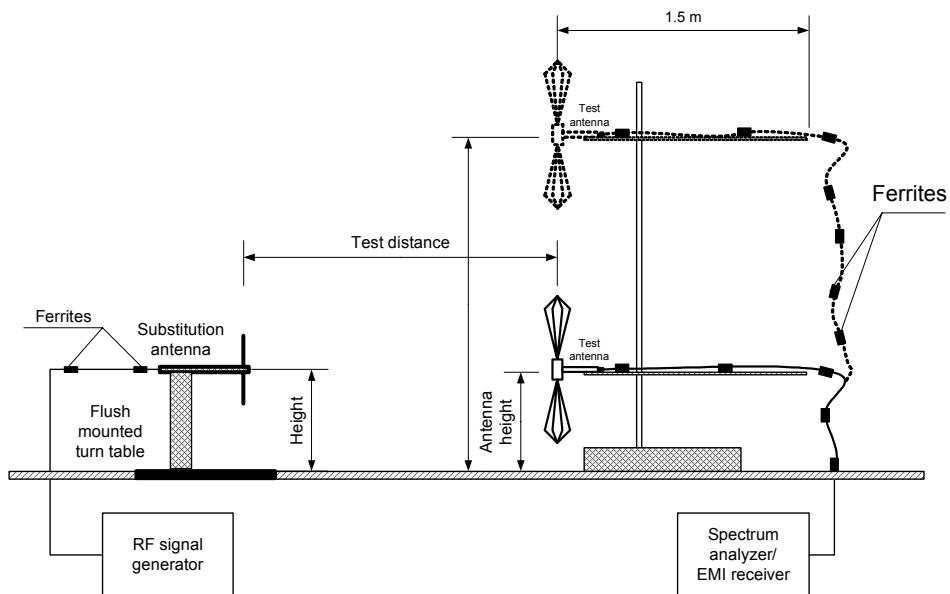


Figure 7.1.2 Setup for substitution ERP measurements



Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:05:37 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Table 7.1.2 Transmitter carrier field strength

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
 TEST SITE: Semi anechoic chamber
 TEST DISTANCE: 3 m
 EUT HEIGHT: 0.8 m
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 TEST ANTENNA TYPE: Biconical
 MODULATION: FSK
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
450.05	120.46	118.2	2.26	120	v	1	0
460.00	120.31	118.2	2.11		v	1	0
469.95	117.19	118.2	-1.01		v	1	0

*- Margin = Field strength – calculated field strength limit.

**- EUT front panel refers to 0 degrees position of turntable.

Table 7.1.3 Transmitter carrier ERP

TEST DISTANCE: 3 m
 SUBSTITUTION ANTENNA HEIGHT: 0.8 m
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: 300 kHz
 SUBSTITUTION ANTENNA TYPE: Tunable dipole

Frequency, MHz	Field strength, dB(µV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
450.05	120.46	120	Vertical	23.46	-1.18	1.63	20.65	20.8	-0.15	Pass
460.00	120.31		Vertical	23.31	-1.37	1.65	20.29	20.8	-0.51	Pass
469.95	117.19		Vertical	20.19	-1.57	1.67	16.95	20.8	-3.85	Pass

*- Margin = ERP – specification limit.

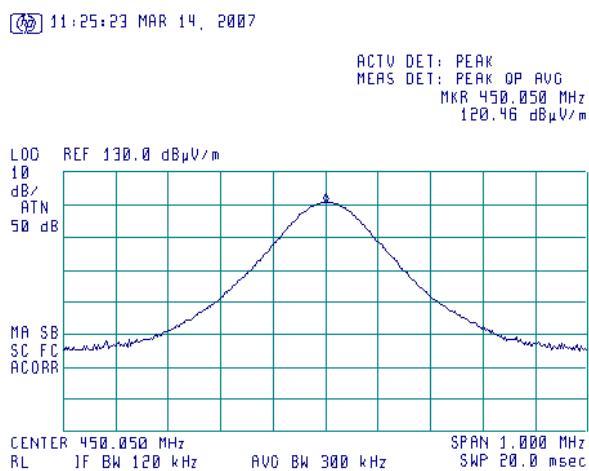
Reference numbers of test equipment used

HL 0521	HL 0589	HL 0593	HL 0594	HL 0604	HL 1984	HL 2009	HL 2259
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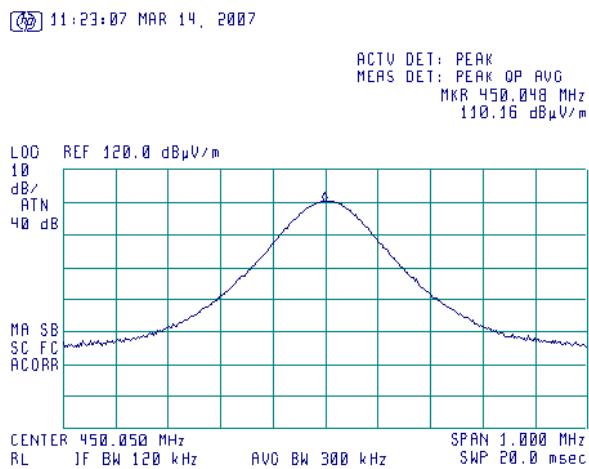
Full description is given in Appendix A.

Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:05:37 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.1.1 Transmitter carrier field strength at low frequency in vertical antenna polarization



Plot 7.1.2 Transmitter carrier field strength at low frequency in horizontal antenna polarization

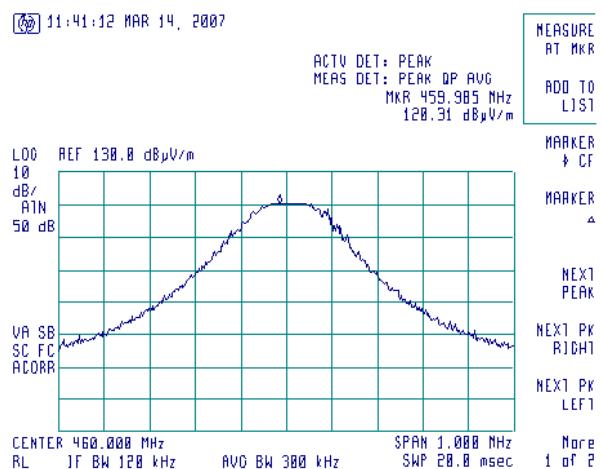




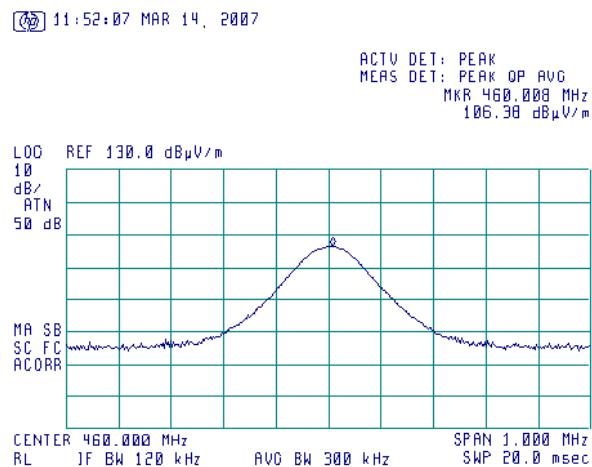
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Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:05:37 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.1.3 Transmitter carrier field strength at mid frequency in vertical antenna polarization

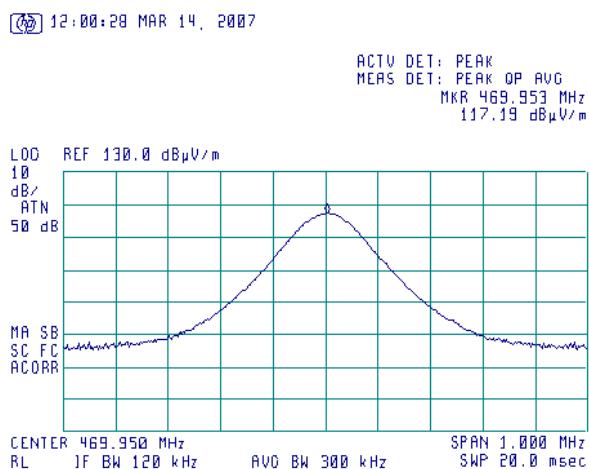


Plot 7.1.4 Transmitter carrier field strength at mid frequency in horizontal antenna polarization

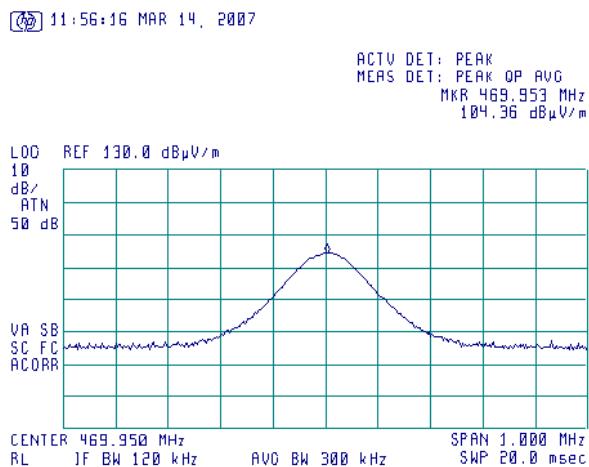


Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:05:37 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.1.5 Transmitter carrier field strength at high frequency in vertical antenna polarization



Plot 7.1.6 Transmitter carrier field strength at high frequency in horizontal antenna polarization



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:07:11 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

7.2 Occupied bandwidth test

7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Occupied bandwidth limits

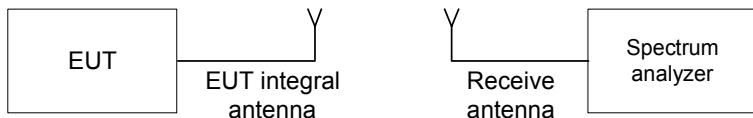
Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450 - 470	26	11.25

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

7.2.2 Test procedure

- 7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.
- 7.2.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.
- 7.2.2.3 The EUT was set to transmit the normally modulated carrier.
- 7.2.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:07:11 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 0.1 kHz
 VIDEO BANDWIDTH: 0.3 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
 MODULATION: FSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 600 kbps

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450.05	10.20	11.25	-1.05	Pass
460.00	9.40	11.25	-1.85	Pass
469.95	10.05	11.25	-1.20	Pass

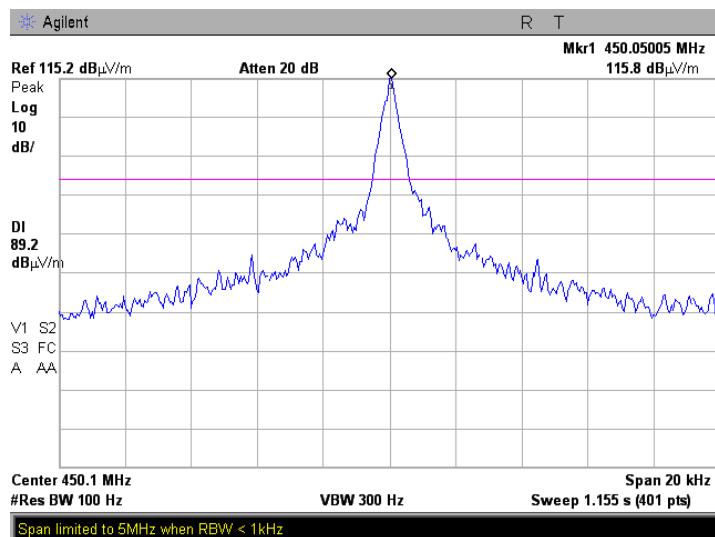
Reference numbers of test equipment used

HL 0034	HL 2871	HL 2909			
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Full description is given in Appendix A.

Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:07:11 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.2.1 Reference unmodulated carrier at low frequency

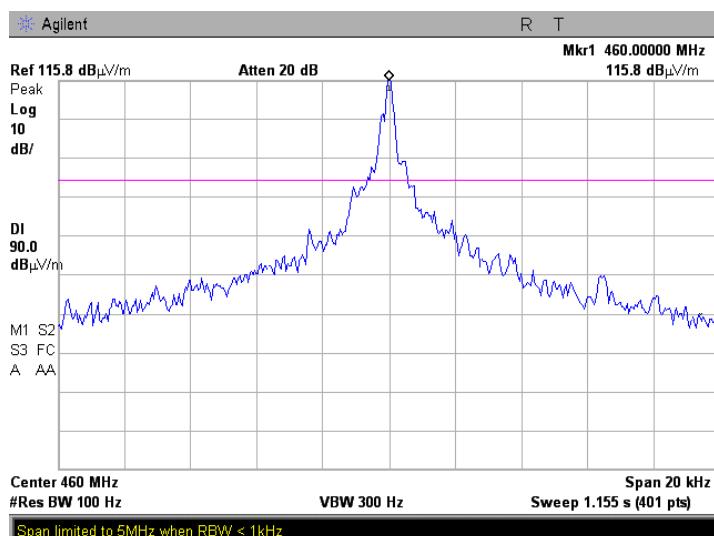


Plot 7.2.2 Occupied bandwidth test result at low frequency



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:07:11 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.2.3 Reference unmodulated carrier at mid frequency

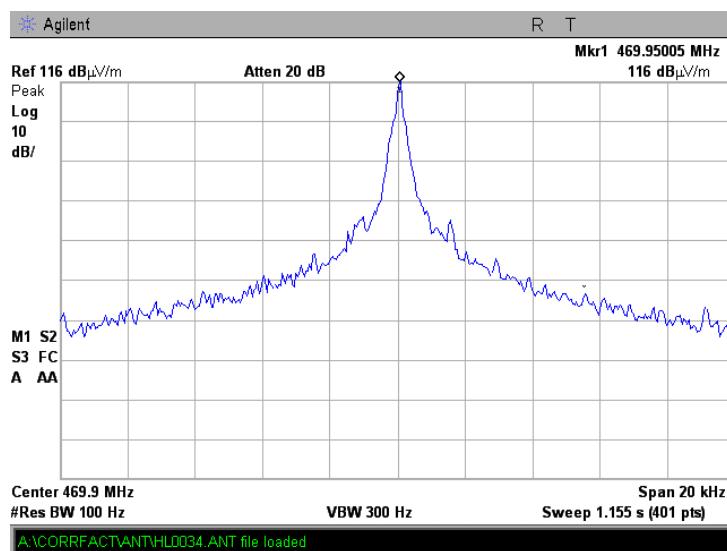


Plot 7.2.4 Occupied bandwidth test result at mid frequency



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:07:11 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.2.5 Reference unmodulated carrier at high frequency



Plot 7.2.6 Occupied bandwidth test result at high frequency



Test specification:	Section 90.213, Frequency stability		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:07:51 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

7.3 Frequency stability test

7.3.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.3.1.

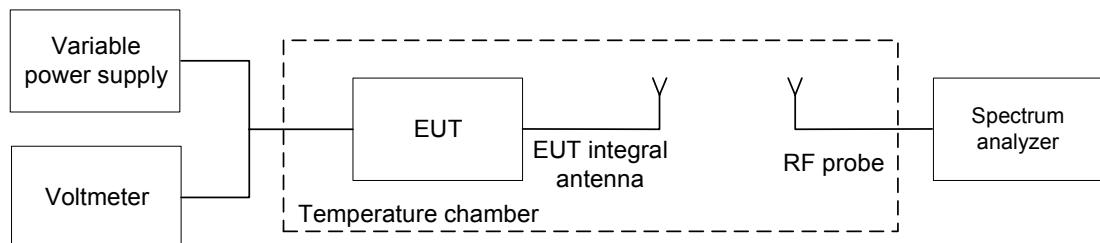
Table 7.3.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450.05		1125
460.00	2.5	1150
469.95		1175

7.3.2 Test procedure

- 7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.
- 7.3.2.2 The EUT power was turned off. Temperature within test chamber was set to +30°C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.
- 7.3.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.
- 7.3.2.4 The above procedure was repeated at 0°C and at the lowest test temperature.
- 7.3.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.
- 7.3.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.3.2.

Figure 7.3.1 Frequency stability test setup



Test specification:	Section 90.213, Frequency stability		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance		Verdict:
Date & Time:	3/25/2007 3:07:51 PM		PASS
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY: 450.0-470.0 MHz
 NOMINAL POWER VOLTAGE: 3.6 V
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Counter
 RESOLUTION BANDWIDTH: 30 Hz
 VIDEO BANDWIDTH: 10 Hz
 MODULATION: Unmodulated

T, °C	Voltage V	Frequency, MHz							Max frequency drift, Hz	Limit, Hz	Margin, Hz	Verdict	
		Start up	1 st min	2 nd min	3 rd min	4 th min	5 th min	0 th min					
Low frequency													
-30	3.6	450.050 265	450.050 242	450.050 232	450.050 225	450.050 215	450.050 220	450.050 207	322	0	1125	-803	Pass
-20	3.6	450.050072	NA	NA	NA	NA	NA	450.050102	159	0		-966	Pass
-10	3.6	450.049997	NA	NA	NA	NA	NA	450.050020	77	0		-1048	Pass
0	3.6	450.049923	450.049962	450.049912	450.049862	450.049912	450.049950	450.049862	19	-81		-1044	Pass
10	3.6	450.049923	NA	NA	NA	NA	NA	450.049935	0	-20		-1105	Pass
20	3.6	450.049923	NA	NA	NA	NA	NA	450.049943	0	-20		-1105	Pass
20	2.7	450.049923	NA	NA	NA	NA	NA	450.050038	95	-20		-1030	Pass
30	3.6	450.049923	450.049887	450.049890	450.049870	450.049895	450.049887	450.049895	0	-73		-1052	Pass
40	3.6	450.049923	NA	NA	NA	NA	NA	450.049870	0	-73		-1052	Pass
50	3.6	450.049923	NA	NA	NA	NA	NA	450.049865	0	-78		-1047	Pass
-30	3.6	450.050265	450.050242	450.050232	450.050225	450.050215	450.050220	450.050207	322	0		-803	Pass
Mid frequency													
-30	3.6	460.000 247	460.000 260	460.000 265	460.000 252	460.000 250	460.000 255	460.000 247	287	0	1150	-863	Pass
-20	3.6	460.000125	NA	NA	NA	NA	NA	460.000112	147	0		-1003	Pass
-10	3.6	460.000057	NA	NA	NA	NA	NA	460.000060	82	0		-1068	Pass
0	3.6	459.999882	459.999898	459.999918	459.999900	459.999978	459.999910	459.999910	0	-96		-1054	Pass
10	3.6	459.999935	NA	NA	NA	NA	NA	459.999950	0	-43		-1107	Pass
20	3.6	459.999975	NA	NA	NA	NA	NA	459.999978	0	-3		-1147	Pass
20	2.7	460.000080	NA	NA	NA	NA	NA	460.000092	114	0		-1036	Pass
30	3.6	459.999875	459.999907	459.999917	459.999920	459.999872	459.999915	459.999875	0	-106		-1044	Pass
40	3.6	459.999872	NA	NA	NA	NA	NA	459.999900	0	-106		-1044	Pass
50	3.6	459.999875	NA	NA	NA	NA	NA	459.999850	0	-128		-1022	Pass
-30	3.6	460.000247	460.000260	460.000265	460.000252	460.000250	460.000255	460.000247	287	0		-863	Pass
High frequency													
-30	3.6	469.950 200	469.950 215	469.950 205	469.950 210	469.950 205	469.950 205	469.950 190	243	0	1175	-932	Pass
-20	3.6	469.950140	NA	NA	NA	NA	NA	469.950130	168	0		-1007	Pass
-10	3.6	469.950075	NA	NA	NA	NA	NA	469.950075	103	0		-1072	Pass
0	3.6	469.949890	469.949897	469.949897	469.949903	469.949907	469.949910	469.949910	0	-82		-1093	Pass
10	3.6	469.949950	NA	NA	NA	NA	NA	469.949945	0	-27		-1148	Pass
20	3.6	469.949967	NA	NA	NA	NA	NA	469.949972	0	-5		-1170	Pass
20	2.7	469.950019	NA	NA	NA	NA	NA	469.950022	50	0		-1125	Pass
30	3.6	469.949967	469.949955	469.949946	469.949932	469.949901	469.949909	469.949898	0	-74		-1101	Pass
40	3.6	469.949872	NA	NA	NA	NA	NA	469.949907	0	-100		-1075	Pass
50	3.6	469.949892	NA	NA	NA	NA	NA	469.949895	0	-80		-1095	Pass
-30	3.6	469.950200	469.950215	469.950205	469.950210	469.950205	469.950205	469.950190	243	0		-932	Pass

* - Reference frequency

Reference numbers of test equipment used

HL 0493	HL 0758	HL 2909				
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Full description is given in Appendix A.

Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:09:31 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

7.4 Band edge emission

7.4.1 General

This test was performed to verify the EUT band edge emission, including all associated side bands and frequency drift under extreme test conditions, was attenuated at least 30 dB below the unmodulated carrier level. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Band edge emission limits

Band edge frequency shift from carrier, kHz	Channel bandwidth, kHz	Attenuation below carrier, dBc
± 25.0	12.5	30

7.4.2 Test procedure

- 7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and the performance check was conducted.
- 7.4.2.2 The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure the peak measurements. The spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.
- 7.4.2.3 The frequency of modulation envelope points beyond which the modulation envelope power drops below the band edge emission limit was measured.
- 7.4.2.4 The total bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained bandwidth was verified to be within the allowed frequency range.
- 7.4.2.5 The test results were recorded in Table 7.4.2 and shown in the associated plots.

Figure 7.4.1 Band edge emission measurement set up



Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance		Verdict: PASS
Date & Time:	3/25/2007 3:09:31 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Table 7.4.2 Band edge emission test results

OPERATING FREQUENCY RANGE: 450.05 – 469.95 MHz
 DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 100 Hz
 VIDEO BANDWIDTH: 300 Hz
 MODULATION: FSK
 MODULATING SIGNAL: Alternating symbols
 BIT RATE: 600 bps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 ATTENUATION BELOW CARRIER: 30 dBc

Band edge	Measured frequency, MHz*	Frequency drift, Hz		Band edge frequency, MHz**	Band edge limit, MHz	Margin, kHz***	Verdict
		Negative	Positive				
Low carrier frequency							
Low	450.0450	-81	NA	450.0449	450.025	-19.9	Pass
High	450.0556	NA	322	450.0559	450.075	-19.1	Pass
Mid carrier frequency							
Low	459.9927	-128	NA	459.9926	459.975	-17.6	Pass
High	460.0087	NA	287	460.0090	460.025	-16.0	Pass
High carrier frequency							
Low	469.9444	-100	NA	469.9443	469.925	-19.3	Pass
High	469.9562	NA	243	469.9564	469.975	-18.6	Pass

* - Measured frequency beyond which the emission level is attenuated at least 30 dB below the unmodulated carrier

** - Band edge frequency = Measured frequency \pm Frequency drift under extreme conditions

*** - Margin = Band edge limit – Band edge frequency

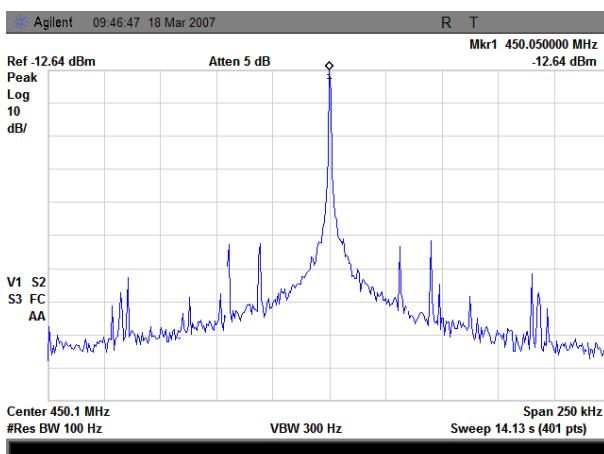
Reference numbers of test equipment used

HL 0493	HL 0758	HL 2909				
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Full description is given in Appendix A.

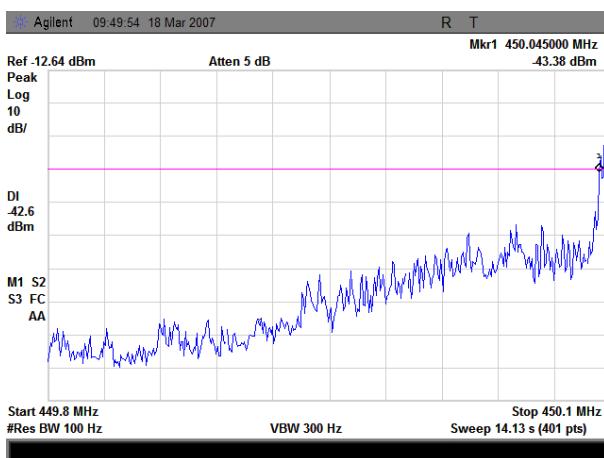
Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:09:31 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.4.1 Band edge emission test results at low carrier frequency unmodulated reference

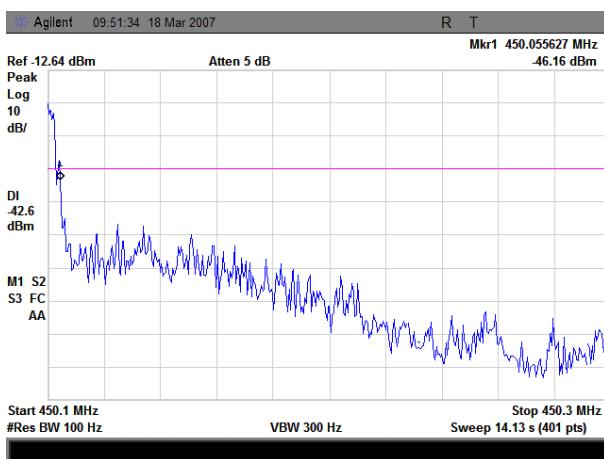


Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:09:31 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.4.2 Band edge emission test results at low carrier frequency, left side

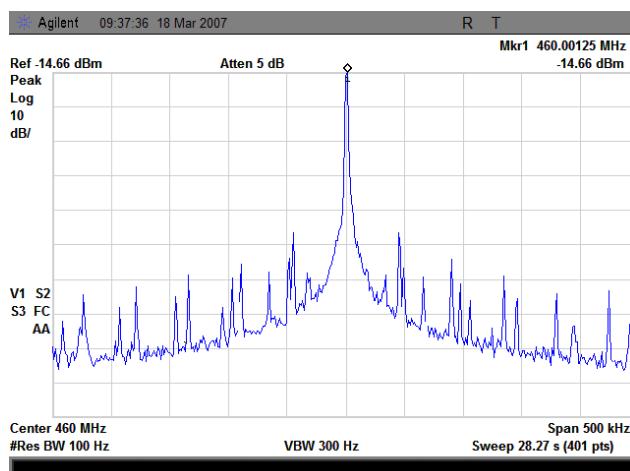


Plot 7.4.3 Band edge emission test results at low carrier frequency, right side



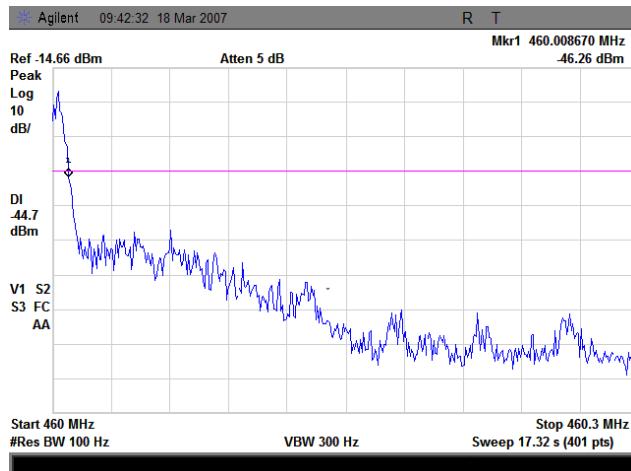
Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:09:31 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.4.4 Band edge emission test results at mid carrier frequency unmodulated reference

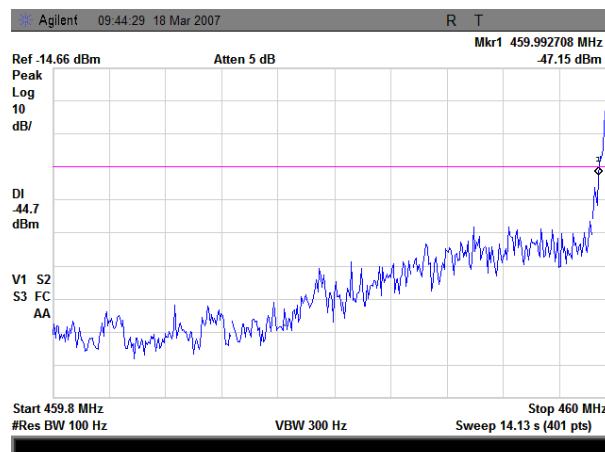


Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:09:31 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.4.5 Band edge emission test results at mid carrier frequency, right side

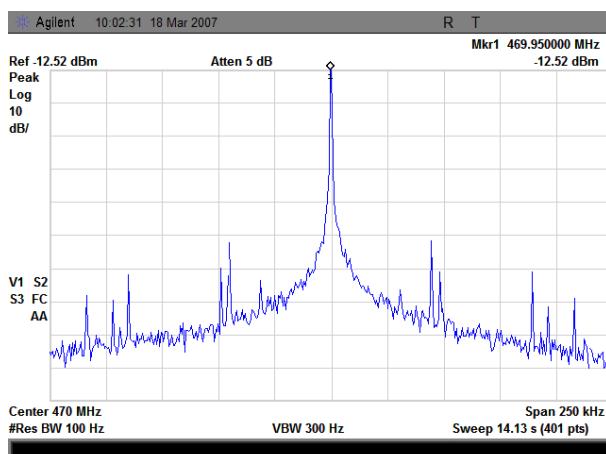


Plot 7.4.6 Band edge emission test results at mid carrier frequency, left side



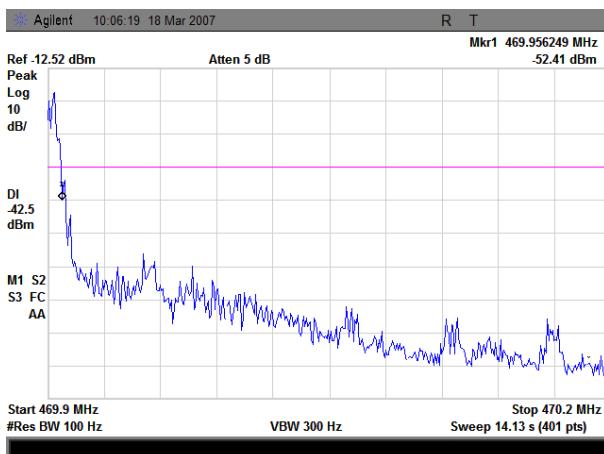
Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:09:31 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.4.7 Band edge emission test results at high carrier frequency unmodulated reference

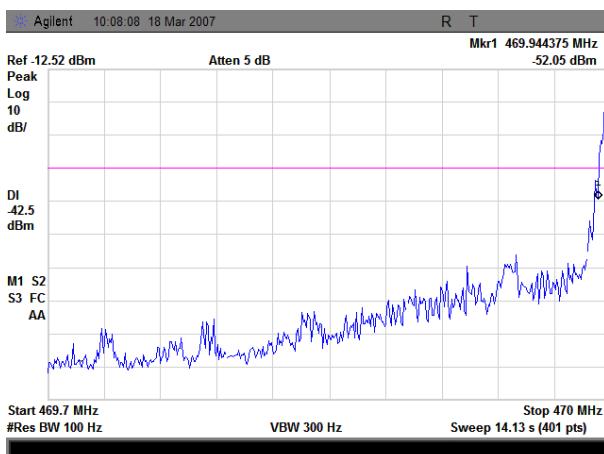


Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:09:31 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.4.8 Band edge emission test results at high carrier frequency, right side



Plot 7.4.9 Band edge emission test results at high carrier frequency, left side



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

7.5 Radiated spurious emission measurements

7.5.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc
0.009 – 10 th harmonic*	30

* - spurious emission limits do not apply to the in band emission within:

± 40 kHz from the carrier for equipment designed to operate with 25 kHz channel bandwidth
± 25 kHz from the carrier for equipment designed to operate with 12.5 kHz channel bandwidth
± 12.5 kHz from the carrier for equipment designed to operate with 6.25 kHz channel bandwidth

** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: $E = \sqrt{30 \times P \times 1.64} / r$, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

7.5.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and the performance check was conducted.

7.5.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.5.2.3 The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

7.5.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.5.3.1 The EUT was set up as shown in Figure 7.5.2, energized and the performance check was conducted.

7.5.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.5.3.3 The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Figure 7.5.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

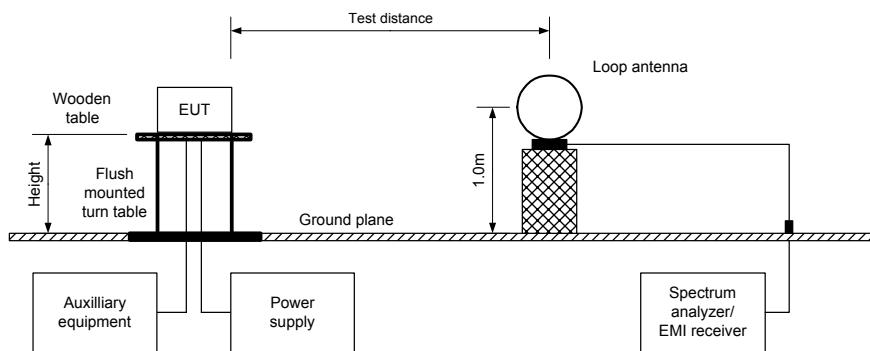
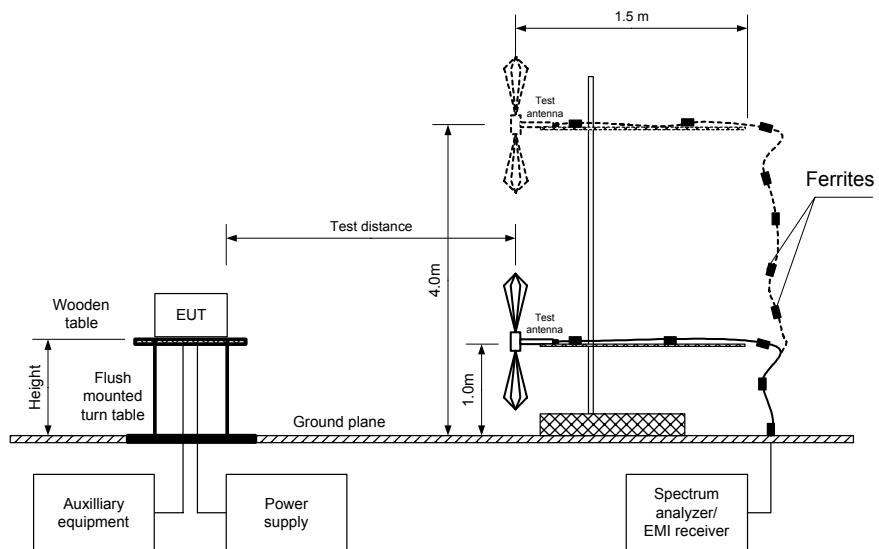


Figure 7.5.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance		Verdict: PASS
Date & Time:	3/25/2007 3:11:18 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Table 7.5.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Anechoic chamber / OATS
 EUT HEIGHT: 0.8 m
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)
 MODULATION: FSK
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
Low carrier frequency MHz							
900.10	63.98	90.46	-26.48	120	V	1	0
1350.15	63.38	90.46	-27.08	1000	V	1	15
1800.20	59.26	90.46	-31.20	1000	V	1.2	9
2250.25	52.9	90.46	-37.56	1000	V	1.2	355
2700.30	58.38	90.46	-32.08	1000	V	1.2	0
3150.35	58.15	90.46	-32.31	1000	V	1.2	12
3600.40	71.17	90.46	-19.29	1000	V	1.2	10
4050.45	64.18	90.46	-26.28	1000	V	1.2	0
4500.50	58.68	90.46	-31.78	1000	V	1.2	358
Mid carrier frequency MHz							
920.00	62.47	90.31	-27.84	120	V	1	0
1380.00	57.13	90.31	-33.18	1000	V	1	15
1840.00	57.84	90.31	-32.47	1000	V	1.2	9
2300.00	57.66	90.31	-32.65	1000	V	1.2	355
2760.00	59.45	90.31	-30.86	1000	V	1.2	0
3220.00	65.08	90.31	-25.23	1000	V	1.2	12
3680.00	67.17	90.31	-23.14	1000	V	1.2	10
4140.00	68.11	90.31	-22.2	1000	V	1.2	0
4600.00	57.46	90.31	-32.85	1000	V	1.2	358
High carrier frequency MHz							
939.90	59.36	87.19	-27.83	1000	V	1	0
1409.85	57.23	87.19	-29.96	1000	V	1	15
1879.80	59	87.19	-28.19	1000	V	1.2	9
2349.75	48.38	87.19	-38.81	1000	V	1.2	355
2819.70	50.03	87.19	-37.16	1000	V	1.2	0
3289.65	57.86	87.19	-29.04	1000	V	1.2	12
3759.60	67.49	87.19	-19.70	1000	V	1.2	10
4229.55	53.73	87.19	-33.46	1000	V	1.2	0
4699.50	48.18	87.19	-39.01	1000	V	1.2	358

*- Margin = Field strength of spurious – calculated field strength limit.

**- EUT front panel refers to 0 degrees position of turntable.

Reference numbers of test equipment used

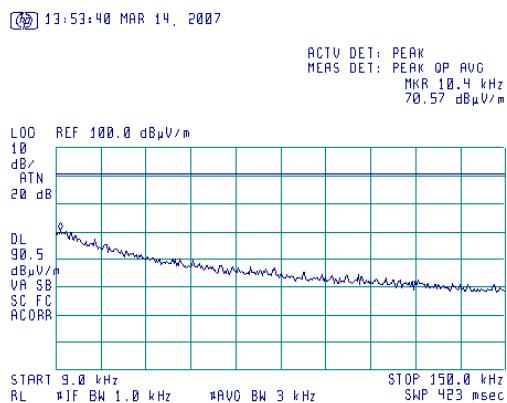
HL 0029	HL 0415	HL 0446	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594
HL 0604	HL 0661	HL 1424	HL 1947	HL 1984	HL 2009	HL 2259	HL 2400

Full description is given in Appendix A.

Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

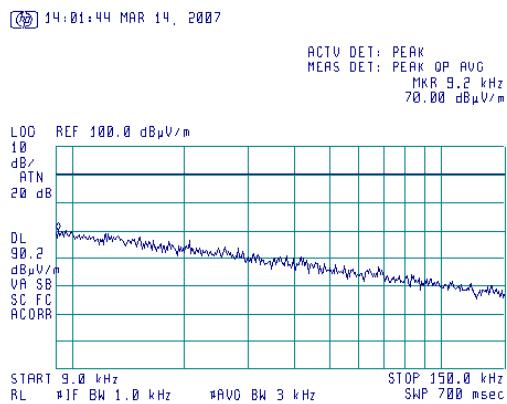
Plot 7.5.1 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Low
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.2 Radiated emission measurements in 9 - 150 kHz range

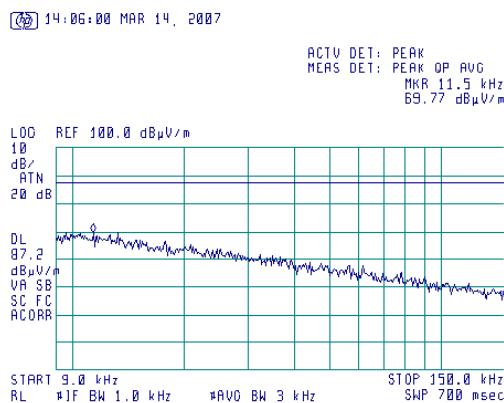
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Mid
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

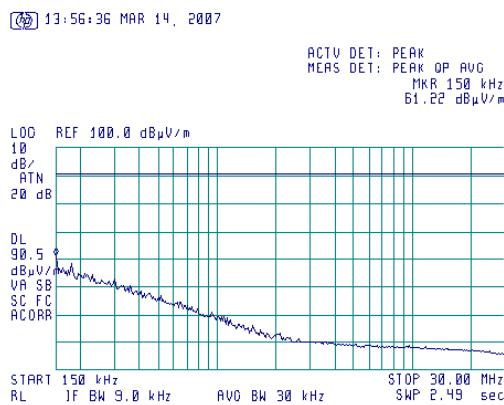
Plot 7.5.3 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: High
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.4 Radiated emission measurements in 0.15 - 30 MHz range

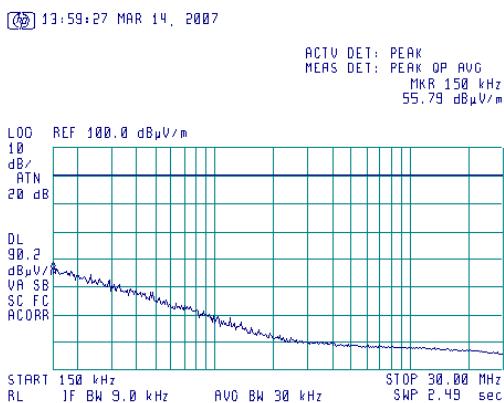
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Low
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

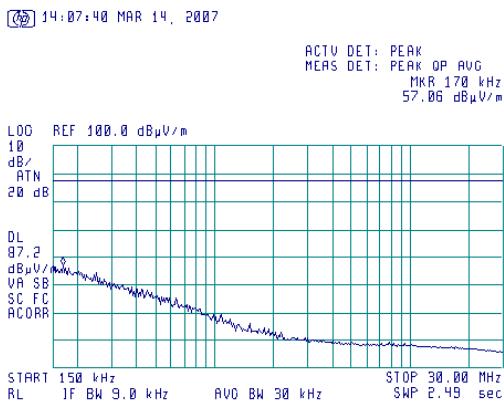
Plot 7.5.5 Radiated emission measurements in 0.15 - 30 MHz range

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Mid
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.6 Radiated emission measurements in 0.15 - 30 MHz range

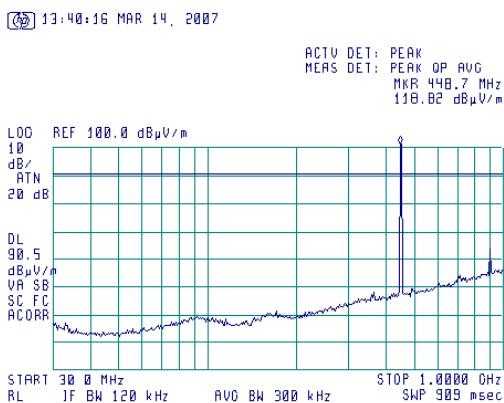
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: High
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

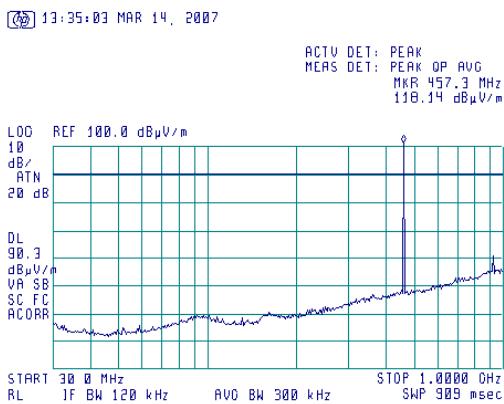
Plot 7.5.7 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Low
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.8 Radiated emission measurements in 30 - 1000 MHz range

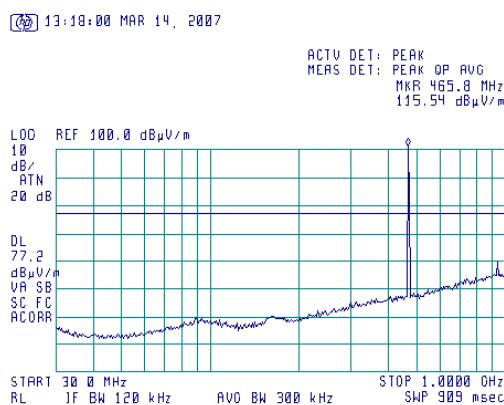
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Mid
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

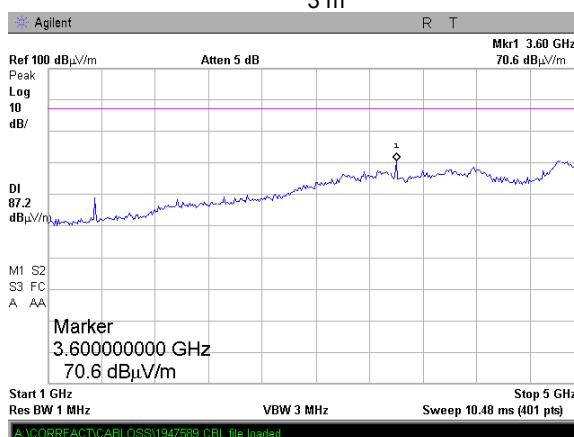
Plot 7.5.9 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: High
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.10 Radiated emission measurements in 1000 - 5000 MHz range

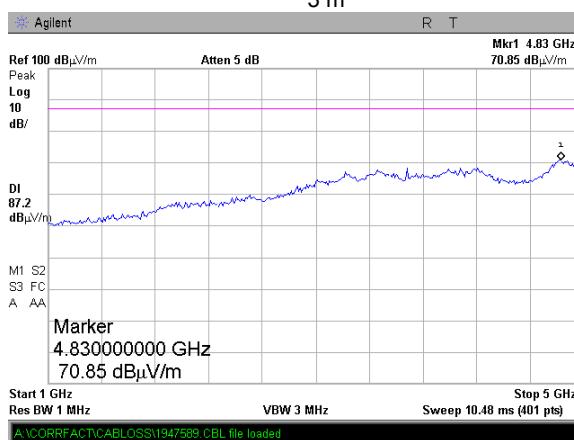
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Low
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:11:18 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.5.11 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Mid
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.12 Radiated emission measurements in 1000 – 5000 MHz range

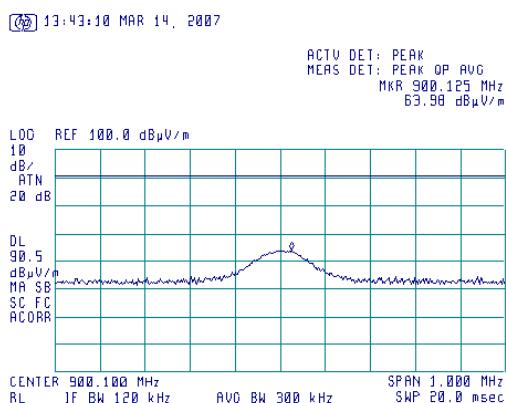
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: High
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

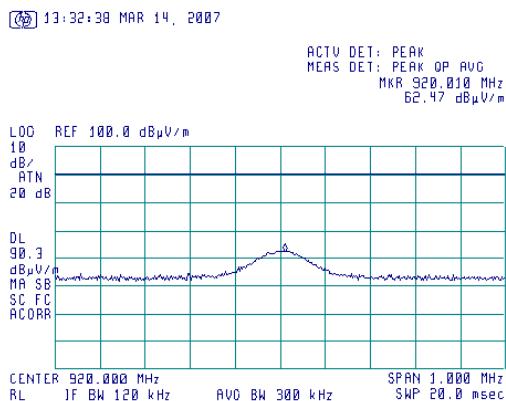
Plot 7.5.13 Radiated emission measurements at the 2nd harmonic

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Low
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.14 Radiated emission measurements at the 2nd harmonic

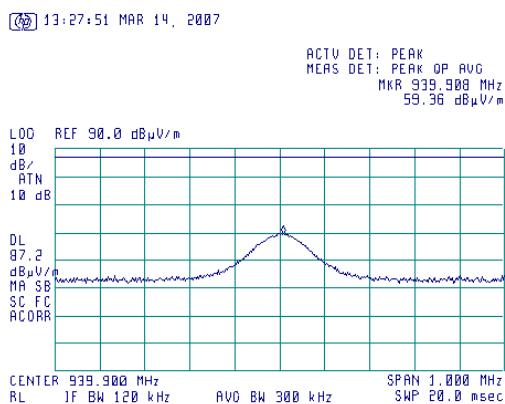
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Mid
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

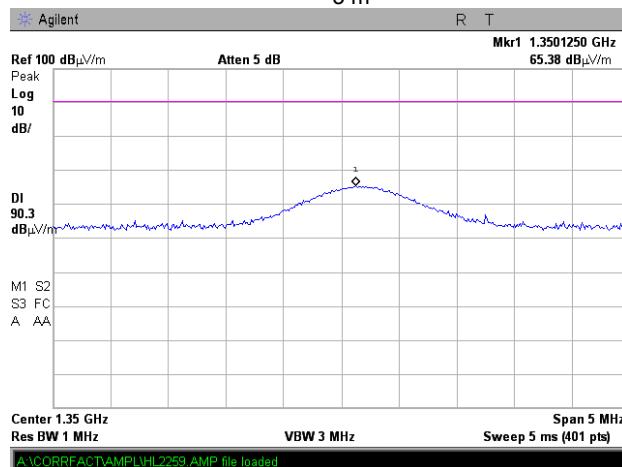
Plot 7.5.15 Radiated emission measurements at the 2nd harmonic

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: High
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.16 Radiated emission measurements at the 3rd harmonic

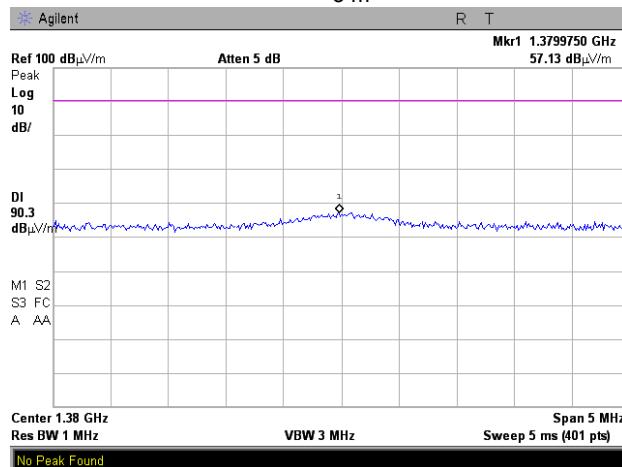
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Low
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:11:18 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

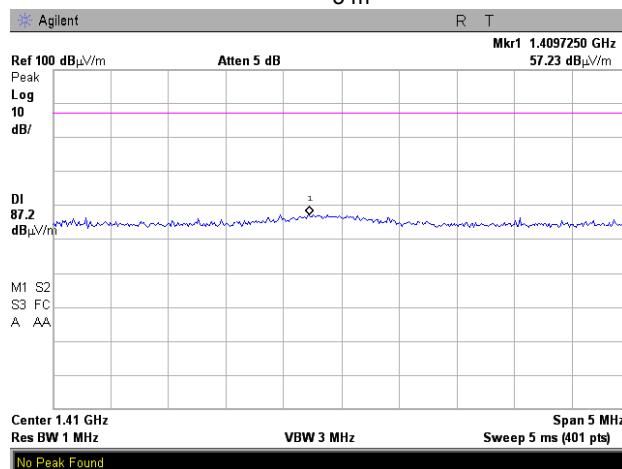
Plot 7.5.17 Radiated emission measurements at the 3rd harmonic

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Mid
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.18 Radiated emission measurements at the 3rd harmonic

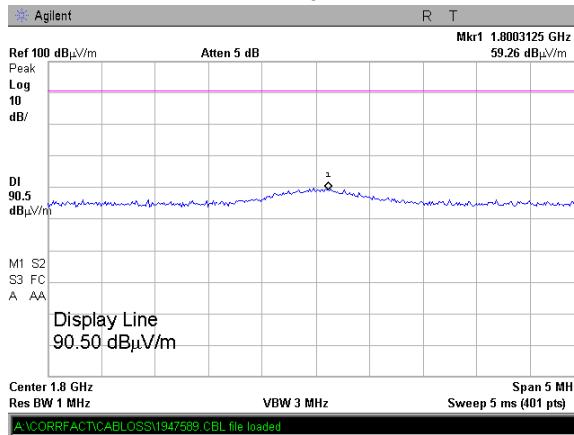
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: High
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

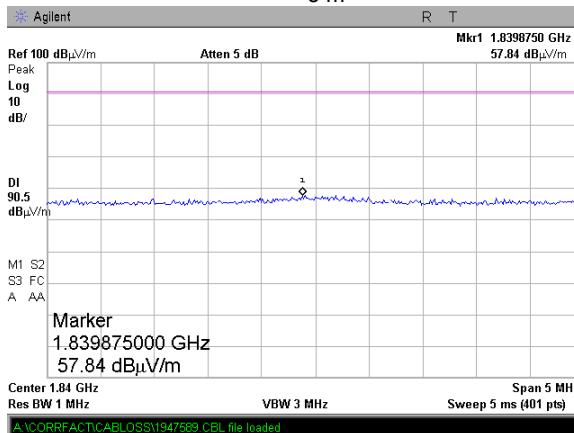
Plot 7.5.19 Radiated emission measurements at the 4th harmonic

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Low
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.20 Radiated emission measurements at the 4th harmonic

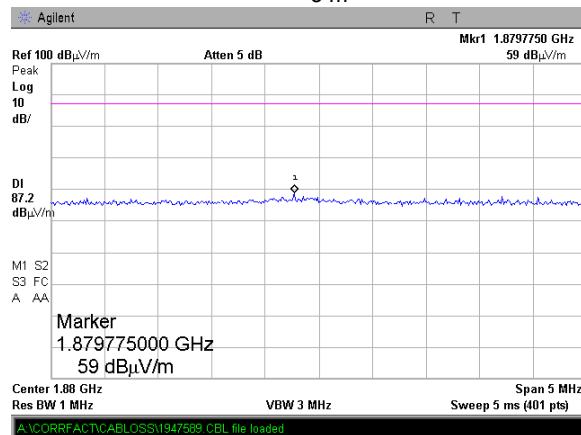
TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: Mid
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:11:18 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

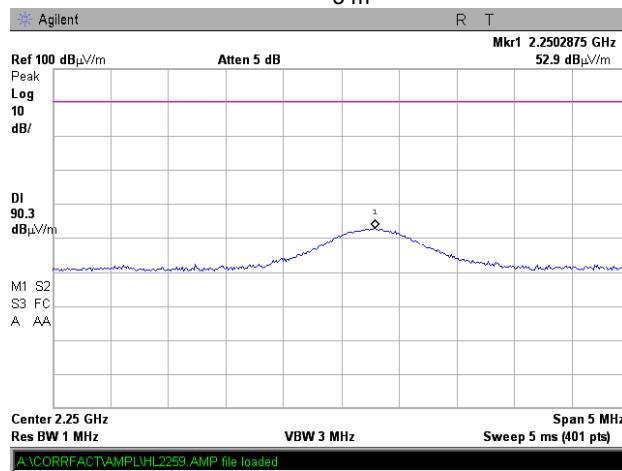
Plot 7.5.21 Radiated emission measurements at the 4th harmonic

TEST SITE: Semi anechoic chamber
 CARRIER FREQUENCY: High
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Plot 7.5.22 Radiated emission measurements at the 5th harmonic

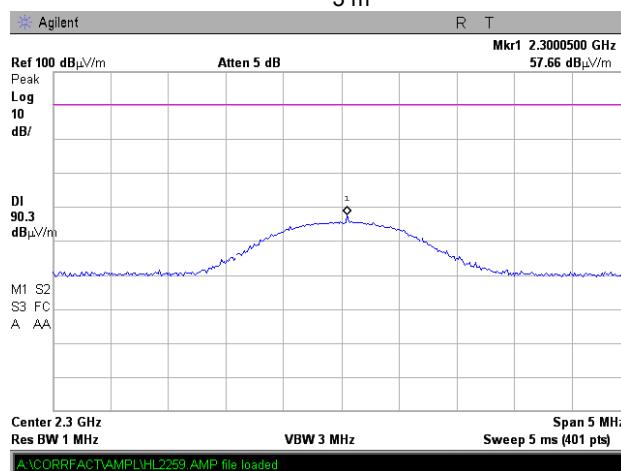
TEST SITE: OATS
 CARRIER FREQUENCY: Low
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

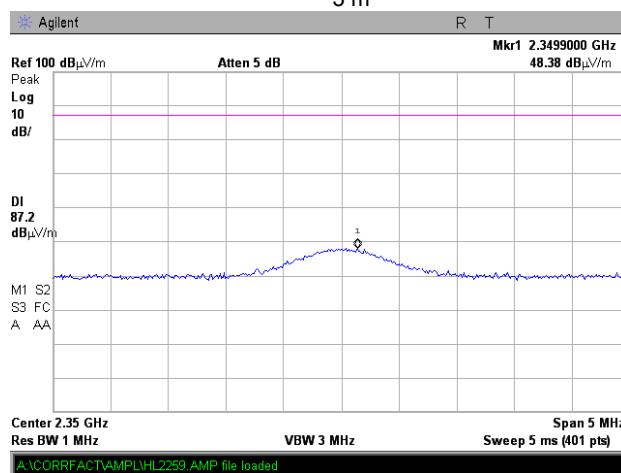
Plot 7.5.23 Radiated emission measurements at the 5th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.5.24 Radiated emission measurements at the 5th harmonic

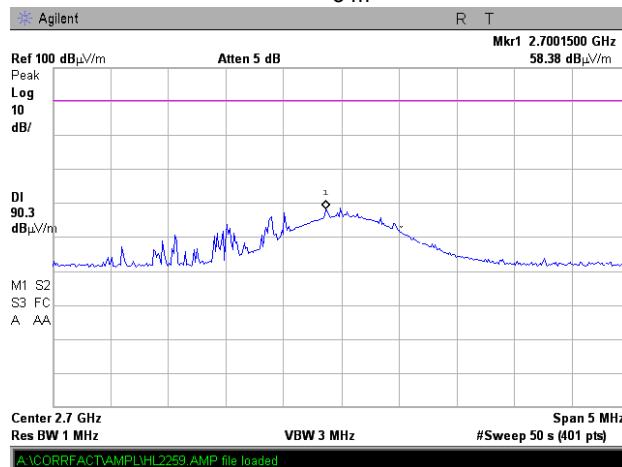
TEST SITE: OATS
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:11:18 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

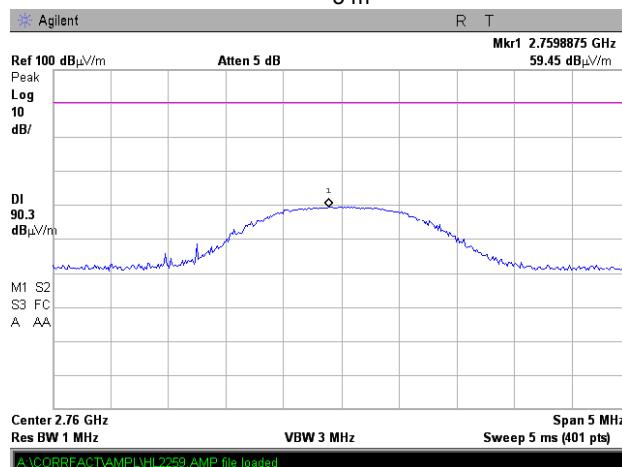
Plot 7.5.25 Radiated emission measurements at the 6th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.5.26 Radiated emission measurements at the 6th harmonic

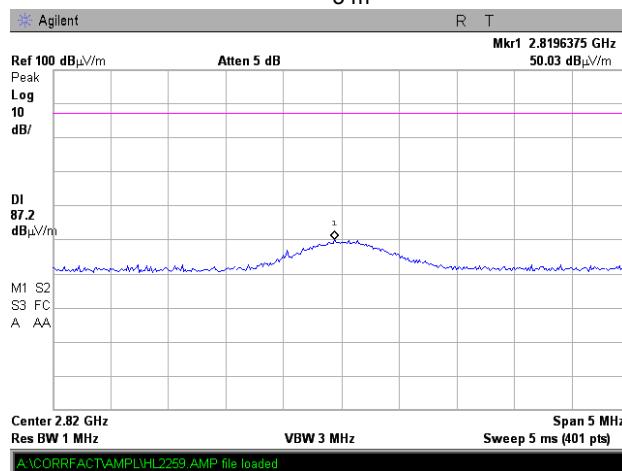
TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:11:18 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

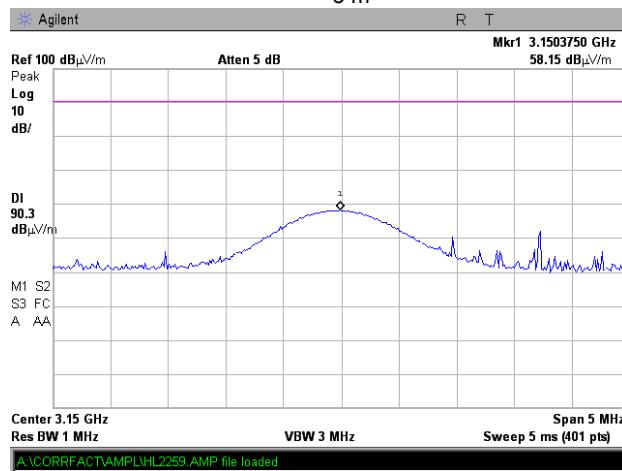
Plot 7.5.27 Radiated emission measurements at the 6th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.5.28 Radiated emission measurements at the 7th harmonic

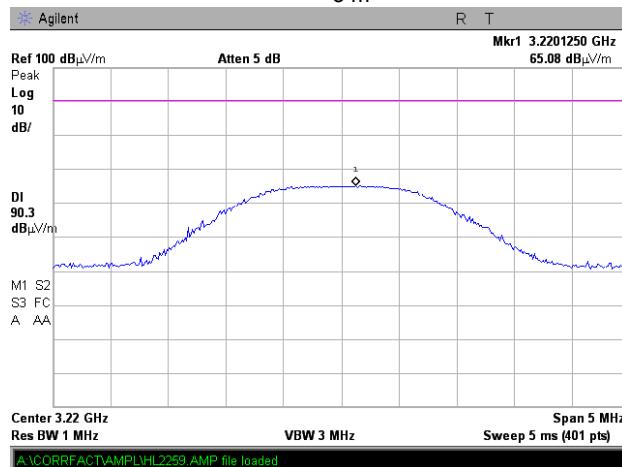
TEST SITE: OATS
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:11:18 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

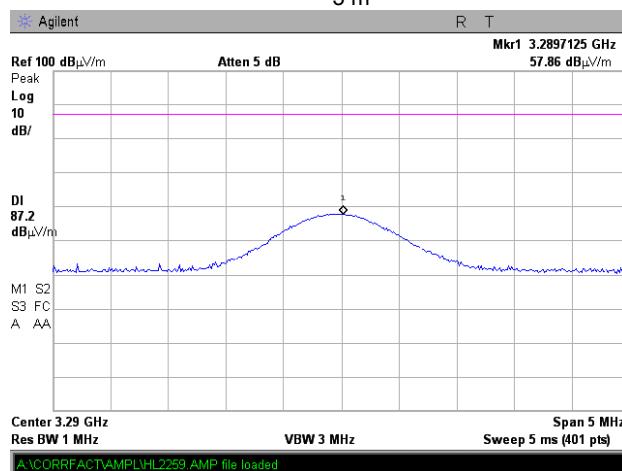
Plot 7.5.29 Radiated emission measurements at the 7th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.5.30 Radiated emission measurements at the 7th harmonic

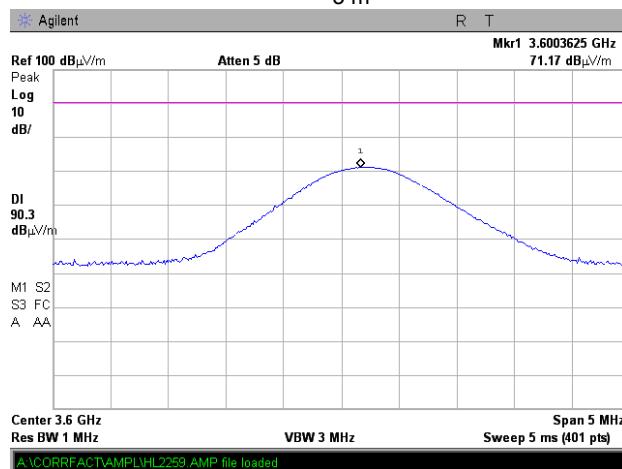
TEST SITE: OATS
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance		
Date & Time:	3/25/2007 3:11:18 PM		
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

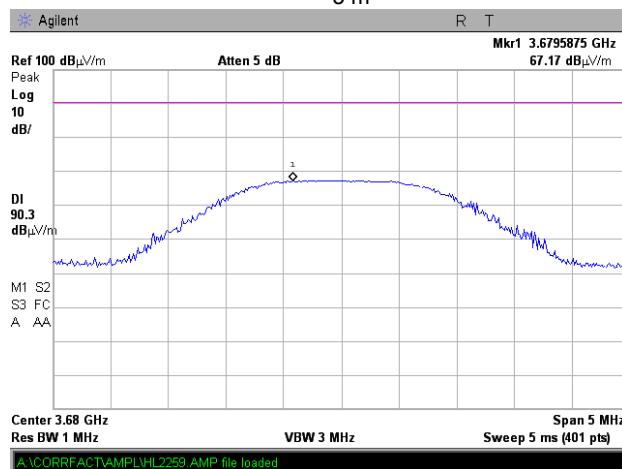
Plot 7.5.31 Radiated emission measurements at the 8th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.5.32 Radiated emission measurements at the 8th harmonic

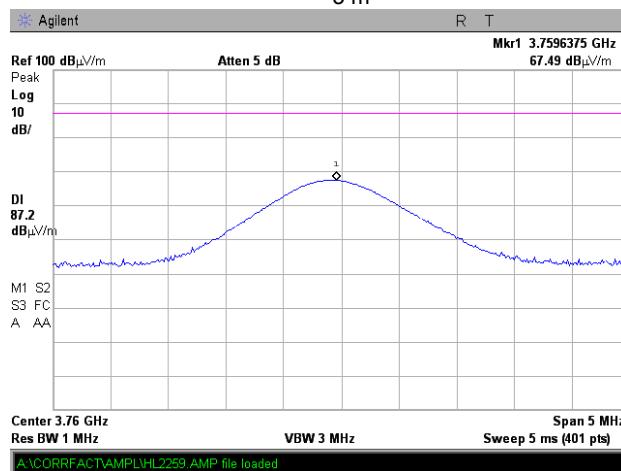
TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

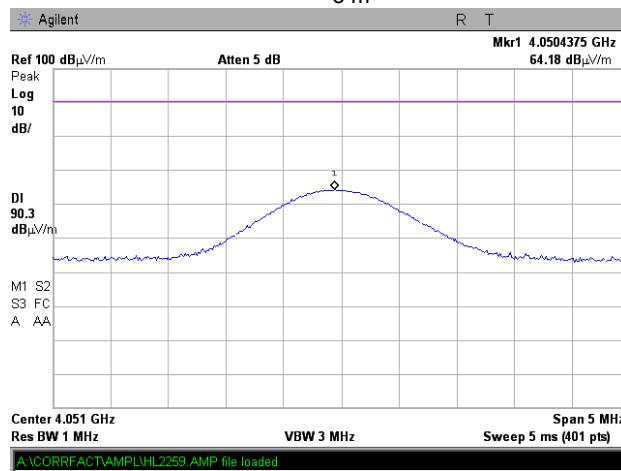
Plot 7.5.33 Radiated emission measurements at the 8th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.5.34 Radiated emission measurements at the 9th harmonic

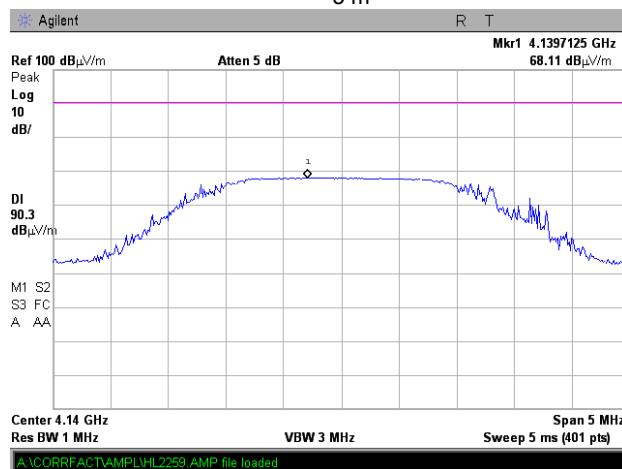
TEST SITE: OATS
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

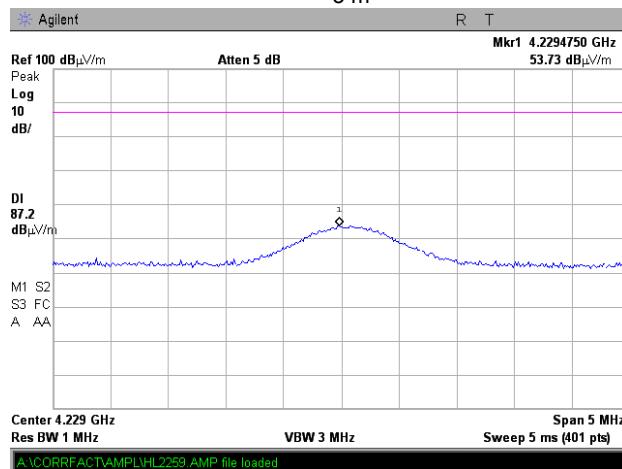
Plot 7.5.35 Radiated emission measurements at the 9th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.5.36 Radiated emission measurements at the 9th harmonic

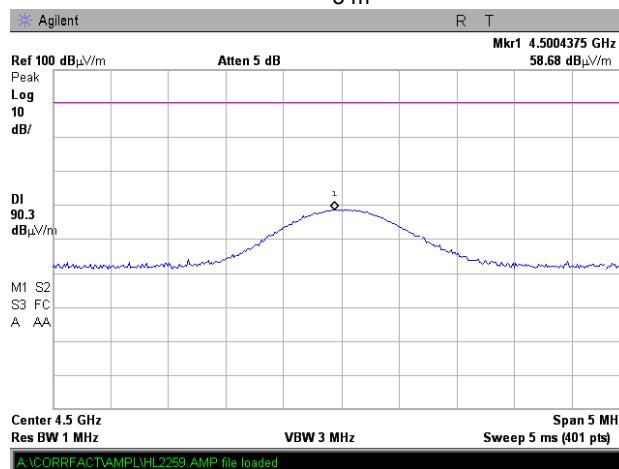
TEST SITE: OATS
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

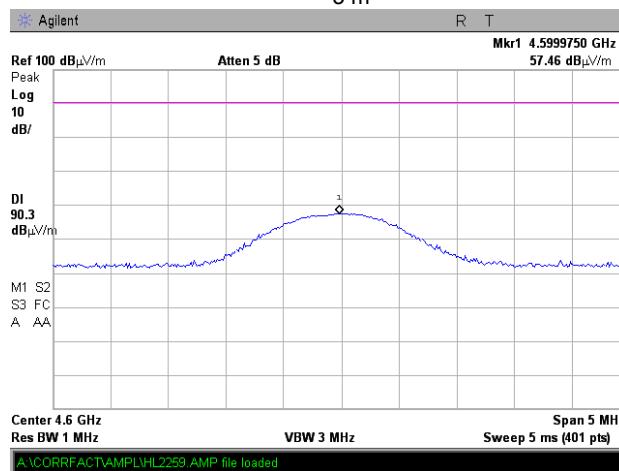
Plot 7.5.37 Radiated emission measurements at the 10th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.5.38 Radiated emission measurements at the 10th harmonic

TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	
Date & Time:	3/25/2007 3:11:18 PM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 44%	Power Supply: 3.6 V battery
Remarks:			

Plot 7.5.39 Radiated emission measurements at the 10th harmonic

TEST SITE:

OATS

CARRIER FREQUENCY:

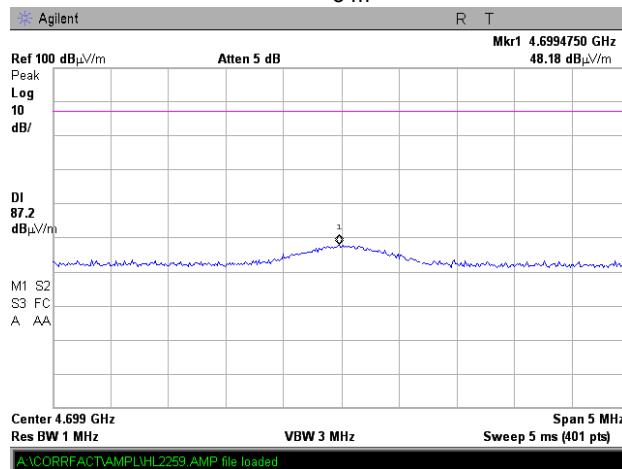
High

ANTENNA POLARIZATION:

Vertical & Horizontal

TEST DISTANCE:

3 m



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance		Verdict:
Date & Time:	3/22/2007 9:18:22 AM		PASS
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 48%	Power Supply: 3.6 V battery
Remarks:			

8 Emission tests according to 47CFR part 15 subpart B requirements

8.1 Radiated emission measurements

8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.1.1.

Table 8.1.1 Radiated emission test limits

Frequency, MHz	Class B limit, dB(μ V/m)		Class A limit, dB(μ V/m)	
	10 m distance	3 m distance	10 m distance	3 m distance
30 - 88	29.5*	40.0	39.0	49.5*
88 - 216	33.0*	43.5	43.5	54.0*
216 - 960	35.5*	46.0	46.4	56.9*
Above 960	43.5*	54.0	49.5	60.0*

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $\text{Lim}_{S2} = \text{Lim}_{S1} + 20 \log (S_1/S_2)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

8.1.2 Test procedure for measurements in semi-anechoic chamber

8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and the performance check was conducted.

8.1.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

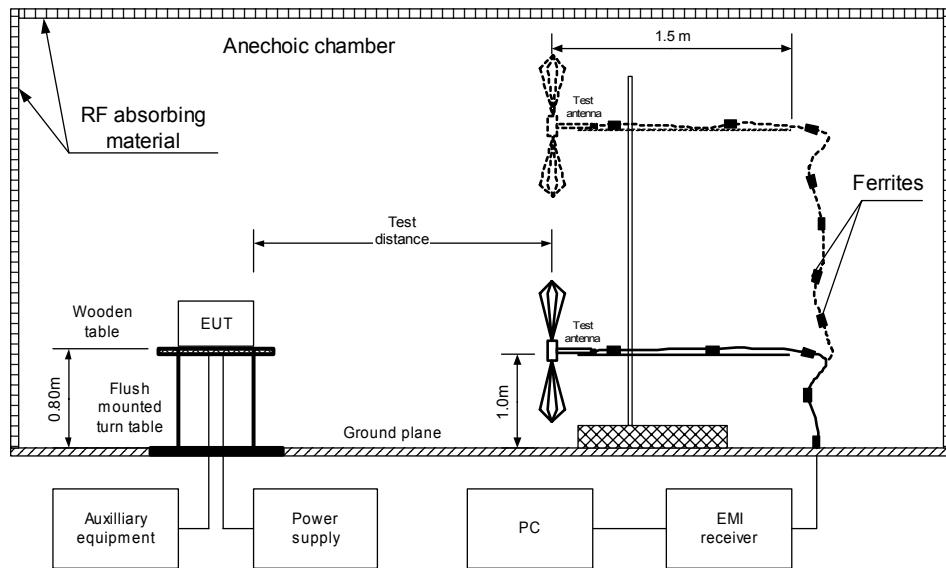
8.1.2.3 The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.



HERMON LABORATORIES

Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance		Verdict:
Date & Time:	3/22/2007 9:18:22 AM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 48%	Power Supply: 3.6 V battery
Remarks:			

Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance		Verdict:
Date & Time:	3/22/2007 9:18:22 AM		PASS
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 48%	Power Supply: 3.6 V battery
Remarks:			

Table 8.1.2 Radiated emission test results

EUT SET UP:

TABLE-TOP

LIMIT:

Class B

EUT OPERATING MODE:

Receive / Stand-by

TEST SITE:

SEMI ANECHOIC CHAMBER

TEST DISTANCE:

3 m

DETECTORS USED:

PEAK / QUASI-PEAK

FREQUENCY RANGE:

30 MHz – 1000 MHz

RESOLUTION BANDWIDTH:

120 kHz

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
No emissions were found								

TEST SITE:

SEMI ANECHOIC CHAMBER

TEST DISTANCE:

3 m

DETECTORS USED:

PEAK / AVERAGE

FREQUENCY RANGE:

1000 MHz – 2000 MHz

RESOLUTION BANDWIDTH:

1000 kHz

Frequency, MHz	Peak emission, dB(µV/m)	Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
No emissions were found								

*- Margin = Measured emission - specification limit.

**- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

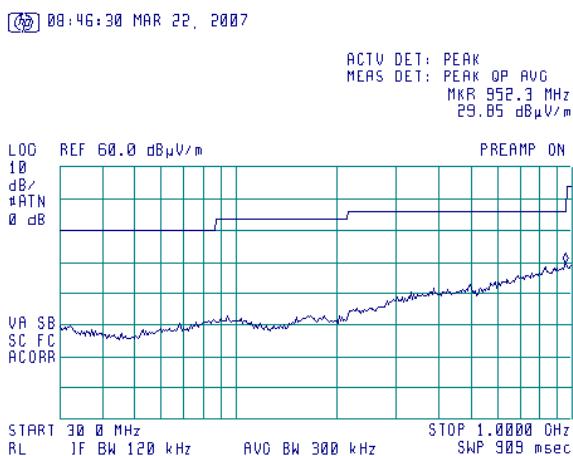
HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604	HL 2009
HL 2432							

Full description is given in Appendix A.

Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	3/22/2007 9:18:22 AM	PASS	
Temperature: 21°C	Air Pressure: 1022 hPa	Relative Humidity: 48%	Power Supply: 3.6 V battery
Remarks:			

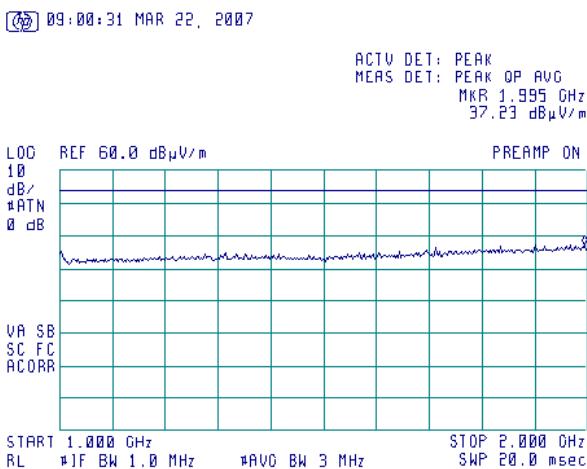
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical and horizontal antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by



Plot 8.1.2 Radiated emission measurements above 1000 MHz, vertical antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.*	Due Cal.*
0029	Antenna, Dipole, Tunable, 200 - 500 MHz	Electro-Metrics	TDS-25/30-1	297	29-Jan-07	29-Jan-08
0034	Antenna, Log Periodic, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	1988	10-Jan-07	10-Jan-08
0415	Cable, Coax, RF, RG-214	HL	CC-3	056	02-Dec-06	02-Dec-07
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	28-Jun-06	28-Jun-07
0465	Anechoic Chamber 9(L) x 6.5(W) x 5.5(H) m	HL	AC - 1	023	23-Aug-05	23-Aug-08
0493	Oven temperature -45...175 deg C	Thermotron	S-1.2 Mini-Max	14016	08-Mar-07	08-Mar-08
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	26-Sep-06	26-Sep-07
0589	Cable Coaxial, GORE A2P01POL118, 2.3 m	HL	GORE-3	176	02-Dec-06	02-Dec-07
0592	Position Controller	HL	L2-SR3000 (HL CRL-3)	100	18-May-06	18-May-07
0593	Antenna Mast, 1-4 m Pneumatic	Madgesh	AM-F1	101	02-Feb-07	02-Feb-08
0594	Turn Table FOR ANECHOIC CHAMBER flush mount d=1.2 m Pneumatic	HL	TT-WDC1	102	26-Jan-07	26-Jan-08
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	10-Jan-07	10-Jan-08
0661	Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm	Hewlett Packard	83640B	3614A002 66	14-Sep-06	14-Sep-07
0758	Power supply, dual, 36 V, 1 A	Horizon Electronics	DHR 36-1	5361231	26-Jun-06	26-Jun-07
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies	8564EC	3946A002 19	30-Aug-06	30-Aug-07
1947	Cable 18GHz, 6.5 m, blue	Rhophase Microwave Limited	NPS-1803A-6500-NPS	T4974	17-Oct-06	17-Oct-07
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	03-Mar-07	03-Mar-08
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	02-Dec-06	02-Dec-07
2259	Amplifier Low Noise 2-20 GHz	Sophia Wireless	LNA0220-C	0223	05-Nov-06	05-Nov-07
2400	Cable 40GHz, 1.5 m, green	Rhophase Microwave Limited	KPS-1503A-1500-KPS	X2946	20-Jun-06	20-Jun-07
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	03-Mar-07	03-Mar-08
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	11-Feb-07	11-Feb-08
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	10-Apr-06	10-Apr-07

* The tests were completed in March 2007. Above mentioned equipment calibration was valid at the moment of the testing.

10 APPENDIX B Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47) and by Industry Canada for electromagnetic emissions (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, telecommunications, environmental, safety standards, and by AMTAC (UK) for safety of medical devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01) and approved by Israel Ministry of environmental protection, radiation hazards department (Permit number 1158).

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11 APPENDIX C Specification references

47CFR part 90: 2006	Private land mobile radio services
47CFR part 1: 2006	Practice and procedure
47CFR part 2: 2006	Frequency allocations and radio treaty matters; general rules and regulations
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 2003	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.
ANSI/TIA/EIA-603-A:2001	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

12 APPENDIX D Test equipment correction factors

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, serial number 1011, HL 0604

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

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
EMC Test Systems, model 3115, serial no: 9911-5964, HL 1984

Frequency, MHz	Antenna gain, dBi	Antenna factor. dB(1/m)
1000.0	5.8	24.5
1500.0	9.0	24.8
2000.0	8.6	27.7
2500.0	9.5	28.7
3000.0	8.9	30.8
3500.0	8.2	32.9
4000.0	9.6	32.7
4500.0	11.2	32.1
5000.0	10.6	33.6
5500.0	9.8	35.3
6000.0	10.1	35.7
6500.0	10.7	35.8
7000.0	10.9	36.2
7500.0	10.5	37.2
8000.0	11.1	37.2
8500.0	10.8	38.1
9000.0	10.7	38.6
9500.0	11.5	38.3
10000.0	11.8	38.4
10500.0	12.3	38.3
11000.0	12.3	38.8
11500.0	11.5	39.9
12000.0	12.2	39.6
12500.0	12.6	39.5
13000.0	12.0	40.5
13500.0	11.7	41.1
14000.0	11.7	41.5
14500.0	12.7	40.8
15000.0	14.2	39.5
15500.0	16.0	38.1
16000.0	16.2	38.1
16500.0	14.5	40.1
17000.0	12.2	42.6
17500.0	9.7	45.4
18000.0	6.6	48.7

Antenna factor 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 horn antenna
Model 3115, serial number: 00027177, HL2432

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

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(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, 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		
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 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 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

13 APPENDIX E Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	±8%
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz ± 13.9 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Unintentional radiator tests	
Radiated emissions at 3 m measuring distance	
Horizontal polarization	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB
Vertical polarization	Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AVRG	average (detector)
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
dB(µA)	decibel referred to one microampere
DC	direct current
DTS	digital transmission system
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
Mbps	Mega bit per second
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
µs	microsecond
NA	not applicable
OATS	open area test site
Ω	Ohm
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt