



HERMON LABORATORIES



Electrical

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

# TEST REPORT

ACCORDING TO: FCC CFR 47 PART 90 SUBPART I and PART 15 SUBPART B

FOR:

**Motorola Communication  
Israel Ltd.**

**Termination unit**

**Model: Piccolo-XR**

**F4614A**

**FCC ID:AZ489FT4871**

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 subpart I requirements .....	8
7.1	Peak output power test .....	8
7.2	Occupied bandwidth test .....	20
7.3	Frequency stability test .....	24
7.4	Transient frequency behaviour test .....	26
7.5	Band edge emission .....	32
7.6	Spurious emissions at RF antenna connector test .....	37
7.7	Radiated spurious emission measurements .....	38
7.8	Radiated emission measurements .....	38
7.9	Spurious emissions at RF antenna connector .....	38
8	APPENDIX A Test equipment and ancillaries used for tests .....	38
9	APPENDIX B Measurement uncertainties .....	38
10	APPENDIX C Test facility description .....	38
11	APPENDIX D Specification references .....	38
12	APPENDIX E Abbreviations and acronyms .....	38
13	APPENDIX F Test equipment correction factors .....	38

## 1 Applicant information

**Client name:** Motorola Communication Israel Ltd.  
**Address:** 3 Kremenetski street, P.O.B. 25016, 67899 Tel Aviv, Israel  
**Telephone:** +972 3565 8888  
**Fax:** +972 5762 8847  
**E-mail:** Tomer.Azov@motorola.com  
**Contact name:** Mr. Tomer Azov

## 2 Equipment under test attributes

**Product name:** Termination unit of Distributed I/O system  
**Product type:** Piccolo-XR  
**Model(s):** F4614A  
**Serial Number:** 870SEL1390 (4DI/4DO)  
**Receipt date** 7/15/2004 9:56:00 AM

## 3 Manufacturer information

**Manufacturer name:** Motorola Communication Israel Ltd.  
**Address:** 3 Kremenetski street, P.O.B. 25016, 67899 Tel Aviv, Israel  
**Telephone:** +972 3565 8888  
**Fax:** +972 5762 8847  
**E-Mail:** Tomer.Azov@motorola.com  
**Contact name:** Mr. Tomer Azov

## 4 Test details

**Project ID:** 16001  
**Location:** Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel  
**Test started:** 7/15/2004  
**Test completed:** 8/22/2004  
**Test specification(s):** 47CFR part 90, §§90.217(b), part 15 §15.109  
**Test suite:** FCC\_90\_BS\_with\_RF\_connector\_below\_120mW (7/15/2004 12:12:42 AM, modified)

## 5 Tests summary

Test	Status
<b>Transmitter characteristics</b>	
Section 90.205, Maximum output power	Pass
Section 90.209, Occupied bandwidth	Pass
Section 90.213, Frequency stability	Pass
Section 90.214, Transient frequency behaviour	Pass
Section 90.217, Band edge emission	Pass
Section 90.217, Conducted spurious emissions	Pass
Section 90.217, Radiated spurious emissions	Pass
Section 2.1091, RF radiation exposure evaluation	Pass
<b>Unintentional emissions</b>	
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	Pass

Testing was completed against all relevant requirements of the test standard. The 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
<b>Tested by:</b>	Mr. Michael Lerman, test engineer	August 22, 2004	
<b>Reviewed by:</b>	Mrs. M. Cherniavsky, certification engineer	September 8, 2004	
	Mr. M. Nikishin, EMC group leader	September 9, 2004	
<b>Approved by:</b>	Mr. A. Usoskin, C.E.O.	September 12, 2004	



## 6 EUT description

### 6.1 General information

The EUT, Piccolo-XR, is a portable device which is most commonly used in the fixed installations enclosed with an indoor plastic housing. The EUT is powered from 6 V external battery.

The EUT has 5 options for input/output configuration:

- 1 digital dry contact input / 1 output for solenoid control;
- 2 digital dry contact inputs / 2 outputs for solenoid control;
- 4 digital dry contact inputs / 4 outputs for solenoid control;
- 7 digital dry contact inputs / 1 output for solenoid control;
- 8 digital dry contact inputs.

The EUT option providing 4 digital dry contact inputs / 4 outputs for solenoid control was tested in full; radiated spurious emission and radiated emission tests were repeated in 8 digital dry contact inputs configuration.

### 6.2 Ports and lines

Port type	Port description	Connected		Connector type	Qty.	Cable type	Cable length	Indoor / outdoor
		From	To					
Power	6 VDC	EUT	Power supply	D-type 26 pin	1	Unshielded	1.0 m	Outdoor
Control	Input	EUT	Open circuit					
Control	Output	EUT	Solenoids					
Control	Auxiliary input	EUT	Open circuit					
Signal	Communication	EUT	PIU					
GND	PE	EUT	PE					
						AWG 18	0.5 m	Outdoor

### 6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Piccolo interface unit	Motorola	PIU	870SEL1430
PC	AST	2500C	337200005890
Monitor	CTX	1785GM	OP3-54401206
Keyboard	IBM	KB-9910	1S37L2528000 7146A
Mouse	Microsoft	1.3A	5099327-3

### 6.4 Operating frequencies

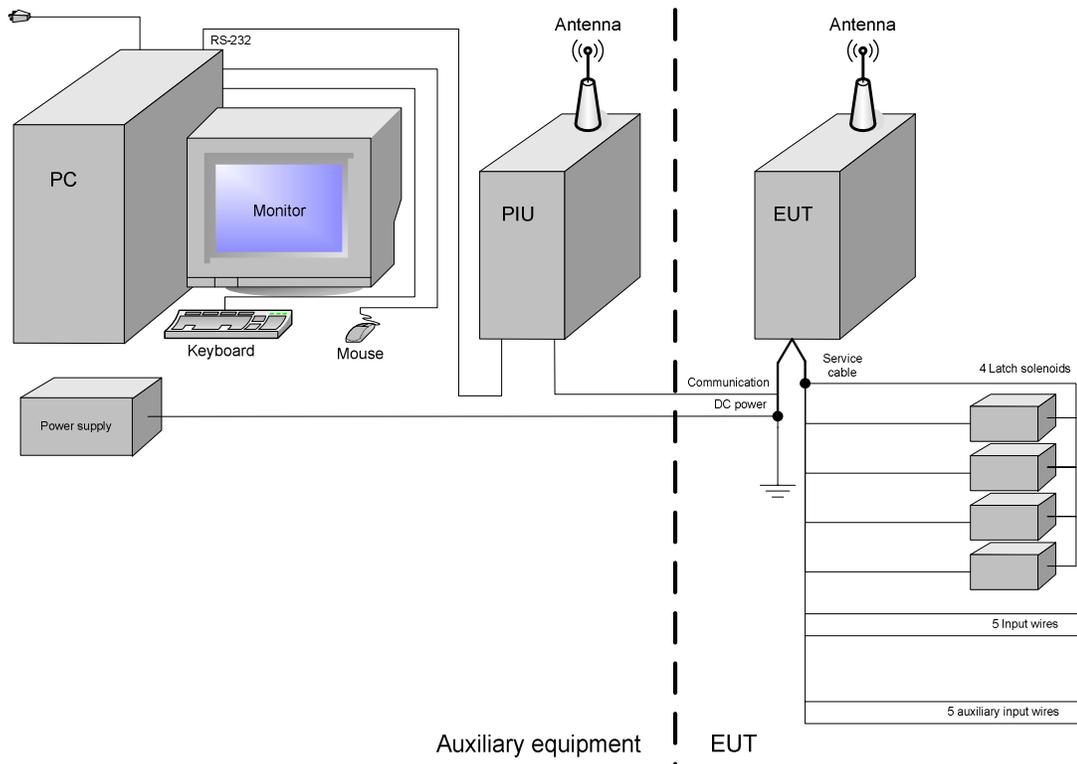
Source	Frequency, MHz	
Clock	8.0	16.8
Receiver LO	405.15 – 425.15	
Transmitter	450.0 – 470.0	

### 6.5 Changes made in the EUT

No changes were implemented.



## 6.6 Test configuration





## 6.7 Transmitter characteristics

<b>Type of equipment</b>			
<input checked="" type="checkbox"/>	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)		
<b>Intended use</b>		<b>Condition of use</b>	
	fixed	Always at a distance more than 2 m from all people	
	mobile	Always at a distance more than 20 cm from all people	
<input checked="" type="checkbox"/>	portable	May operate at a distance closer than 20 cm to human body	
<b>Assigned frequency range</b>		450 - 470 MHz	
<b>Operating frequency range</b>		450 - 470 MHz	
<b>RF channel spacing</b>		12.5 kHz	
<b>Maximum rated output power</b>		At transmitter 50 $\Omega$ RF output connector	20 dBm
<b>Is transmitter output power variable?</b>			
	No		
<input checked="" type="checkbox"/>	Yes	continuous variable	
		<input checked="" type="checkbox"/>	stepped variable with stepsize
			10 dB
			minimum RF power
			10 dBm
			maximum RF power
			20 dBm
<b>Antenna connection</b>			
	unique coupling	<input checked="" type="checkbox"/>	standard connector SMA type
			integral
			with temporary RF connector
			without temporary RF connector
<b>Antenna/s technical characteristics</b>			
Type	Manufacturer	Model number	Gain
External	Centurion Wireless Technologies, Inc.	EXC450SM	Unity
<b>Transmitter aggregate data rate/s</b>		1200 bps	
<b>Transmitter aggregate symbol (baud) rate/s</b>		600 symbols (Mbaud) per second	
<b>Type of modulation</b>		DPSK	
<b>Type of multiplexing</b>		NA	
<b>Modulating test signal (baseband)</b>		PRBS	
<b>Maximum transmitter duty cycle in normal use</b>		100%	
<b>Transmitter power source</b>			
	Battery	<b>Nominal rated voltage</b>	VDC
<input checked="" type="checkbox"/>	DC	<b>Nominal rated voltage</b>	6.0 VDC (4.8 – 7.8 V DC)
	AC mains	<b>Nominal rated voltage</b>	VAC
			Frequency
			Hz
<b>Common power source for transmitter and receiver</b>		<input checked="" type="checkbox"/>	yes
			no
<b>Emission designator</b>		5K10F2D	



<b>Test specification:</b> Section 90.205, Maximum output power			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/6/2004 10:42:41 AM			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

## 7 Transmitter tests according to 47CFR part 90 subpart I requirements

### 7.1 Peak output power test

#### 7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1. The test results are provided in Table 7.1.2 and associated plots.

Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Maximum peak output power	
	mW	dBm
450.0 – 470.0	120	20.8

#### 7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.1.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.1.2 and associated plots.

Figure 7.1.1 Peak output power test setup





<b>Test specification:</b>		<b>Section 90.205, Maximum output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE: 450 – 470 MHz  
DETECTOR USED: Peak  
RESOLUTION BANDWIDTH: 30 kHz  
VIDEO BANDWIDTH: 100 kHz  
MODULATION: FM  
MODULATING SIGNAL: PRBS  
BIT RATE: 1200 bps  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
<b>1DI – 1DO</b>							
450.0125	19.67	included	included	19.67	20.8	-1.13	Pass
460.0125	20.00	included	included	20.00	20.8	-0.80	Pass
469.9875	20.00	included	included	20.00	20.8	-0.80	Pass
<b>2DI – 2DO</b>							
450.0125	19.83	included	included	19.83	20.8	-0.97	Pass
460.0125	20.17	included	included	20.17	20.8	-0.63	Pass
469.9875	20.17	included	included	20.17	20.8	-0.63	Pass
<b>4DI – 4DO</b>							
450.0125	20.00	included	included	20.00	20.8	-0.80	Pass
460.0125	20.17	included	included	20.17	20.8	-0.63	Pass
469.9875	20.17	included	included	20.17	20.8	-0.63	Pass
<b>7DI – 1DO</b>							
450.0125	19.83	included	included	19.83	20.8	-0.97	Pass
460.0125	20.17	included	included	20.17	20.8	-0.63	Pass
469.9875	20.17	included	included	20.17	20.8	-0.63	Pass
<b>8DI – 0DO</b>							
450.0125	19.83	included	included	19.83	20.8	-0.97	Pass
460.0125	20.17	included	included	20.17	20.8	-0.63	Pass
469.9875	20.17	included	included	20.17	20.8	-0.63	Pass

## Reference numbers of test equipment used

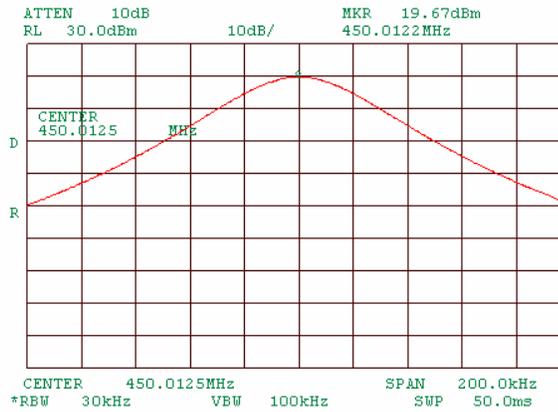
HL 1424	HL 2399	HL 2524				
---------	---------	---------	--	--	--	--

Full description is given in Appendix A.

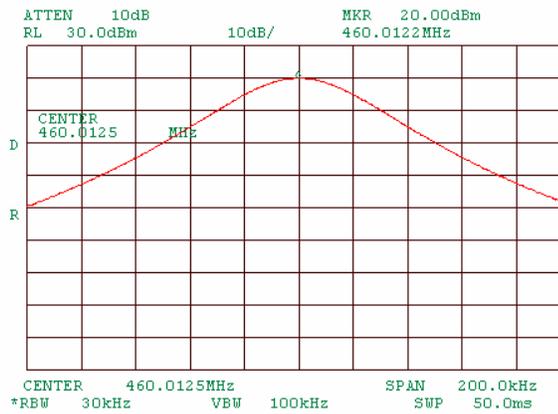


<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.1.1 Peak output power test results at low frequency, 1DI- 1D0



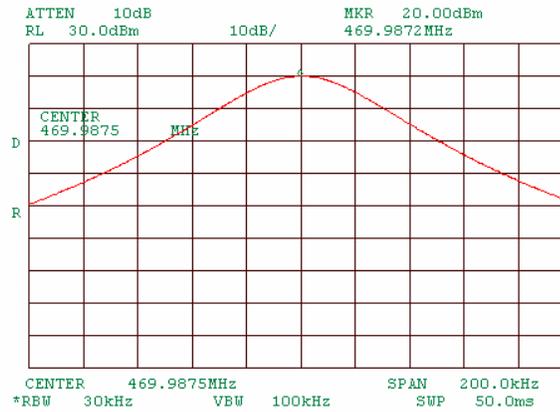
Plot 7.1.2 Peak output power test results at mid frequency, 1DI- 1D0





<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

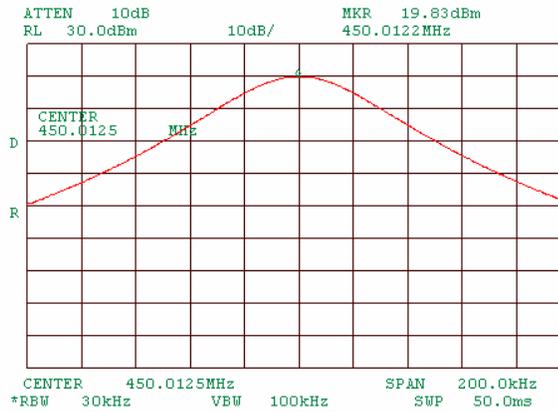
Plot 7.1.3 Peak output power test results at high frequency, 1DI- 1DO



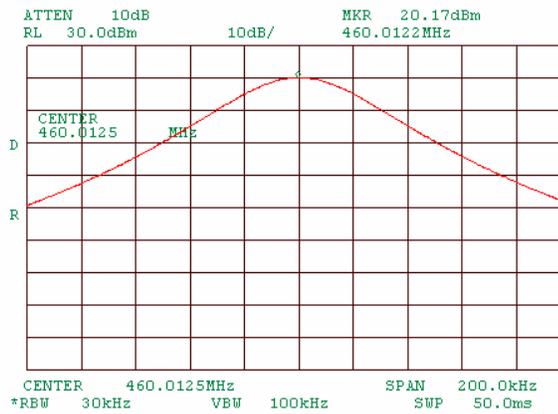


<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.1.4 Peak output power test results at low frequency, 2DI- 2DO



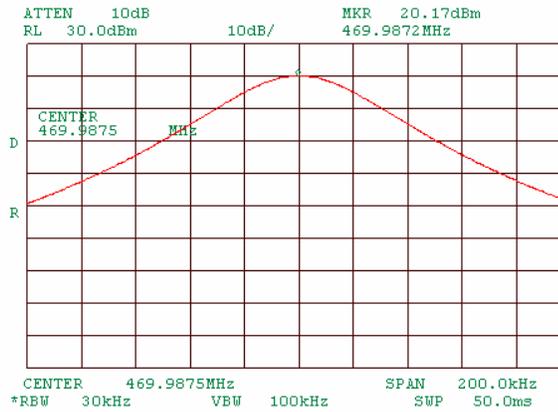
Plot 7.1.5 Peak output power test results at mid frequency, 2DI- 2DO





<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

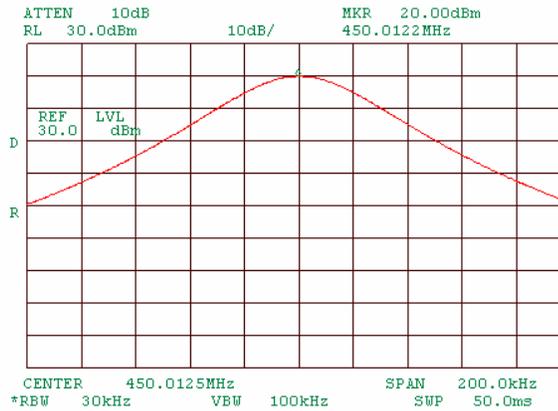
Plot 7.1.6 Peak output power test results at high frequency, 2DI- 2DO



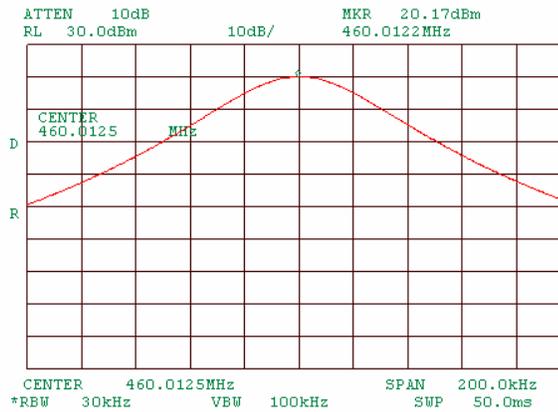


<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.1.7 Peak output power test results at low frequency, 4DI- 4DO



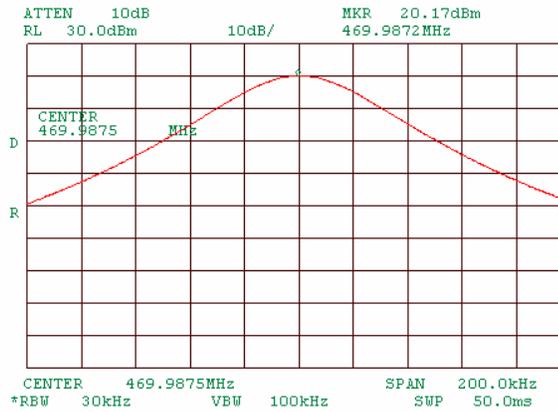
Plot 7.1.8 Peak output power test results at mid frequency, 4DI- 4DO





<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

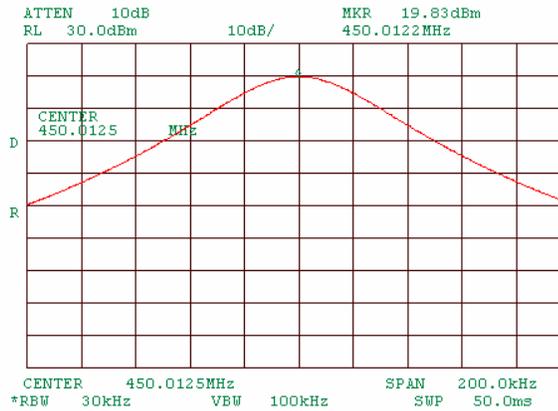
Plot 7.1.9 Peak output power test results at high frequency, 4DI- 4DO



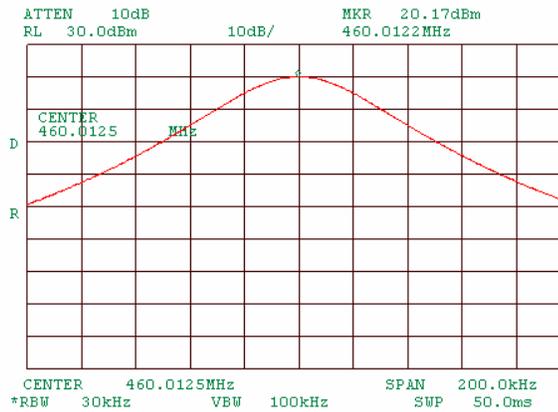


<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.1.10 Peak output power test results at low frequency, 7DI- 1D0



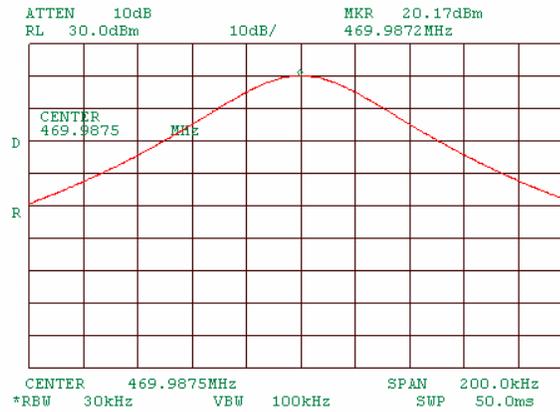
Plot 7.1.11 Peak output power test results at mid frequency, 7DI- 1D0





<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

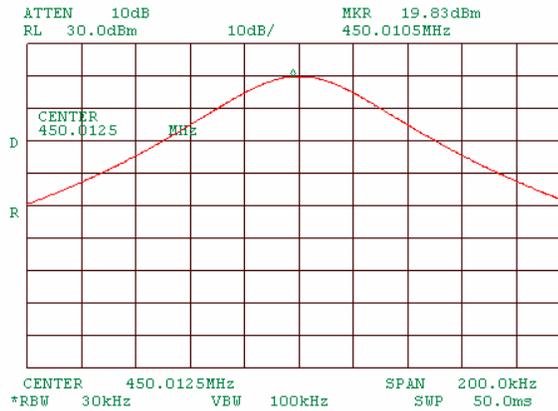
Plot 7.1.12 Peak output power test results at high frequency, 7DI- 1D0



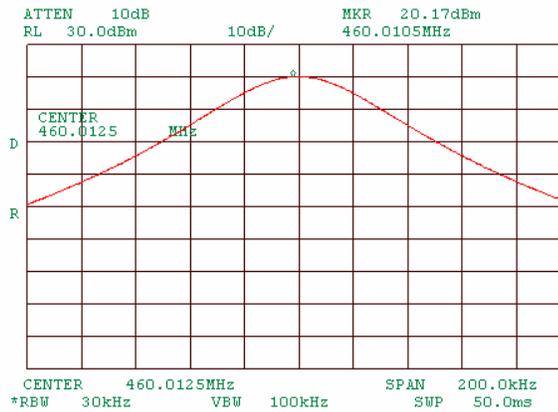


<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.1.13 Peak output power test results at low frequency, 8DI- 0DO



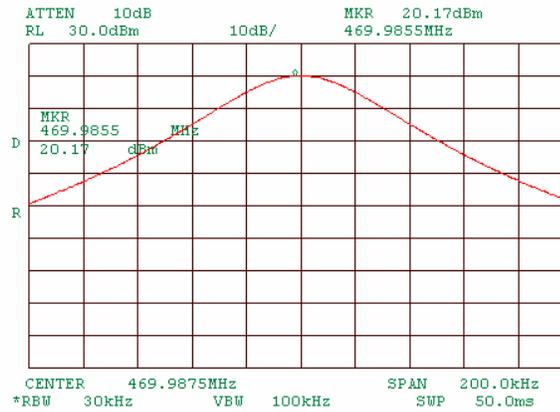
Plot 7.1.14 Peak output power test results at mid frequency, 8DI- 0DO





<b>Test specification:</b>	<b>Section 90.205, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:42:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.1.15 Peak output power test results at high frequency, 8DI- 0DO





<b>Test specification:</b> Section 90.209, Occupied bandwidth			
<b>Test procedure:</b> 47 CFR, Section 2.1049			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/6/2004 10:09:30 AM			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

## 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. The test results are provided in Table 7.2.2 and associated plots.

Table 7.2.1 Occupied bandwidth limits

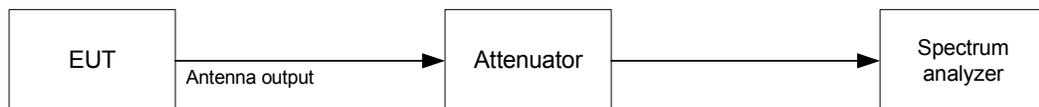
Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450 - 470	26	11.25

\* - Modulation envelope reference points provided in terms of attenuation below 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 unmodulated carrier and reference peak power level was measured.
- 7.2.2.3 The EUT was set to transmit modulated carrier.
- 7.2.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.2.2 and associated plot.

Figure 7.2.1 Occupied bandwidth test setup





<b>Test specification:</b>		<b>Section 90.209, Occupied bandwidth</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1049	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:09:30 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

**Table 7.2.2 Occupied bandwidth test results**

DETECTOR USED: Peak hold  
 RESOLUTION BANDWIDTH: 100 Hz  
 VIDEO BANDWIDTH: 300 Hz  
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc  
 MODULATION: FM  
 MODULATING SIGNAL: Pseudo random  
 BIT RATE: 1200 bps

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450.0125	5.00	11.25	-6.25	Pass
460.0125	5.03	11.25	-6.22	Pass
469.9875	5.03	11.25	-6.22	Pass

**Reference numbers of test equipment used**

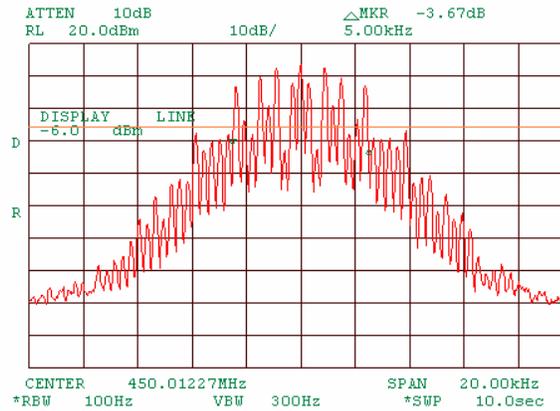
HL 1424	HL 2399	HL 2524				
---------	---------	---------	--	--	--	--

Full description is given in Appendix A.

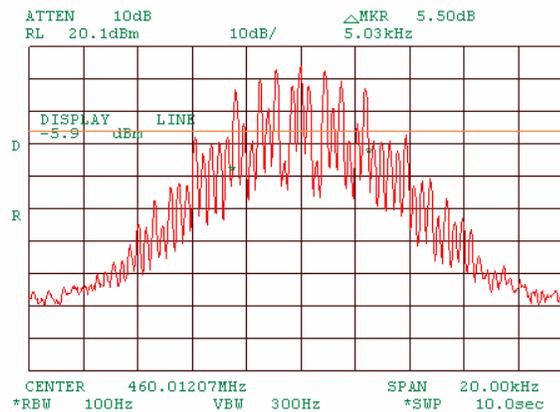


<b>Test specification:</b>	<b>Section 90.209, Occupied bandwidth</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1049		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	8/6/2004 10:09:30 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.2.1 Occupied bandwidth test result at low frequency



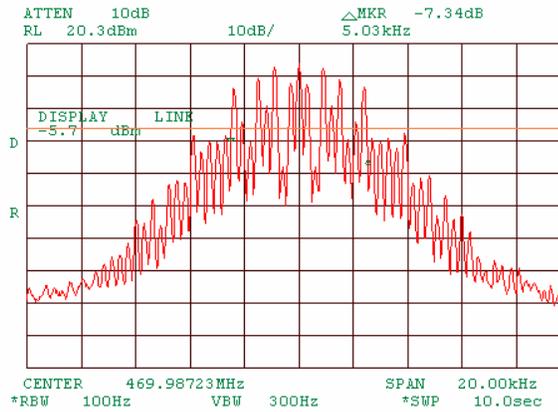
Plot 7.2.2 Occupied bandwidth test result at mid frequency





<b>Test specification:</b>	<b>Section 90.209, Occupied bandwidth</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1049		
<b>Test mode:</b>	Compliance	<b>Verdict:</b> PASS	
<b>Date &amp; Time:</b>	8/6/2004 10:09:30 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.2.3 Occupied bandwidth test result at high frequency





<b>Test specification:</b>	<b>Section 90.213, Frequency stability</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/22/2004 9:16:14 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1006 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

### 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. The test results are provided in Table 7.3.2.

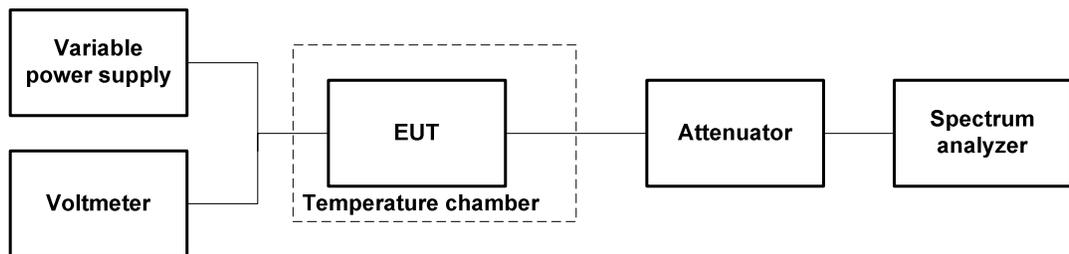
Table 7.3.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450.0125	1.5	675
460.0125		690
469.9875		705

#### 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





<b>Test specification:</b>		<b>Section 90.213, Frequency stability</b>			
<b>Test procedure:</b>		47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2			
<b>Test mode:</b>		Compliance		<b>Verdict:</b> PASS	
<b>Date &amp; Time:</b>		8/22/2004 9:16:14 AM			
<b>Temperature:</b> 24 °C		<b>Air Pressure:</b> 1006 hPa		<b>Relative Humidity:</b> 37 %	
<b>Power Supply:</b> 6 VDC		<b>Remarks:</b>			

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY: 450 – 470 MHz MHz  
 NOMINAL POWER VOLTAGE: 6 VDC  
 TEMPERATURE STABILIZATION PERIOD: 20 min  
 POWER DURING TEMPERATURE TRANSITION: Off  
 SPECTRUM ANALYZER MODE: Counter  
 RESOLUTION BANDWIDTH: 10 Hz  
 VIDEO BANDWIDTH: 30 Hz  
 MODULATION: Unmodulated

T, °C	Voltage, V	Frequency, MHz								Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1 <sup>st</sup> min	2 <sup>nd</sup> min	3 <sup>rd</sup> min	4 <sup>th</sup> min	5 <sup>th</sup> min	10 <sup>th</sup> min	Positive	Negative				
<b>Low frequency</b>														
-30	nominal	450.012520	450.012553	450.012617	450.012542	450.012581	450.012509	450.012498	271	0	675	-404	PASS	
-20	nominal	450.012427	NA	NA	NA	NA	NA	450.012458	178	0		-497	PASS	
-10	nominal	450.012413	NA	NA	NA	NA	NA	450.012376	141	0		-534	PASS	
0	nominal	450.012389	450.012387	450.012417	450.012330	450.012416	450.012394	450.012362	71	-16		-604	PASS	
10	nominal	450.012327	NA	NA	NA	NA	NA	450.012328	0	-24		-651	PASS	
20	+15%	450.012320	NA	NA	NA	NA	NA	450.012376	30	-26		-645	PASS	
20	nominal	450.012307	NA	NA	NA	NA	NA	450.012346*	7	-39		-675	PASS	
20	-15%	450.012073	NA	NA	NA	NA	NA	450.012350	4	-273		-402	PASS	
30	nominal	450.012376	450.012424	450.012450	450.012445	450.012451	450.012457	450.012439	111	0		-564	PASS	
40	nominal	450.012502	NA	NA	NA	NA	NA	450.012555	209	0		-466	PASS	
50	nominal	450.012556	NA	NA	NA	NA	NA	450.012585	239	0		-436	PASS	
<b>Mid frequency</b>														
-30	nominal	460.012322	460.012373	460.012343	460.012382	460.012392	460.012378	460.012318	0	0	690	-690	PASS	
-20	nominal	460.012317	NA	NA	NA	NA	NA	460.012256	20	0		-670	PASS	
-10	nominal	460.012265	NA	NA	NA	NA	NA	460.012207	85	0		-605	PASS	
0	nominal	460.012207	460.012206	460.012222	460.012221	460.012229	460.012220	460.012221	122	0		-568	PASS	
10	nominal	460.012240	NA	NA	NA	NA	NA	460.012278	68	0		-622	PASS	
20	+15%	460.012263	NA	NA	NA	NA	NA	460.012339	0	0		-690	PASS	
20	nominal	460.012310	NA	NA	NA	NA	NA	460.012351*	61	-53		-629	PASS	
20	-15%	460.012374	NA	NA	NA	NA	NA	460.012355	0	-3		-687	PASS	
30	nominal	460.012377	460.012419	460.012552	460.012453	460.012395	460.012418	460.012411	0	-25		-665	PASS	
40	nominal	460.012446	NA	NA	NA	NA	NA	460.012441	0	-72		-618	PASS	
50	nominal	460.012504	NA	NA	NA	NA	NA	460.012449	0	-98		-592	PASS	
<b>High frequency</b>														
-30	nominal	469.987296	469.987295	469.987245	469.987299	469.987297	469.987297	469.987304	0	-415	705	-290	PASS	
-20	nominal	469.987320	NA	NA	NA	NA	NA	469.987396	0	-408		-297	PASS	
-10	nominal	469.987337	NA	NA	NA	NA	NA	469.987451	0	-323		-382	PASS	
0	nominal	469.987423	469.987527	469.987413	469.987506	469.987528	469.987414	469.987464	0	-247		-458	PASS	
10	nominal	469.987442	NA	NA	NA	NA	NA	469.987527	0	-220		-485	PASS	
20	+15%	469.987473	NA	NA	NA	NA	NA	469.987597	0	-187		-518	PASS	
20	nominal	469.987533	NA	NA	NA	NA	NA	469.987660*	0	-128		-577	PASS	
20	-15%	469.987541	NA	NA	NA	NA	NA	469.987757	96	-119		-586	PASS	
30	nominal	469.987636	469.987748	469.987691	469.987600	469.987672	469.987640	469.987777	117	-61		-588	PASS	
40	nominal	469.987641	NA	NA	NA	NA	NA	469.987865	205	-19		-500	PASS	
50	nominal	469.987725	NA	NA	NA	NA	NA	469.987928	268	0		-437	PASS	

\* - Reference frequency

## Reference numbers of test equipment used

HL 0493	HL 0808	HL 2358	HL 2524			
---------	---------	---------	---------	--	--	--

Full description is given in Appendix A.



<b>Test specification:</b>	<b>Section 90.214, Transient frequency behaviour</b>		
<b>Test procedure:</b>	TIA/EIA-603-A, Section 2.2.19		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:30:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 39 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

## 7.4 Transient frequency behaviour test

### 7.4.1 General

This test was performed to measure carrier frequency drift as function of time during transmitter start up and shut down. Specification test limits are given in Table 7.4.1. The test results are provided in the associated plots.

**Table 7.4.1 Transient frequency limits**

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
25.0	± 25.0	5.0	t <sub>1</sub>
	± 12.5	20.0	t <sub>2</sub>
	± 25.0	5.0	t <sub>3</sub>
12.5	± 12.5	5.0	t <sub>1</sub>
	± 6.25	20.0	t <sub>2</sub>
	± 12.5	5.0	t <sub>3</sub>
6.25	± 6.25	5.0	t <sub>1</sub>
	± 3.125	20.0	t <sub>2</sub>
	± 6.25	5.0	t <sub>3</sub>

\* - t<sub>on</sub> is the instant when a 1 kHz test signal is completely suppressed;

t<sub>1</sub> is the time period immediately following t<sub>on</sub>;

t<sub>2</sub> is the time period immediately following t<sub>1</sub>;

t<sub>3</sub> is the time period from the instant when the transmitter is turned off until t<sub>off</sub>;

t<sub>off</sub> is the instant when the 1 kHz test signal starts to rise.

### 7.4.2 Test procedure

**7.4.2.1** The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

**7.4.2.2** The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 12.5 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

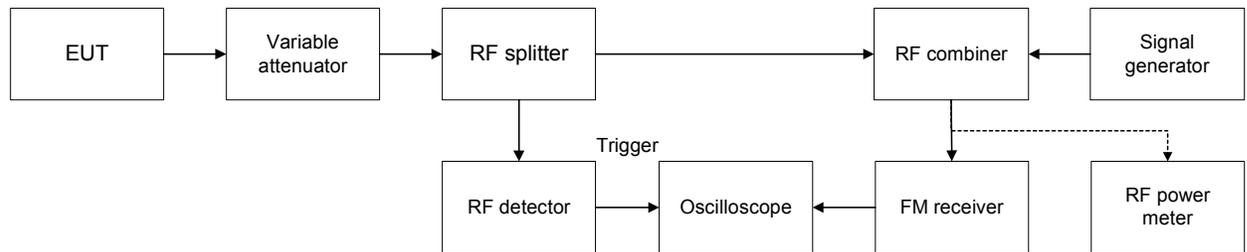
**7.4.2.3** The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

**7.4.2.4** The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.



<b>Test specification:</b>	<b>Section 90.214, Transient frequency behaviour</b>		
<b>Test procedure:</b>	TIA/EIA-603-A, Section 2.2.19		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:30:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 39 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Figure 7.4.1 Transient frequency test setup





<b>Test specification:</b>	<b>Section 90.214, Transient frequency behaviour</b>		
<b>Test procedure:</b>	TIA/EIA-603-A, Section 2.2.19		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	8/6/2004 10:30:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 39 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Table 7.4.2 Transient frequency behaviour test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
<b>Channel bandwidth 12.5 kHz</b>						
450.0125	t <sub>1</sub>	5.0	0.194	± 12.5	-12.300	Pass
	t <sub>2</sub>	20.0	0.000	± 6.25	-6.250	
	t <sub>3</sub>	5.0	7.460	± 12.5	-5.040	
460.0125	t <sub>1</sub>	5.0	0.125	± 12.5	-12.375	Pass
	t <sub>2</sub>	20.0	0.069	± 6.25	-6.180	
	t <sub>3</sub>	5.0	6.833	± 12.5	-5.667	
469.9875	t <sub>1</sub>	5.0	0.125	± 12.5	-12.375	Pass
	t <sub>2</sub>	20.0	0.319	± 6.25	-5.930	
	t <sub>3</sub>	5.0	8.681	± 12.5	-3.819	

**Reference numbers of test equipment used**

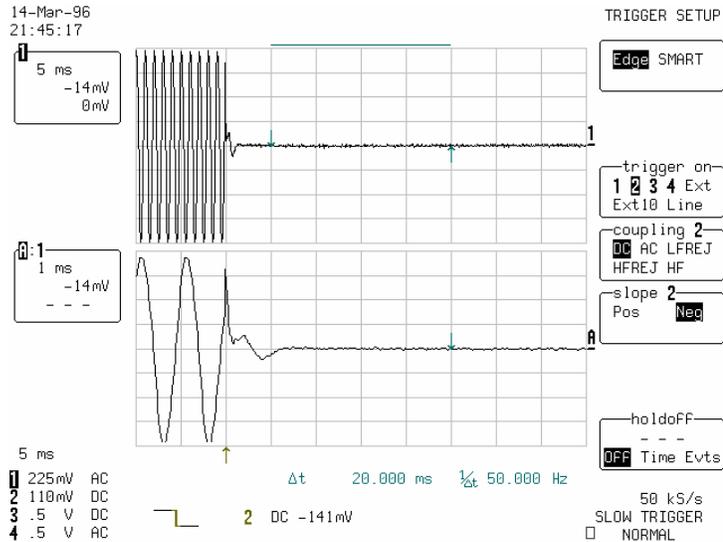
HL 0539	HL 0670	HL 0788	HL 0808	HL 1533	HL 1556	HL 1907	HL 2227
HL 2399							

Full description is given in Appendix A.

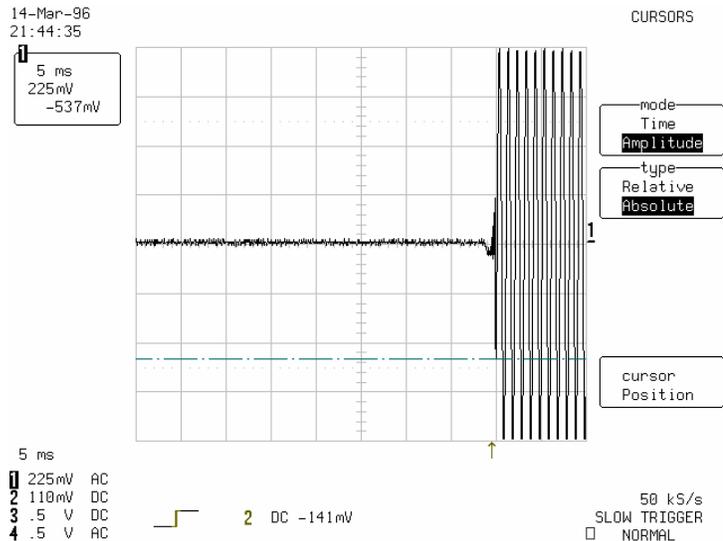


<b>Test specification:</b>	<b>Section 90.214, Transient frequency behaviour</b>		
<b>Test procedure:</b>	TIA/EIA-603-A, Section 2.2.19		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/6/2004 10:30:41 AM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 39 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.4.1 Transient frequency during power ON test results at low carrier frequency



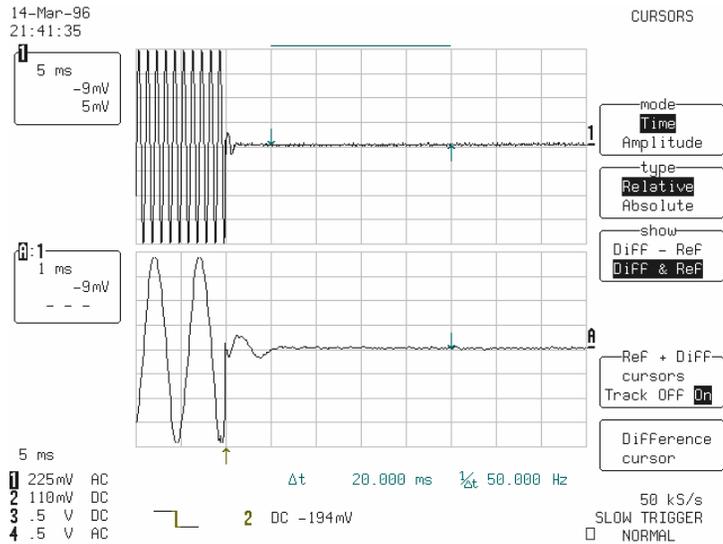
Plot 7.4.2 Transient frequency during power OFF test results at low carrier frequency



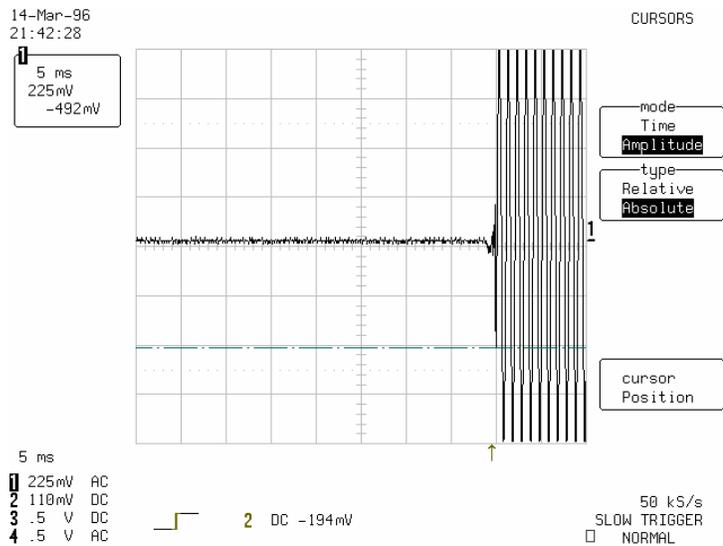


<b>Test specification:</b> Section 90.214, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-A, Section 2.2.19			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/6/2004 10:30:41 AM			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 39 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.4.3 Transient frequency during power ON test results at mid carrier frequency



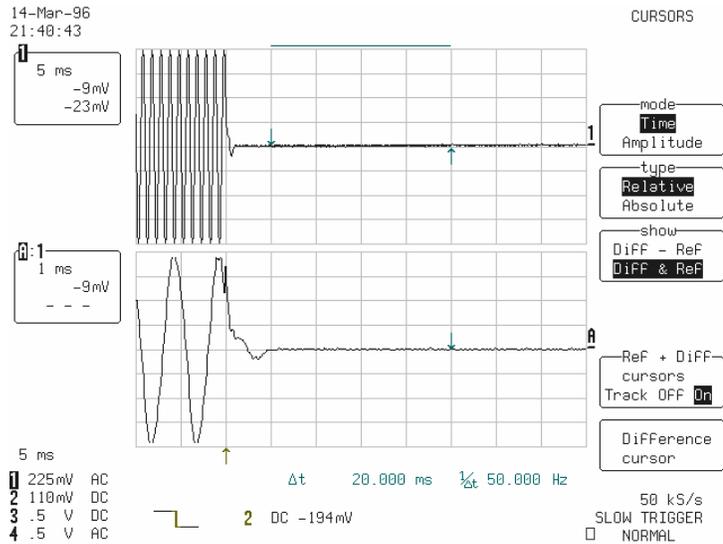
Plot 7.4.4 Transient frequency during power OFF test results at mid carrier frequency



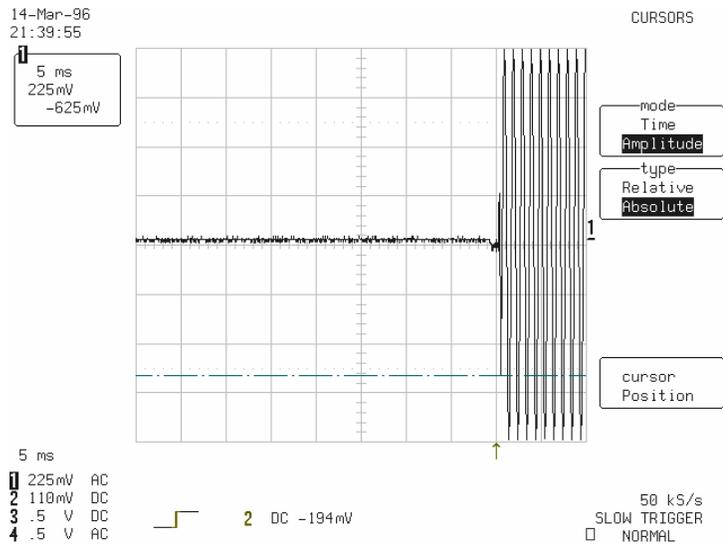


<b>Test specification:</b> Section 90.214, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-A, Section 2.2.19			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/6/2004 10:30:41 AM			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 39 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.4.5 Transient frequency during power ON test results at high carrier frequency



Plot 7.4.6 Transient frequency during power OFF test results at high carrier frequency





<b>Test specification:</b>	<b>Section 90.217, Band edge emission</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/22/2004 9:21:42 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

## 7.5 Band edge emission

### 7.5.1 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 7.5.1.

Table 7.5.1 Band edge emission limits

Band edge frequency shift from carrier, kHz	Channel bandwidth, kHz	Attenuation below carrier, dBc
± 40.0	25.0	30
± 25.0	12.5	30
± 12.5	6.25	30

### 7.5.2 Test procedure

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

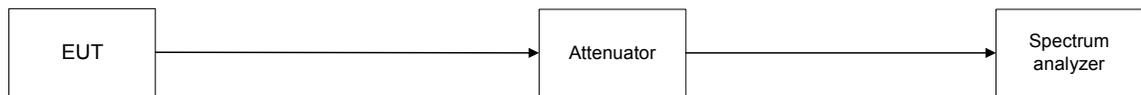
7.5.2.2 The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

7.5.2.3 The frequency of modulation envelope points beyond which power level drops below the band edge emission limit was measured.

7.5.2.4 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.

7.5.2.5 The test results were recorded in Table 7.5.2 and shown in the associated plots.

Figure 7.5.1 Band edge emission measurement set up





<b>Test specification:</b>		<b>Section 90.217, Band edge emission</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/22/2004 9:21:42 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Table 7.5.2 Band edge emission test results

OPERATING FREQUENCY RANGE: 450 – 470 MHz  
DETECTOR USED: Peak hold  
SWEEP RATE: 2 kHz/s  
RESOLUTION BANDWIDTH: 100 Hz  
VIDEO BANDWIDTH: 300 Hz  
MODULATION: FM  
MODULATING SIGNAL: PRBS  
BIT RATE: 1200 bps  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
ATTENUATION BELOW CARRIER: 30 dBc

Band edge	Measured frequency, MHz*	Frequency drift, kHz		Band edge frequency, MHz**	Band edge limit, MHz	Margin, kHz***	Verdict
		Negative	Positive				
<b>Low carrier frequency</b>							
Low	450.008420	343	NA	450.00876	450.0063	-0.00246	Pass
High	450.016500	NA	273	450.01677	450.0188	-0.00203	Pass
<b>Mid carrier frequency</b>							
Low	460.008420	424	NA	460.00884	460.0063	-0.00259	Pass
High	460.016510	NA	181	460.01669	460.0188	-0.00206	Pass
<b>High carrier frequency</b>							
Low	469.983420	460	NA	469.98388	469.9813	-0.00263	Pass
High	469.991500	NA	470	469.99197	469.9938	-0.00178	Pass

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

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

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

## Reference numbers of test equipment used

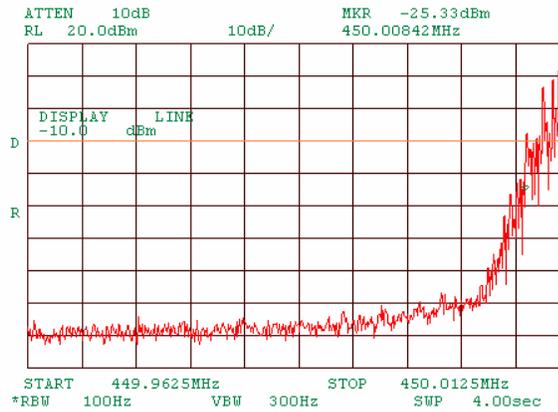
HL 1424	HL 2254	HL 2524				
---------	---------	---------	--	--	--	--

Full description is given in Appendix A.

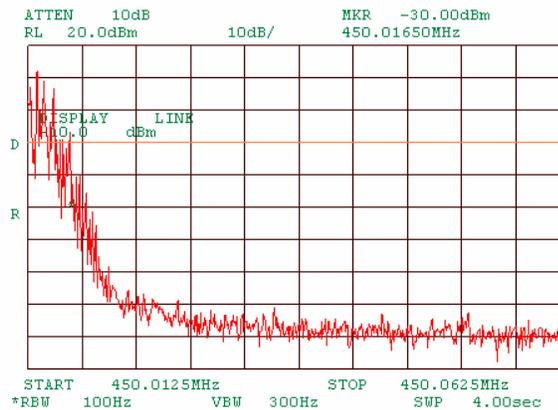


<b>Test specification:</b>	<b>Section 90.217, Band edge emission</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	8/22/2004 9:21:42 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.5.1 Band edge emission test results at low carrier frequency left side



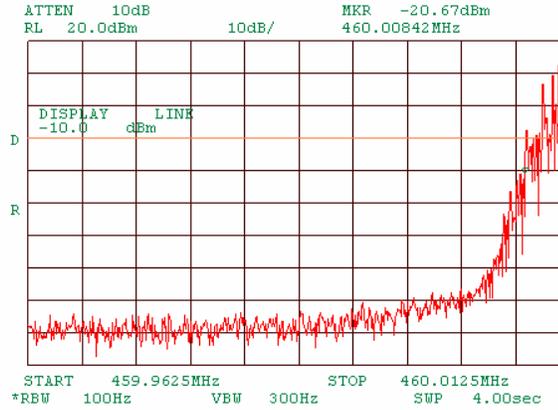
Plot 7.5.2 Band edge emission test results at low carrier frequency right side



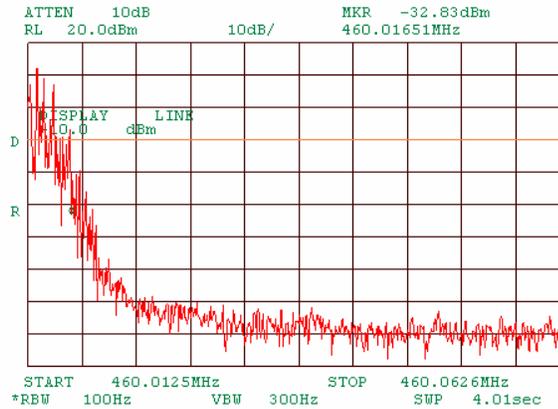


<b>Test specification:</b>	<b>Section 90.217, Band edge emission</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	8/22/2004 9:21:42 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.5.3 Band edge emission test results at mid carrier frequency left side



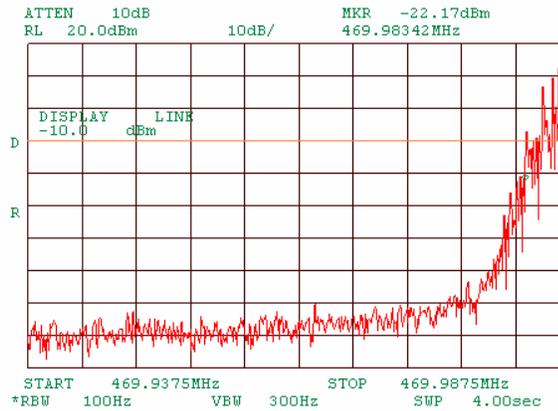
Plot 7.5.4 Band edge emission test results at mid carrier frequency right side



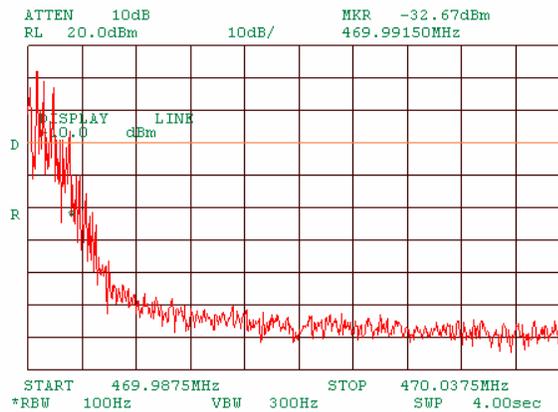


<b>Test specification:</b>	<b>Section 90.217, Band edge emission</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	8/22/2004 9:21:42 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.5.5 Band edge emission test results at high carrier frequency left side



Plot 7.5.6 Band edge emission test results at high carrier frequency right side





<b>Test specification:</b>		<b>Section 90.217, Conducted spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

## 7.6 Spurious emissions at RF antenna connector test

### 7.6.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.6.1. The test results are provided in Table 7.6.2 and associated plots.

Table 7.6.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	Spurious emission, dBm
0.009 – 10 <sup>th</sup> harmonic*	30	-10

\* - 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

### 7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

7.6.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.6.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.6.2 and associated plots.

Figure 7.6.1 Spurious emission test setup





<b>Test specification:</b>		<b>Section 90.217, Conducted spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Table 7.6.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: ≥ Resolution bandwidth  
 MODULATION: FM  
 MODULATING SIGNAL: DQPSK  
 BIT RATE: 1200 bps  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 TRANSMITTER OUTPUT POWER: 20.00 dBm at low frequency  
 20.17 dBm at mid frequency  
 20.17 dBm at high frequency

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
<b>Low carrier frequency</b>									
900.0267	-40.67	included	included	100	-40.67	60.67	30	30.67	Pass
1350.048	-41.67	included	included	1000	-41.67	61.67	30	31.67	Pass
2250.035	-41.67	included	included	1000	-41.67	61.67	30	31.67	Pass
<b>Mid carrier frequency</b>									
920.0267	-41.83	included	included	100	-41.83	62.00	30	32.00	Pass
1380.051	-41.67	included	included	1000	-41.67	61.84	30	31.84	Pass
2300.056	-41.67	included	included	1000	-41.67	61.84	30	31.84	Pass
<b>High carrier frequency</b>									
939.9693	-43.17	included	included	100	-43.17	63.34	30	33.34	Pass
1409.863	-43.00	included	included	1000	-43.00	63.17	30	33.17	Pass
2349.945	-44.67	included	included	1000	-44.67	64.84	30	34.84	Pass

\*- Margin = Spurious emission – specification limit.

## Reference numbers of test equipment used

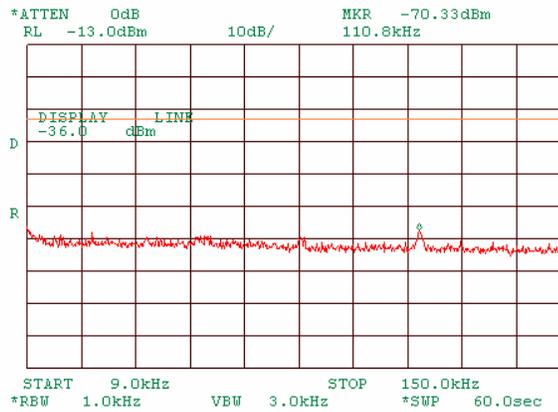
HL 1424	HL 2399	HL 2524					
---------	---------	---------	--	--	--	--	--

Full description is given in Appendix A.

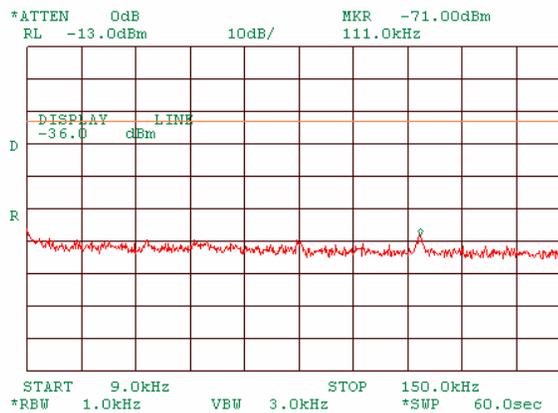


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.1 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency



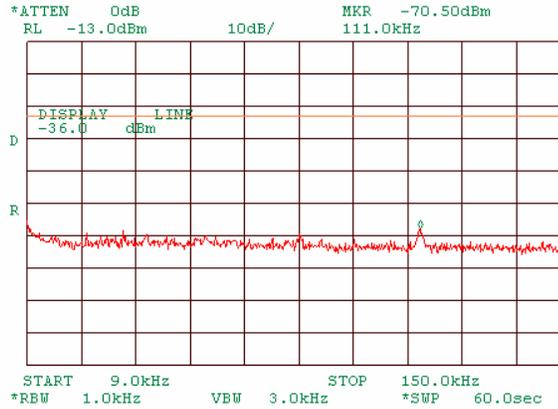
Plot 7.6.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency



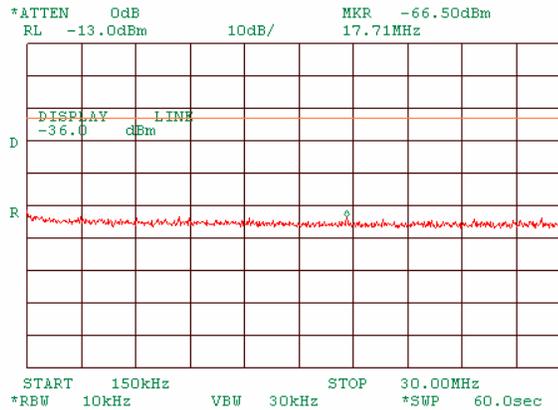


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.3 Spurious emission measurements in 9 - 150 kHz range at high carrier frequency



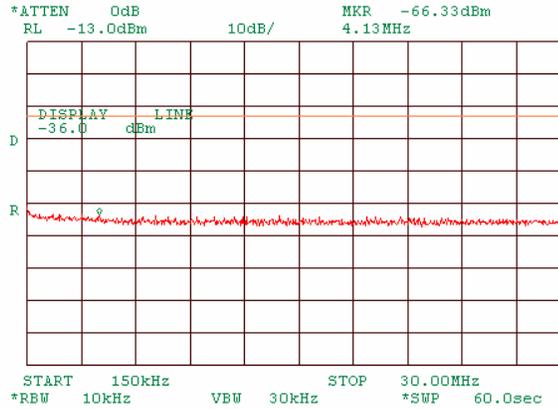
Plot 7.6.4 Spurious emission measurements in 0.150 - 30.0 MHz range at low carrier frequency



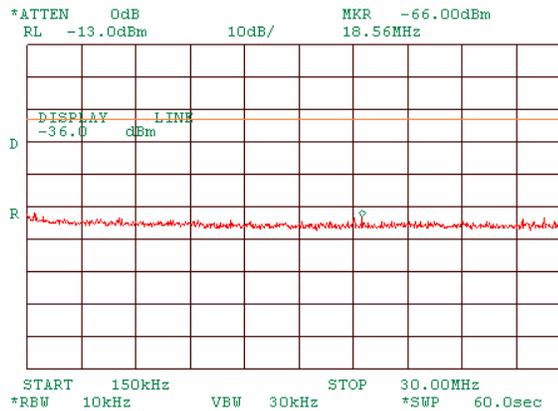


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.5 Spurious emission measurements in 0.150 - 30.0 MHz range at mid carrier frequency



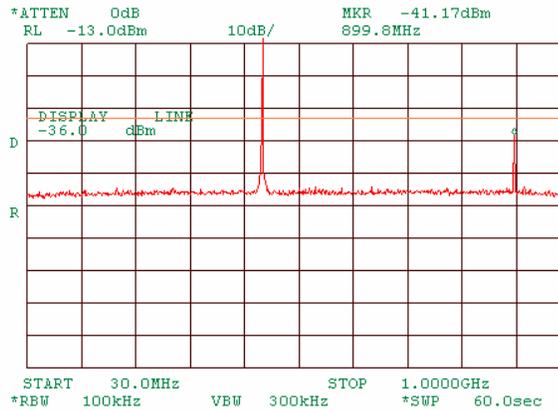
Plot 7.6.6 Spurious emission measurements in 0.150 – 30.0 MHz range at high carrier frequency



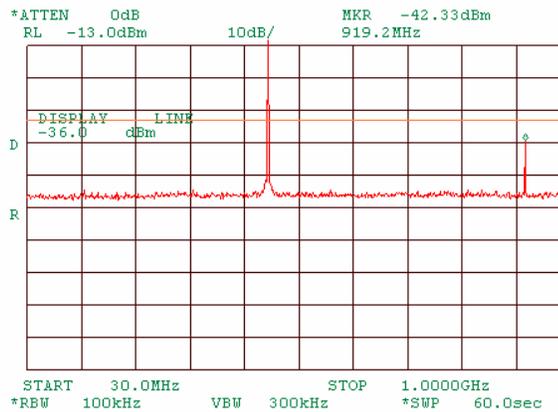


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.7 Spurious emission measurements in 30.0 - 1000 MHz range at low carrier frequency



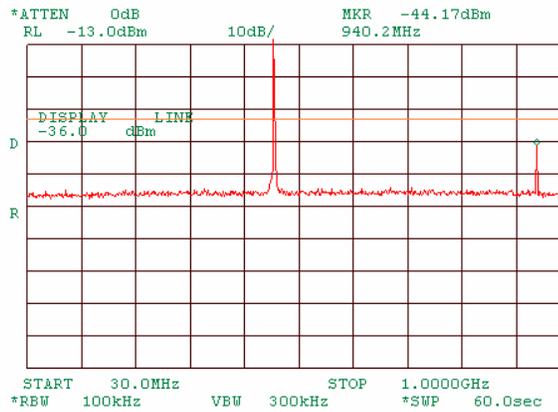
Plot 7.6.8 Spurious emission measurements in 30.0 - 1000 MHz range at mid carrier frequency



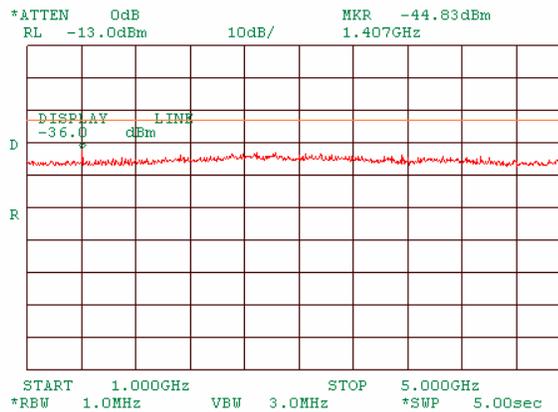


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.9 Spurious emission measurements in 30.0 - 1000 MHz range at high carrier frequency



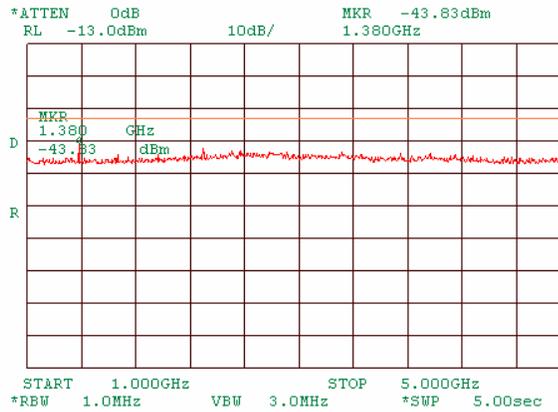
Plot 7.6.10 Spurious emission measurements in 1000 - 5000 MHz range at low carrier frequency



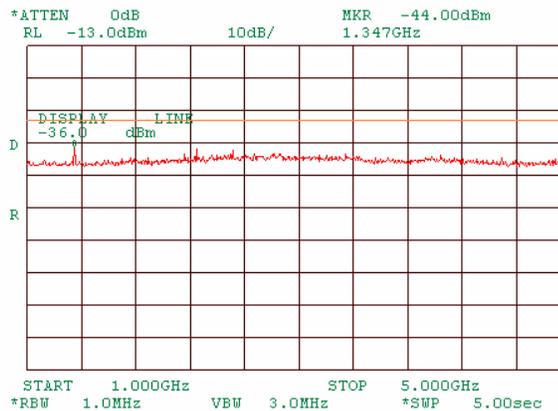


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.11 Spurious emission measurements in 1000 - 5000 MHz at mid carrier frequency



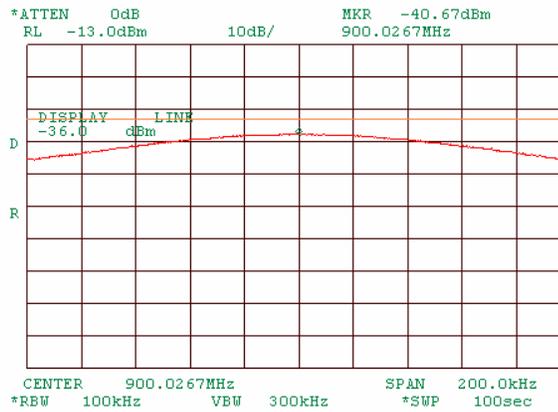
Plot 7.6.12 Spurious emission measurements in 1000 - 5000 MHz at high carrier frequency



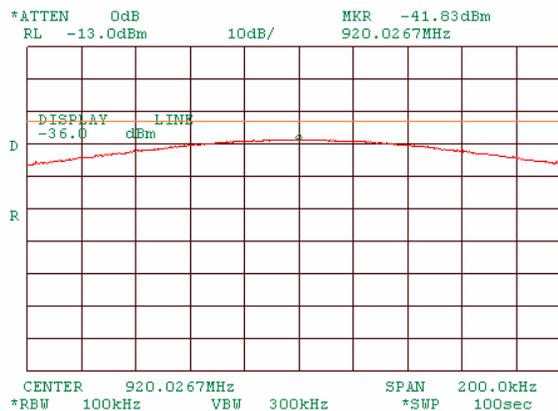


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.13 Conducted spurious emission measurements at the 2<sup>nd</sup> harmonic of low carrier frequency



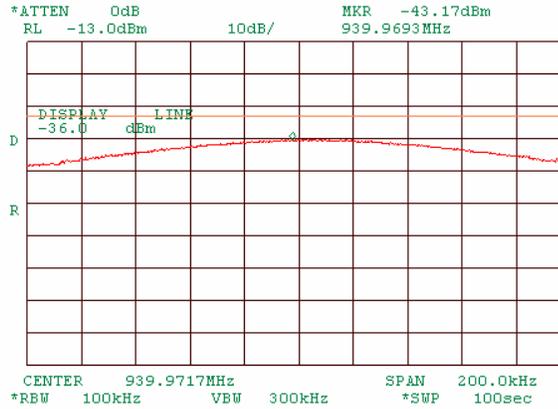
Plot 7.6.14 Conducted spurious emission measurements at the 2<sup>nd</sup> harmonic of mid carrier frequency



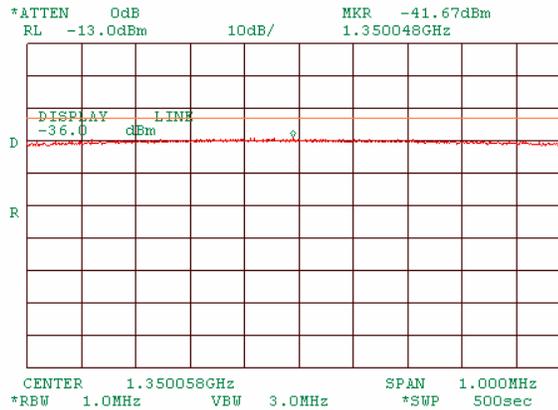


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.15 Conducted spurious emission measurements at the 2<sup>nd</sup> harmonic of high carrier frequency



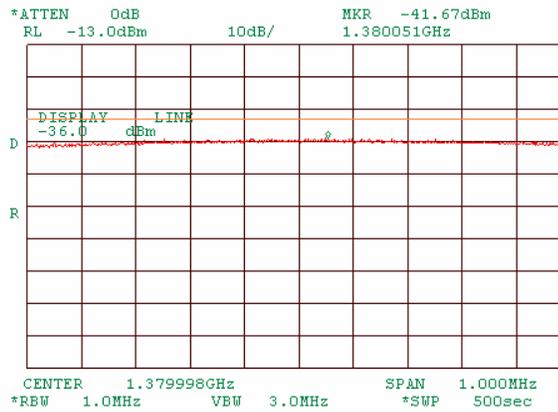
Plot 7.6.16 Conducted spurious emission measurements at the 3<sup>rd</sup> harmonic of low carrier frequency



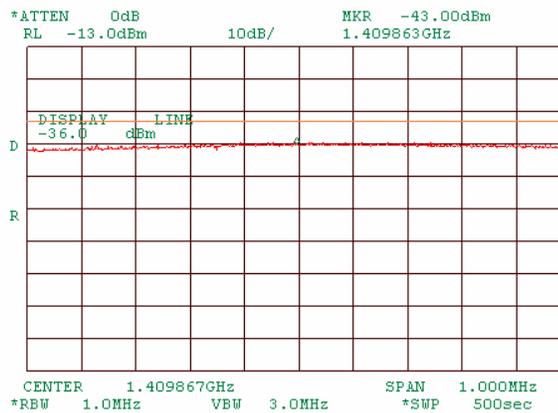


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.17 Conducted spurious emission measurements at the 3<sup>rd</sup> harmonic of mid carrier frequency



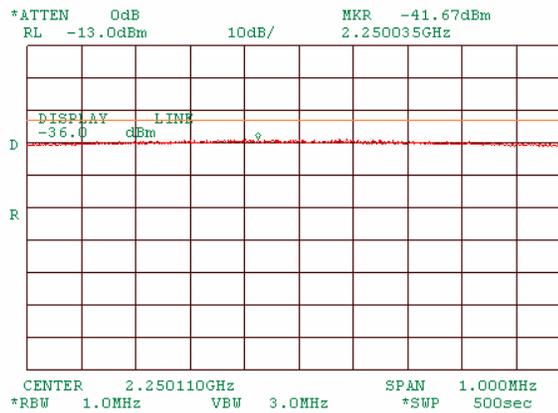
Plot 7.6.18 Conducted spurious emission measurements at the 3<sup>rd</sup> harmonic of high carrier frequency



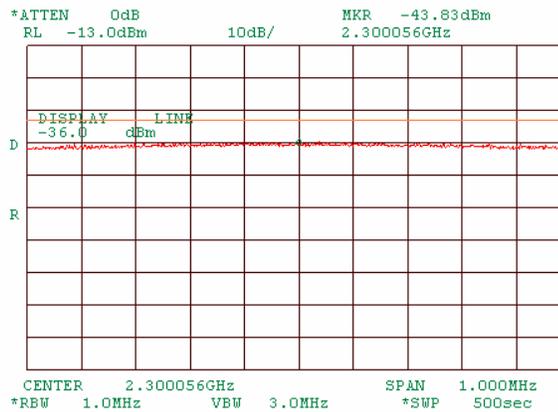


<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.19 Conducted spurious emission measurements at the 5<sup>th</sup> harmonic of low carrier frequency



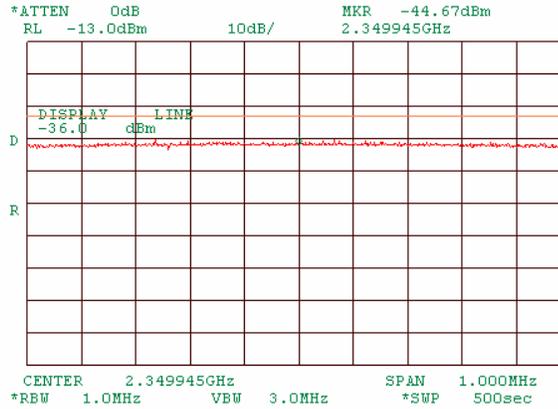
Plot 7.6.20 Conducted spurious emission measurements at the 5<sup>th</sup> harmonic of mid carrier frequency





<b>Test specification:</b>	<b>Section 90.217, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/21/2004 6:05:43 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.6.21 Conducted spurious emission measurements at the 5<sup>th</sup> harmonic of high carrier frequency





<b>Test specification:</b>		<b>Section 90.217, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

## 7.7 Radiated spurious emission measurements

### 7.7.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.7.1.

Table 7.7.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)**
0.009 – 10 <sup>th</sup> harmonic*	30	-10	85.23

\* - 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

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

- 7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and the performance check was conducted.
- 7.7.2.2 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.
- 7.7.2.3 The worst test results (the lowest margins) were recorded in Table 7.7.2 and shown in the associated plots.

### 7.7.3 Test procedure for spurious emission field strength measurements above 30 MHz

- 7.7.3.1 The EUT was set up as shown in Figure 7.7.2, energized and the performance check was conducted.
- 7.7.3.2 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.
- 7.7.3.3 The worst test results (the lowest margins) were recorded in Table 7.7.2 and shown in the associated plots.



<b>Test specification:</b> Section 90.217, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12			
<b>Test mode:</b> Compliance			<b>Verdict:</b> PASS
<b>Date &amp; Time:</b> 8/9/2004 5:41:33 PM			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Figure 7.7.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

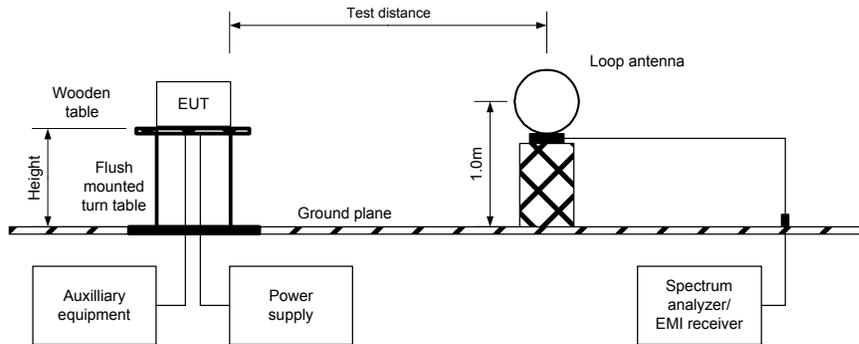
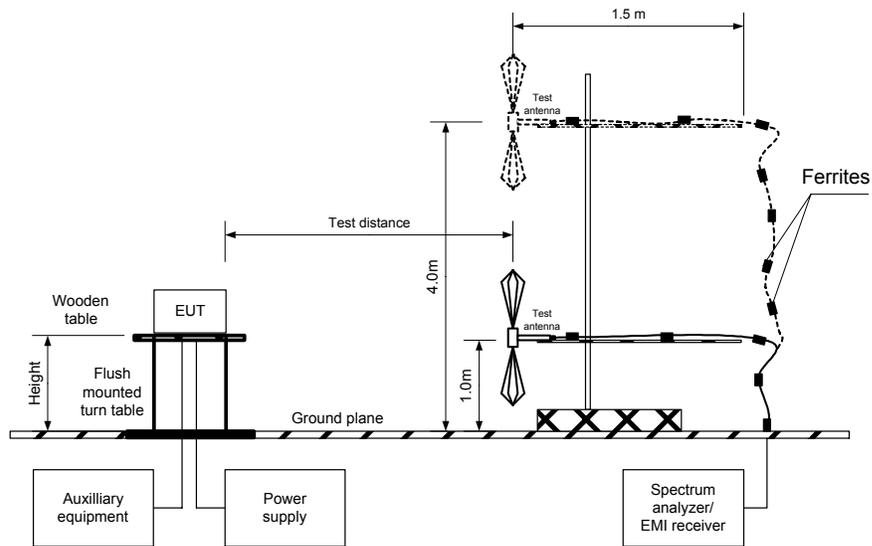


Figure 7.7.2 Setup for spurious emission field strength measurements above 30 MHz





<b>Test specification:</b>	<b>Section 90.217, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Table 7.7.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE:	450 - 470 MHz
TEST DISTANCE:	3 m
TEST SITE:	Semi anechoic chamber
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) Biconical (30 MHz – 200 MHz) Log periodic (200 MHz – 1000 MHz) Biconilog (30 MHz – 1000 MHz) Double ridged guide (above 1000 MHz)
MODULATION:	FM
MODULATING SIGNAL:	CW
BIT RATE:	1200 bps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum

Frequency, MHz	Resolution bandwidth, kHz	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
0.009 – 0.150	1	No emissions were found						Pass
0.150 - 30	10	All found emissions were at least 20 dB below specified limit						
30 – 1000	120	All found emissions were at least 20 dB below specified limit						
1000 - 5000	1000	No emissions were found						

\*- 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 0446	HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604
HL 1004	HL 1947	HL 1984	HL 2009				

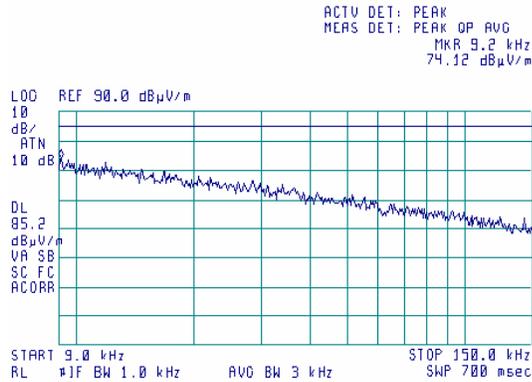
Full description is given in Appendix A.



<b>Test specification:</b>	<b>Section 90.217, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

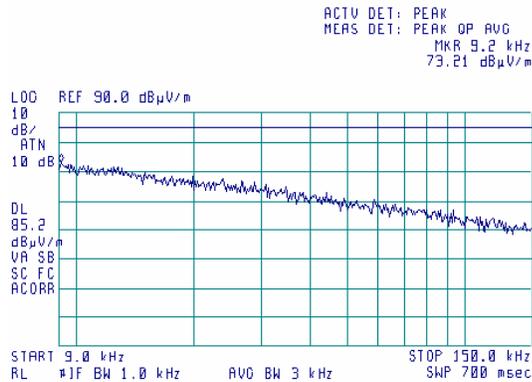
**Plot 7.7.1 Radiated emission measurements in 9 - 150 kHz range**

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: Low  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



**Plot 7.7.2 Radiated emission measurements in 9 - 150 kHz range**

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: Mid  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

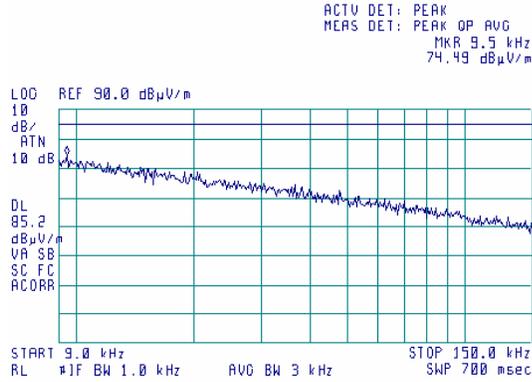




<b>Test specification:</b> Section 90.217, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/9/2004 5:41:33 PM			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

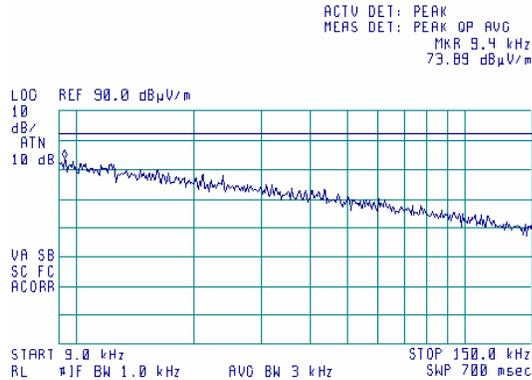
Plot 7.7.3 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: High  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



Plot 7.7.4 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: Low  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

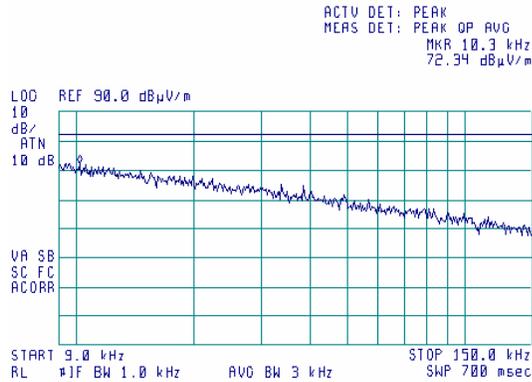




<b>Test specification:</b> Section 90.217, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/9/2004 5:41:33 PM			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

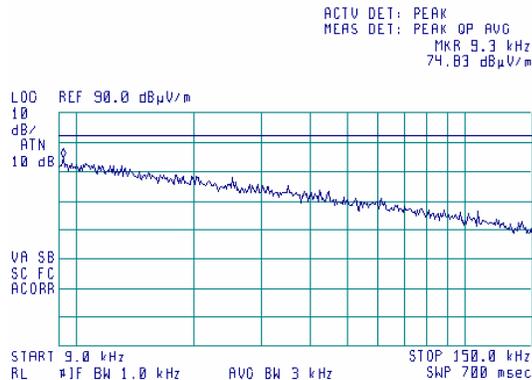
Plot 7.7.5 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: Mid  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



Plot 7.7.6 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: High  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

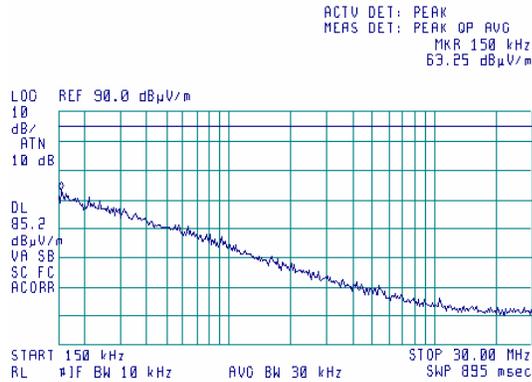




<b>Test specification:</b>	<b>Section 90.217, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

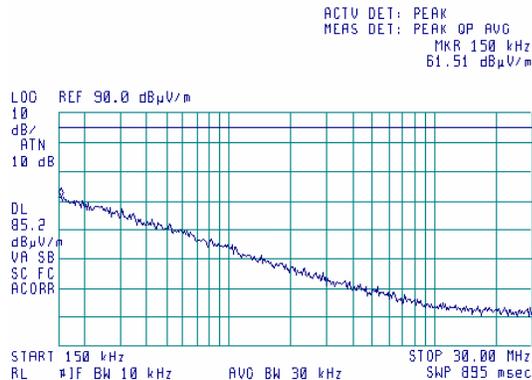
**Plot 7.7.7 Radiated emission measurements in 0.15 - 30 MHz range**

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: Low  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



**Plot 7.7.8 Radiated emission measurements in 0.15 - 30 MHz range**

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: Mid  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

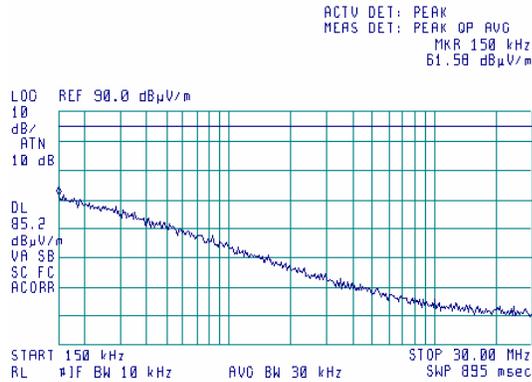




<b>Test specification:</b> Section 90.217, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/9/2004 5:41:33 PM			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

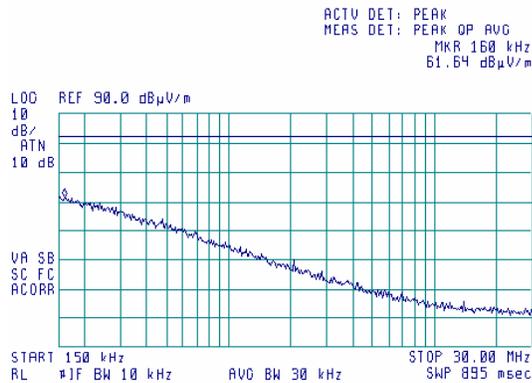
Plot 7.7.9 Radiated emission measurements in 0.15 - 30 MHz range

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: High  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



Plot 7.7.10 Radiated emission measurements in 0.15 - 30 MHz range

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: Low  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

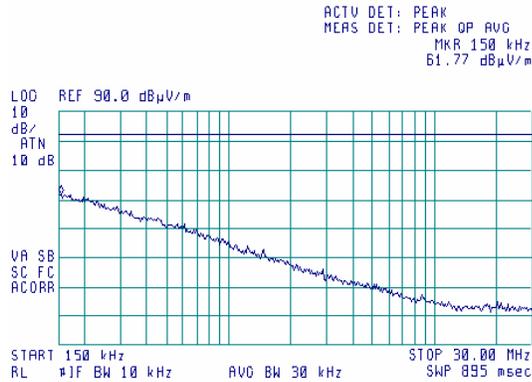




<b>Test specification:</b>	<b>Section 90.217, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

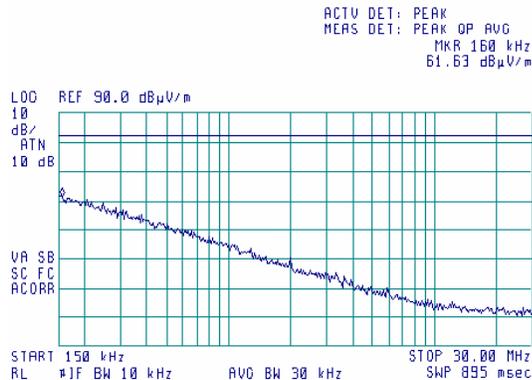
**Plot 7.7.11 Radiated emission measurements in 0.15 - 30 MHz range**

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: Mid  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



**Plot 7.7.12 Radiated emission measurements in 0.15 - 30 MHz range**

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: High  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

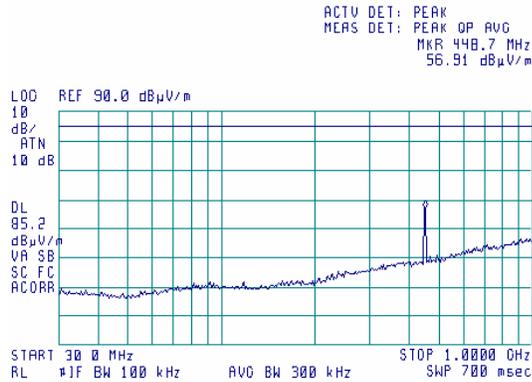




<b>Test specification:</b>		<b>Section 90.217, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

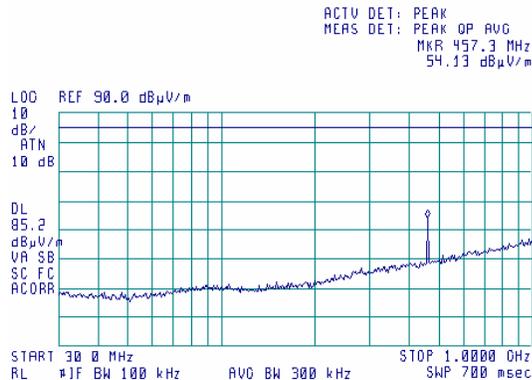
Plot 7.7.13 Radiated emission measurements in 30 – 1000 MHz range

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: Low  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



Plot 7.7.14 Radiated emission measurements in 30 – 1000 MHz range

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: Mid  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

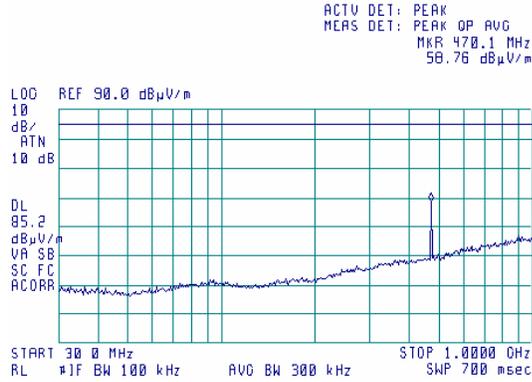




<b>Test specification:</b>		<b>Section 90.217, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

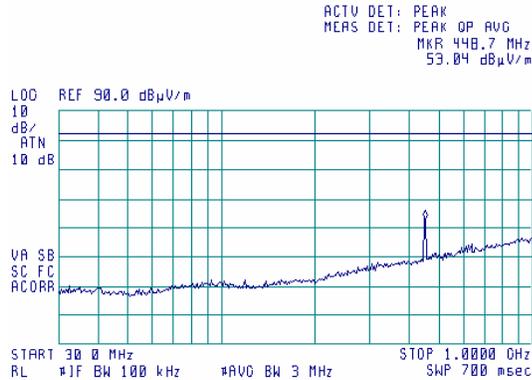
**Plot 7.7.15 Radiated emission measurements in 30 – 1000 MHz range**

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: High  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



**Plot 7.7.16 Radiated emission measurements in 30 – 1000 MHz range**

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: Low  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

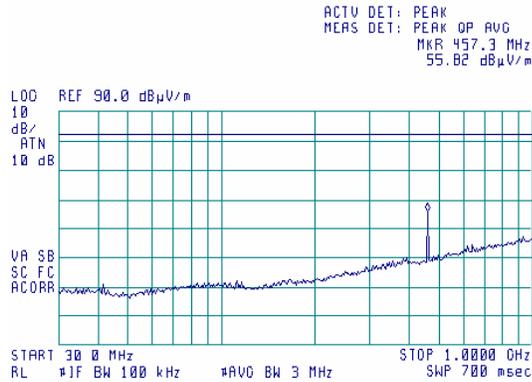




<b>Test specification:</b>		<b>Section 90.217, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

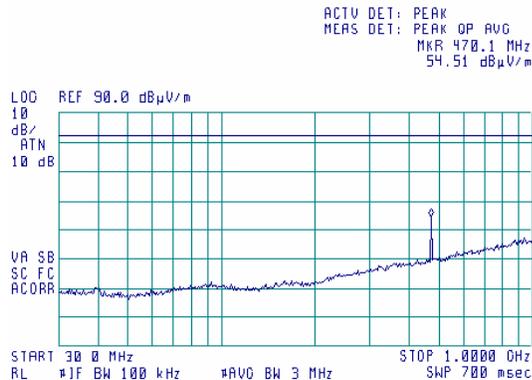
**Plot 7.7.17 Radiated emission measurements in 30 – 1000 MHz range**

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: Mid  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



**Plot 7.7.18 Radiated emission measurements in 30 – 1000 MHz range**

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: High  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

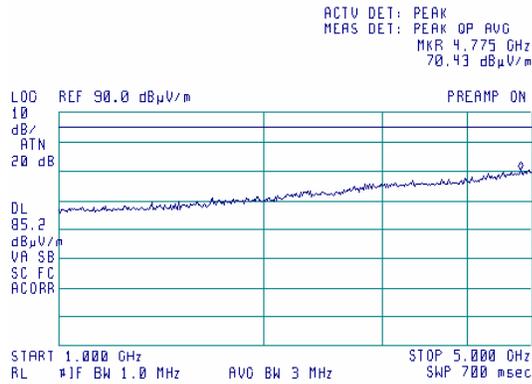




<b>Test specification:</b>	<b>Section 90.217, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

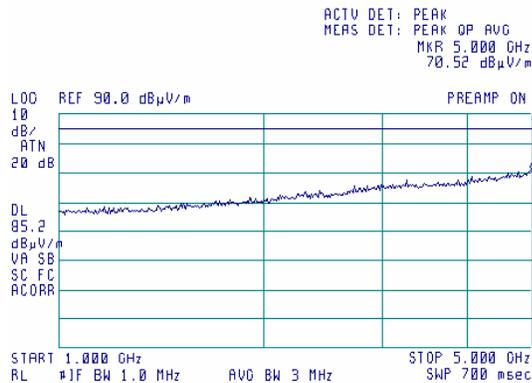
Plot 7.7.19 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: Low  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



Plot 7.7.20 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: Mid  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

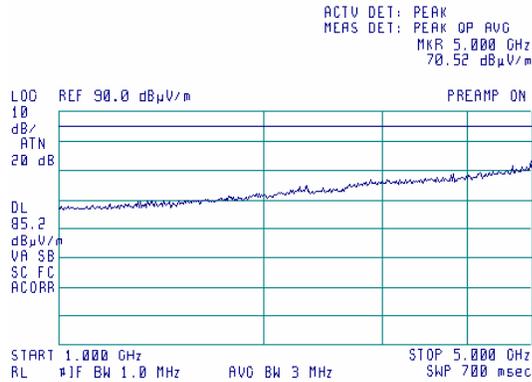




<b>Test specification:</b>	<b>Section 90.217, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

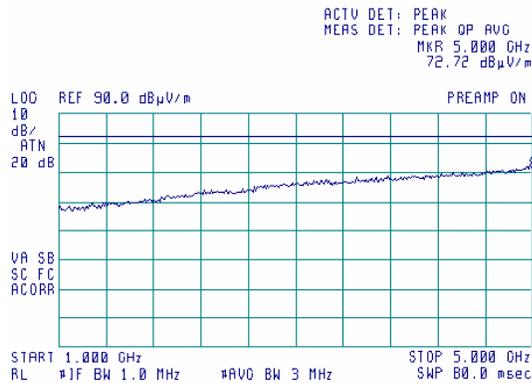
Plot 7.7.21 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
CARRIER FREQUENCY: High  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



Plot 7.7.22 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: Low  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m

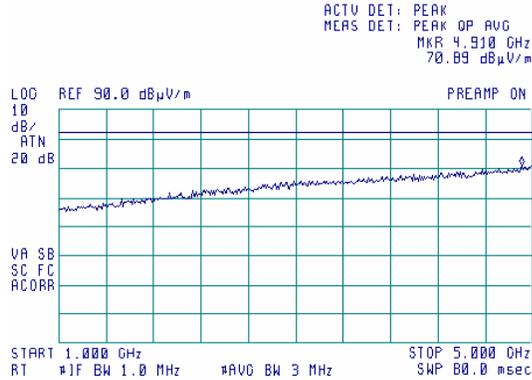




<b>Test specification:</b>	<b>Section 90.217, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/9/2004 5:41:33 PM		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 37 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

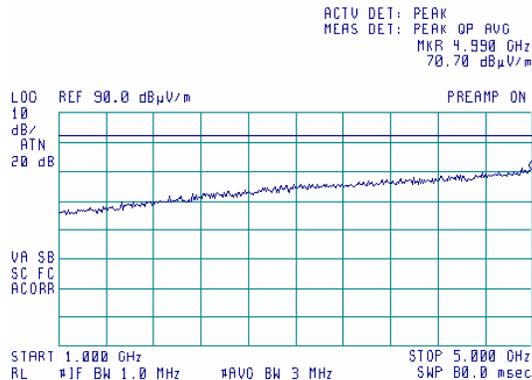
Plot 7.7.23 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: Mid  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m



Plot 7.7.24 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber  
EUT 8 IN / 0 OUT  
CARRIER FREQUENCY: High  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m





<b>Test specification:</b>		<b>Section 15.109, Radiated emission</b>	
<b>Test procedure:</b>		ANSI C63.4, Sections 11.6 and 12.1.4	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	8/9/2004 2:32:17 PM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1012 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> 6 V DC
<b>Remarks:</b>			

## 7.8 Radiated emission measurements

### 7.8.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 7.8.1.

Table 7.8.1 Radiated emission test limits

Frequency, MHz	Class B limit, dB(μV/m)		Class A limit, dB(μV/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:  $Lim_{S_2} = Lim_{S_1} + 20 \log(S_1/S_2)$ , where  $S_1$  and  $S_2$  – standard defined and test distance respectively in meters.

### 7.8.2 Test procedure for measurements in semi-anechoic chamber

7.8.2.1 The EUT was set up as shown in Figure 7.8.1 and associated photograph/s, energized and the performance check was conducted.

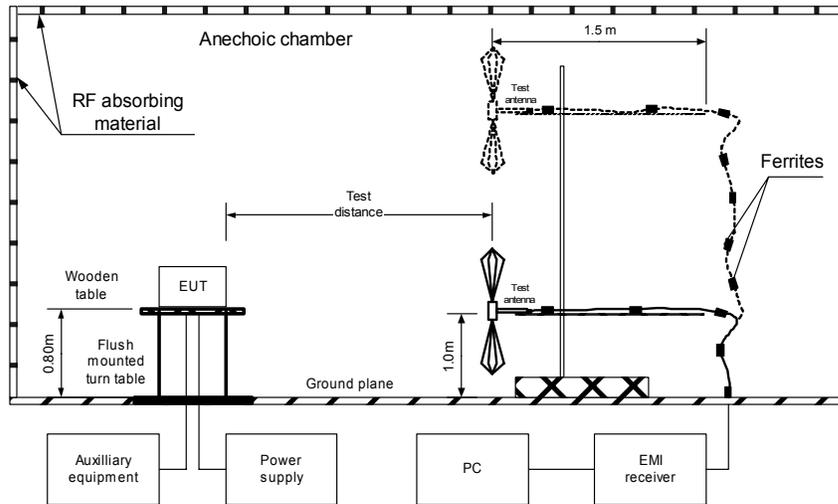
7.8.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position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

7.8.2.3 The worst test results (the lowest margins) were recorded in Table 7.8.2 and shown in the associated plots.



<b>Test specification:</b>	<b>Section 15.109, Radiated emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.6 and 12.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/9/2004 2:32:17 PM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1012 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> 6 V DC
<b>Remarks:</b>			

Figure 7.8.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment





<b>Test specification:</b>	<b>Section 15.109, Radiated emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.6 and 12.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date &amp; Time:</b>	8/9/2004 2:32:17 PM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1012 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> 6 V DC
<b>Remarks:</b>			

Table 7.8.2 Radiated emission test results

EUT SET UP:	TABLE-TOP
LIMIT:	Class B
EUT OPERATING MODE:	Stand-by
TEST SITE:	SEMI ANECHOIC CHAMBER
TEST DISTANCE:	3 m
DETECTORS USED:	PEAK / QUASI-PEAK
FREQUENCY RANGE:	30 MHz – 4000 MHz

Frequency, MHz	Resolution bandwidth, kHz	Measured emission, dB( $\mu$ V/m)	Limit, dB( $\mu$ V/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
30 – 1000	120	All emissions were found at least 20 dB below specified limit						Pass
1000 - 4000	1000	No emissions were found						

## Reference numbers of test equipment used

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

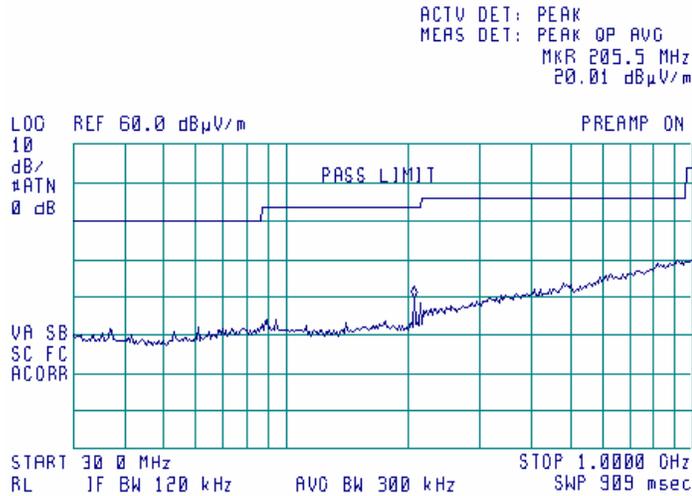
Full description is given in Appendix A.



<b>Test specification:</b> Section 15.109, Radiated emission			
<b>Test procedure:</b> ANSI C63.4, Sections 11.6 and 12.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/9/2004 2:32:17 PM			
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1012 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> 6 V DC
<b>Remarks:</b>			

Plot 7.8.1 Radiated emission measurements in 30- 1000 MHz range, vertical and horizontal antenna polarization

TEST SITE: Semi anechoic chamber  
EUT 4 IN / 4 OUT  
LIMIT: Class B  
TEST DISTANCE: 3 m  
RECEIVE FREQUENCY LOW, MID, HIGH  
EUT OPERATING MODE: Receive

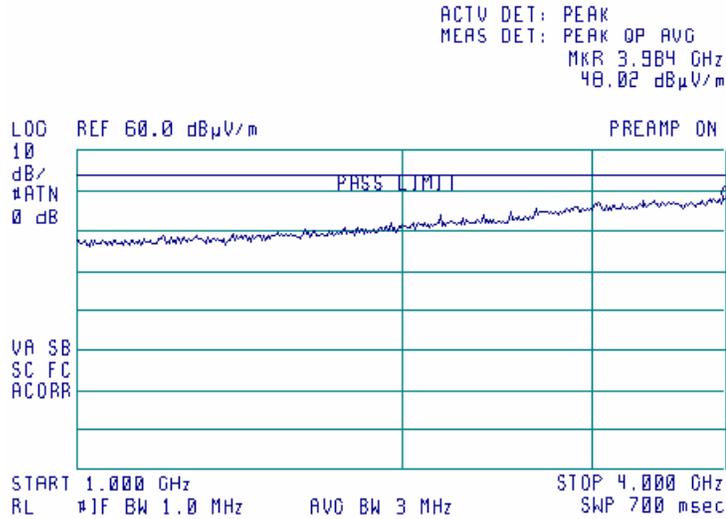




<b>Test specification:</b>		<b>Section 15.109, Radiated emission</b>	
<b>Test procedure:</b>		ANSI C63.4, Sections 11.6 and 12.1.4	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	8/9/2004 2:32:17 PM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1012 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> 6 V DC
<b>Remarks:</b>			

**Plot 7.8.2 Radiated emission measurements above 1000 MHz, vertical and horizontal antenna polarization**

TEST SITE: Semi anechoic chamber  
 EUT: 4 IN / 4 OUT  
 LIMIT: Class B  
 TEST DISTANCE: 3 m  
 RECEIVE FREQUENCY: LOW, MID, HIGH  
 EUT OPERATING MODE: Stand-by

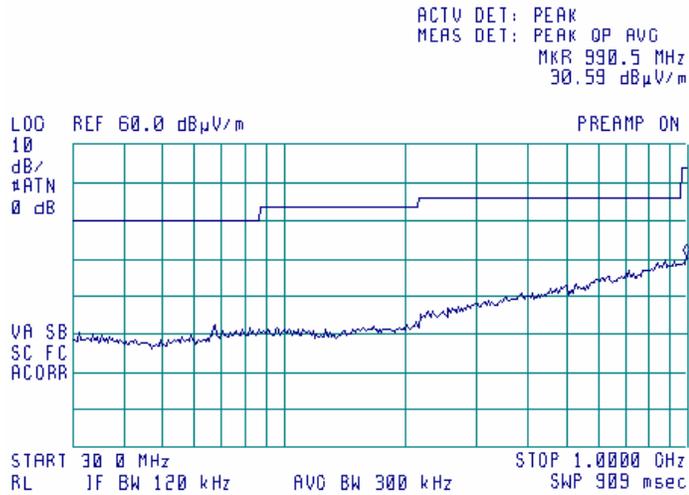




<b>Test specification:</b> Section 15.109, Radiated emission			
<b>Test procedure:</b> ANSI C63.4, Sections 11.6 and 12.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/9/2004 2:32:17 PM			
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1012 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> 6 V DC
<b>Remarks:</b>			

**Plot 7.8.3 Radiated emission measurements in 30- 1000 MHz range, vertical and horizontal antenna polarization**

TEST SITE: Semi anechoic chamber  
EUT: 8 IN / 0 OUT  
LIMIT: Class B  
TEST DISTANCE: 3 m  
RECEIVE FREQUENCY: LOW, MID, HIGH  
EUT OPERATING MODE: Receive





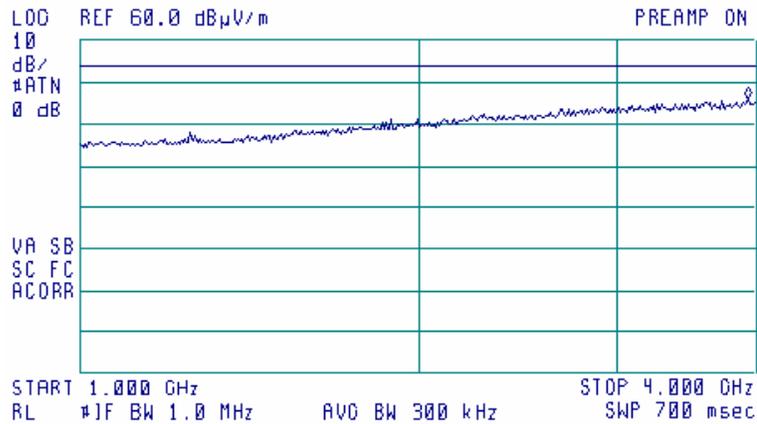
<b>Test specification:</b> Section 15.109, Radiated emission			
<b>Test procedure:</b> ANSI C63.4, Sections 11.6 and 12.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date &amp; Time:</b> 8/9/2004 2:32:17 PM			
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1012 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> 6 V DC
<b>Remarks:</b>			

**Plot 7.8.4 Radiated emission measurements above 1000 MHz, vertical and horizontal antenna polarization**

TEST SITE: Semi anechoic chamber  
 EUT: 8 IN / 0 OUT  
 LIMIT: Class B  
 TEST DISTANCE: 3 m  
 RECEIVE FREQUENCY: LOW, MID, HIGH  
 EUT OPERATING MODE: Stand-by



ACTV DET: PEAK  
 MEAS DET: PEAK QP AVG  
 MKR 3.922 GHz  
 46.10 dBµV/m





<b>Test specification:</b>		<b>Section 15.111, Conducted emission at receiver antenna port</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 12.1.5	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	7/22/2004 10:28:24 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

## 7.9 Spurious emissions at RF antenna connector

### 7.9.1 General

This test was performed to measure spurious emissions at RF antenna connector of receiver operated within 30 to 960 MHz band or a citizens band (CB) receiver which was tested for compliance with radiated emission limits with the antenna port connected to resistive termination. Specification test limits are given in Table 7.9.1. The test results are provided in Table 7.9.2 and associated plots.

Table 7.9.1 Spurious emission limits

Frequency, MHz	EUT type	Power of spurious	
		nW	dBm
25 MHz – 5 <sup>th</sup> harmonic*	Citizens band (CB) receiver	2.0	-57.0
30 MHz – 2 <sup>nd</sup> harmonic**	Superheterodyne receiver		
30 MHz – 5 <sup>th</sup> harmonic*	Other receiver operates within 30 – 960 MHz		

\* - harmonic of the highest frequency the EUT generates, uses, operates or tunes to.

\*\* - harmonic of the local oscillator frequency.

### 7.9.2 Test procedure

7.9.2.1 The EUT was set up as shown in Figure 7.9.1, energized and its proper operation was checked.

7.9.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 7.9.2 and associated plots.

Figure 7.9.1 Spurious emission test setup





<b>Test specification:</b>		<b>Section 15.111, Conducted emission at receiver antenna port</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 12.1.5	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date &amp; Time:</b>	7/22/2004 10:28:24 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Table 7.9.2 Spurious emission test results

INVESTIGATED FREQUENCY RANGE: 30 – 5000 MHz  
 RECEIVER TYPE: CB  
 EUT OPERATING MODE: Receive  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 100 kHz and 1000 kHz above 1 GHz  
 VIDEO BANDWIDTH: > Resolution bandwidth

Frequency, MHz	Spurious emission, dBm	Limit, dBm	Margin, dB	Verdict
3736.314	-73.83	-57.0	-16.83	Pass

Reference numbers of test equipment used

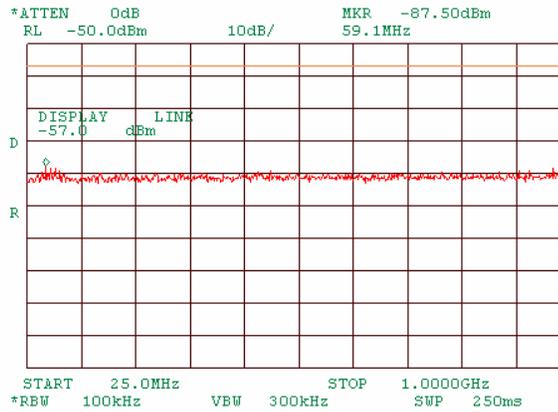
HL1424	HL 2399					
--------	---------	--	--	--	--	--

Full description is given in Appendix A.

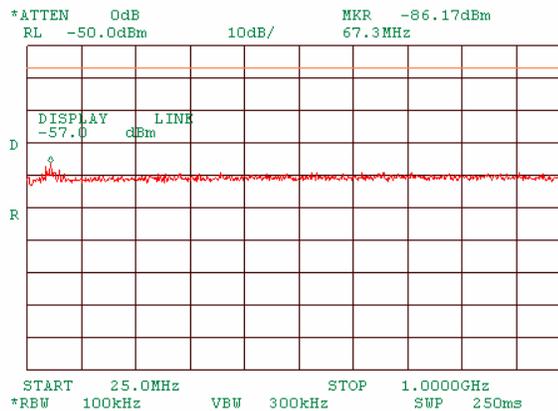


<b>Test specification:</b>	<b>Section 15.111, Conducted emission at receiver antenna port</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 12.1.5		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/22/2004 10:28:24 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.9.1 Spurious emission test results in range 25 – 1000 MHz at low receive frequency



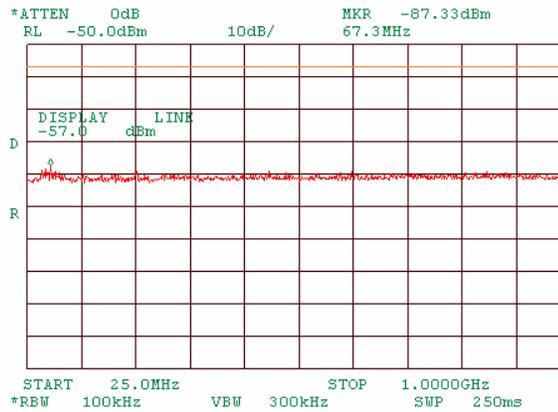
Plot 7.9.2 Spurious emission test results in range 25 – 1000 MHz at mid receive frequency



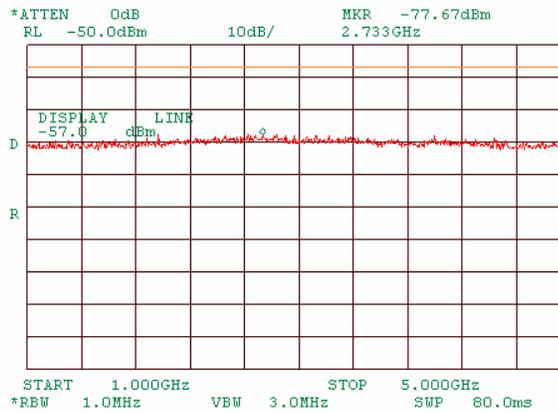


<b>Test specification:</b>	<b>Section 15.111, Conducted emission at receiver antenna port</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 12.1.5		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/22/2004 10:28:24 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.9.3 Spurious emission test results in range 25 – 1000 MHz at high receive frequency



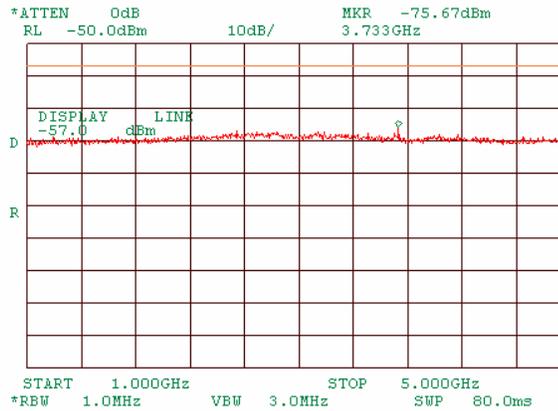
Plot 7.9.4 Spurious emission test results in range 1000 – 5000 MHz at low receive frequency



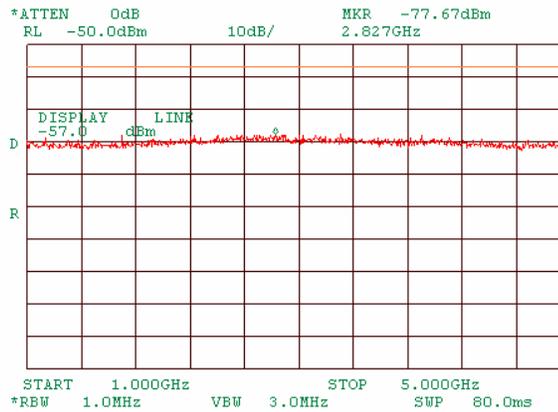


<b>Test specification:</b>	<b>Section 15.111, Conducted emission at receiver antenna port</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 12.1.5		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/22/2004 10:28:24 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.9.5 Spurious emission test results in range 1000 – 5000 MHz at mid receive frequency



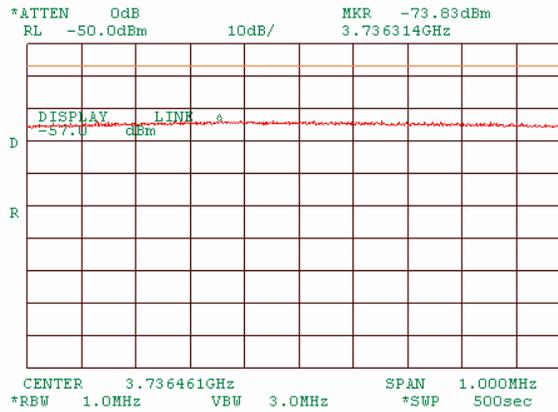
Plot 7.9.6 Spurious emission test results in range 1000 – 5000 MHz at high receive frequency





<b>Test specification:</b>	<b>Section 15.111, Conducted emission at receiver antenna port</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 12.1.5		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date &amp; Time:</b>	7/22/2004 10:28:24 AM		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 6 VDC
<b>Remarks:</b>			

Plot 7.9.7 Spurious emission test results at 3.736 GHz frequency



**8 APPENDIX A Test equipment and ancillaries used for tests**

HL No.	Description	Manufacturer information			Due Calibr. Month/Year
		Name	Model No.	Serial No.	
0174	Monitor, field, 10kHz-1GHz, 1-300V/m, w/fiberoptic	Amplifier Research	FM1000	60525	2/05
0446	Active loop antenna, 10 kHz-30 MHz	Electro-Mechanics	6502	2857	10/04
0465	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	10/05 check
0493	Oven temperature, -45°C ÷ +125°C	Thermotron	S-1.2 Mini-Max	4016	9/05
0521	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/05
0539	Signal generator	Marconi Instruments	52023-001H	1041	12/04
0589	Cable coaxial, GORE A2POL118.2, 3 m	Hermon Labs	GORE-3	589	11/04
0592	Position controller	Hermon Labs	L2-SR3000	100	5/05 check
0593	Antenna mast, 1-4 m/ 1-6 m Pneumatic	Hermon Labs	AM-F1	101	2/05 check
0594	Turntable for Anechoic Chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	102	1/05 check
0604	Antenna biconilog log-periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	1/05
0670	Oscilloscope, Digital storage 500 MHz, 2 Gs/s, 4 ch with Telecom Mask Tester	LeCroy Corporation	LC 334A	2387	8/05
0788	Power splitter/combiner	Mini-Circuits	ZFSC-2-1	923705	9/05
0808	Analyzer spectrum, 100 Hz to 2.2 GHz, AM/FM modulator	Anritsu	MS2601B	M178731	3/05
1004	Cable coaxial, ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/04
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/05
1533	Cable RF, 1.0 m	Alpha wire	RG-213/U	1533	9/05
1556	Cable RF, 0.5 m	Telequis	MIL-C-17F-RG 058 CU	1556	12/04
1565	Antenna, dipole, tunable, 500 - 1000 MHz	Electro-Metrics	TDS-30-2	334	1/05
1907	Power splitter/combiner, 5-500 MHz	Mini-Circuits	ZFSCC-2-1	NA	7/05
1947	Cable 18 GHz, 6.5 m, blue	Rhophase Microwave Ltd	NPS-1803A- 6500-NPS	T4974	10/04
1984	Antenna, double ridged waveguide horn, 1-18 GHz, 300W, N-type	EMC Test Systems	3115	9911-5964	3/05
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	12/04
2078	Isotropic Field Probe, 80 MHz - 40 GHz	Amplifier Research	FP2080	302541	2/05
2227	Crystal Detector 0.01-18 GHz	Hewlett Packard	8472A	2227	10/04
2254	Cable 40GHz, 0.8 m, blue	Rhophase Microwave Ltd.	KPS-1503A- 800-KPS	W4907	11/04



HL No.	Description	Manufacturer information			Due Calibr. Month/Year
		Name	Model No.	Serial No.	
2358	Power supply, 2 X 0-36 VDC, 5A, 5 VDC / 5A	Horizon Electronics	DHR3655D	767469	4/05
2399	Cable 40 GHz, 1.5 m, blue	Rhophase Microwave Ltd.	KPS-1503A-1500-KPS	X2945	6/05
2524	Attenuator, 10 dB, DC-18 GHz	Midwest Microwave	263-10	2524	3/05

**9 APPENDIX B Measurement uncertainties****Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements**

Test description	Expanded uncertainty
<b>Transmitter tests</b>	
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 %
<b>Unintentional radiator tests</b>	
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization  Vertical polarization	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error. The standards and instruments used in the calibration system conform to the present requirements of ISO/IEC 17025 (or alternately ANSI/NCSL Z540-1).

The laboratory calibrates its measurement standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements. The Hermon Labs EMC measurements uncertainty is given in the table above.



## 10 APPENDIX C 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).

Address: P.O. Box 23, Binyamina 30500, Israel.  
Telephone: +972 4628 8001  
Fax: +972 4628 8277  
e-mail: mail@hermonlabs.com  
website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

## 11 APPENDIX D Specification references

47CFR part 90: 2002	Private land mobile radio services
47CFR part 1: 2003	Practice and procedure
47CFR part 2: 2002	Frequency allocations and radio treaty matters; general rules and regulations
47CFR part 15: 2004	Radio frequency devices
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 2001	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI/TIA/EIA-603-A:2001	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards



## 12 APPENDIX E Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB( $\mu$ V)	decibel referred to one microvolt
dB( $\mu$ V/m)	decibel referred to one microvolt per meter
dB( $\mu$ A)	decibel referred to one microampere
dB $\Omega$	decibel referred to one Ohm
DC	direct current
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
ITE	information technology equipment
k	kilo
kHz	kilohertz
LISN	line impedance stabilization network
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
$\mu$ s	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
$\Omega$	Ohm
QP	quasi-peak
PCB	printed circuit board
PM	pulse modulation
PS	power supply
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
VA	volt-ampere

**13 APPENDIX F Test equipment correction factors****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( $\mu$ V) to convert it into field intensity in dB( $\mu$ 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( $\mu$ V) to convert it into field intensity in dB( $\mu$ V/m).



**Antenna factor**  
**Active Loop Antenna**  
**EMC Test Systems, model 6502, serial number 2857, HL 0446**

Frequency, MHz	Magnetic Antenna Factor, dB(S/m)	Electric Antenna Factor, dB(1/m)
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	9.7
0.750	-41.9	9.6
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.1
4.000	-41.4	10.1
5.000	-41.5	10.0
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(S/m) is to be added to receiver meter reading in dB( $\mu$ V) to convert it into field intensity in dB( $\mu$ A/m).  
Antenna factor in dB(1/m) is to be added to receiver meter reading in dB( $\mu$ V) to convert it into field intensity in dB( $\mu$ V/m).



## 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		±0.17
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 40 GHz, 0.8 m, blue, model: KPS-1503A-800-KPS, S/N W4907, HL 2254**

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

**Cable loss****Cable coaxial, 40GHz, 1.5 m, Blue, Rhophase Microwave Limited, model: KPS-1503A-1500-KPS, HL 2399**

Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB
0.03	0.07	6.5	1.57	15.50	2.50
0.05	0.10	6.7	1.60	16.00	2.51
0.1	0.16	6.9	1.55	16.50	2.58
0.2	0.26	7.1	1.65	17.00	2.65
0.3	0.33	7.3	1.65	17.50	2.73
0.5	0.38	7.5	1.70	18.00	2.74
0.7	0.41	7.7	1.71	18.50	2.67
0.9	0.58	7.9	1.73	19.00	2.67
1.1	0.64	8.1	1.79	19.50	2.74
1.3	0.70	8.3	1.81	20.00	2.69
1.5	0.75	8.5	1.84	20.50	2.80
1.7	0.79	8.7	1.85	21.00	2.82
1.9	0.83	8.9	1.90	21.50	2.87
2.1	0.88	9.1	1.95	22.00	2.87
2.3	0.93	9.3	1.93	22.50	2.92
2.5	0.97	9.5	1.98	23.50	3.04
2.7	1.01	9.7	1.96	24.00	3.05
2.9	1.04	9.9	2.03	24.50	3.03
3.1	1.08	10.1	1.99	25.00	3.11
3.3	1.14	10.30	2.02	25.50	3.10
3.5	1.17	10.50	2.02	26.00	3.17
3.7	1.21	10.70	2.02	26.50	3.11
3.9	1.24	10.90	2.08	27.00	3.16
4.1	1.26	11.10	2.02	28.00	3.19
4.3	1.26	11.30	2.09	29.00	3.19
4.5	1.29	11.50	2.05	30.00	3.30
4.7	1.34	11.70	2.11	31.00	3.31
4.9	1.34	11.90	2.11	32.00	3.35
5.1	1.40	12.10	2.12	33.00	3.46
5.3	1.43	12.40	2.17	34.00	3.45
5.5	1.45	13.00	2.29	35.00	3.49
5.7	1.47	13.50	2.31	36.00	3.54
5.9	1.40	14.00	2.43	37.00	3.62
6.1	1.53	14.50	2.43	39.00	3.69
6.3	1.55	15.00	2.46	40.00	3.75