

TEST REPORT

ACCORDING TO: FCC part 15 subpart C, §15.247 and subpart B

FOR:

Motorola Communication Israel Ltd.

Hands free imager

Model: F3127A

FCC ID: AZ489FT7012

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.

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1 Applicant information

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E-mail: Gad.Noor@motorola.com
Contact name: Mr. Gad Noor

2 Equipment under test attributes

Product name: Wireless barcode reader (Hands free imager)
Model(s): F3127A
Serial number: HFI#7
Receipt date: 11/25/2004

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
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Contact name: Mr. Gad Noor

4 Test details

Project ID: 16183
Location: Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel
Test started: 11/25/2004
Test completed: 11/30/2004
Test specification(s): FCC part 15 subpart C, §15.247; subpart B, §15.109
Test suite: FCC_15.247_FHSS_without_RF_connector (5/3/2004 5:44:12 PM, modified)

5 Tests summary

Test	Status
Transmitter characteristics	
Section 15.247(a)1, 20 dB bandwidth	Pass
Section 15.247(a)1, Frequency separation	Pass
Section 15.247(a)1, Number of hopping frequencies	Pass
Section 15.247(a)1, Average time of occupancy	Pass
Section 15.247(b), Peak output power	Pass
Section 15.247(c), Emissions at band edges	Pass
Section 15.247(c), Radiated spurious emissions	Pass
Section 15.203, Antenna requirements	Pass
Section 15.207(a), Conducted emission	Not required
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Not required
Section 15.109, Radiated emission	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
Tested by:	Mr. M. Lerman, test engineer	November 30, 2004	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	December 2, 2004	
	Mr. M. Nikishin, EMC group leader	December 5, 2004	
Approved by:	Mr. A. Usoskin, C.E.O.	December 5, 2004	

6 EUT description

6.1 General information

The EUT is hands free imager based on camera engine with Bluetooth radio. It is intended for reading and decoding of bar code labels and acquire images. The hands free imager transmits the data to hand held terminal or PC via Bluetooth protocol. It may be used either indoor or outdoor and is powered from 3.6V Li-Ion battery.

6.2 Support and test equipment

Description	Manufacturer	Model number	Serial number
Li-Ion Battery	Motorola	FNN7816A	Engineering sample

6.3 Operating frequencies

Source	Frequency, MHz					
Digital portion	0.032768	0.1152	12.0	13.495	96.0	150.0
Transmitter / receiver	2400-2483.5					

6.4 Changes made in the EUT

No changes were implemented.

6.5 Test configuration



6.6 Transmitter characteristics

Type of equipment						
<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)					
Intended use		Condition of use				
	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				
Assigned frequency range		2400.0 – 2483.5 MHz				
Operating frequency range		2402.0 – 2480.0 MHz				
RF channel spacing		1000.0 kHz				
Maximum rated output power		At transmitter 50 Ω RF output connector		2 dBm		
		Effective radiated power (for equipment with no RF connector)				
Is transmitter output power variable?		<input checked="" type="checkbox"/>	No			
			Yes			
			continuous variable			
			stepped variable with stepsize		dB	
		minimum RF power		dBm		
		maximum RF power		dBm		
Antenna connection						
	unique coupling		standard connector	<input checked="" type="checkbox"/>	integral	
				<input checked="" type="checkbox"/>	with temporary RF connector	
					without temporary RF connector	
Antenna/s technical characteristics						
Type	Manufacturer	Model number		Gain		
PCB printed	Motorola	NA		-6 dBi		
Transmitter 99% power bandwidth		1000 kHz				
Transmitter aggregate data rate/s		1.0 Mbps				
Transmitter aggregate symbol (baud) rate/s		1.0 Msymbols (MBAud) per second				
Type of modulation		GFSK				
Type of multiplexing		TDMA				
Modulating test signal (baseband)		PRBS				
Maximum transmitter duty cycle in normal use		50 %	Tx ON time	msec	Period	
Transmitter duty cycle supplied for test		100 %	Tx ON time	msec	Period	
Transmitter power source						
<input checked="" type="checkbox"/>	Battery	Nominal rated voltage	3.6 VDC	Battery type	Li-Ion	
	DC	Nominal rated voltage	VDC			
	AC mains	Nominal rated voltage	VAC	Frequency	Hz	
Common power source for transmitter and receiver				<input checked="" type="checkbox"/>	yes	
					no	
Emission designator		1M00F1D				
Spread spectrum parameters for transmitters tested per FCC 15.247 only						
FHSS	total number of hops		79			
	dwell time		2.967 msec			
	bandwidth per hop		1.0 MHz			
	max. separation of hops		1.0 MHz			

Test specification: Section 15.247(a)1, 20 dB bandwidth			
Test procedure: Public notice DA 00-705			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/28/2004 2:55:55 PM			
Temperature: 22°C	Air Pressure: 1010 hPa	Relative Humidity: %	Power Supply: 3.6 V DC
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C requirements

7.1 20 dB bandwidth

7.1.1 General

This test was performed to measure 20 dB bandwidth of the transmitter hopping channel. Specification test limits are given in Table 7.1.1.

Table 7.1.1 20 dB bandwidth limits

Assigned frequency, MHz	Minimum bandwidth, kHz	Modulation envelope reference points*, dBc
2400.0 – 2483.5	NA	20

* - Modulation envelope reference points provided in terms of attenuation below the peak of modulated carrier.

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 set to transmit modulated carrier at maximum data rate.
- 7.1.2.3 The transmitter bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.1.2 and associated plot.
- 7.1.2.4 The test was repeated for each data rate and each modulation format.

Figure 7.1.1 20 dB bandwidth test setup



Test specification:	Section 15.247(a)1, 20 dB bandwidth		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/28/2004 2:55:55 PM		
Temperature: 22°C	Air Pressure: 1010 hPa	Relative Humidity: %	Power Supply: 3.6 V DC
Remarks:			

Table 7.1.2 20 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 2400 – 2483.5 MHz
DETECTOR USED: Peak
SWEEP TIME: Auto
RESOLUTION BANDWIDTH: ≥ 1% of the 20 dB bandwidth
VIDEO BANDWIDTH: ≥ RBW
MODULATION ENVELOPE REFERENCE POINTS: 20.0 dBc
MODULATING SIGNAL: PRBS
FREQUENCY HOPPING: Disabled

Carrier frequency, MHz	Type of modulation	Data rate, Mbps	Symbol rate, Msymbols/s	20 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency							
2402	GFSK	1	1	953	NA	NA	Pass
Mid frequency							
2440	GFSK	1	1	950	NA	NA	Pass
High frequency							
2480	GFSK	1	1	947	NA	NA	Pass

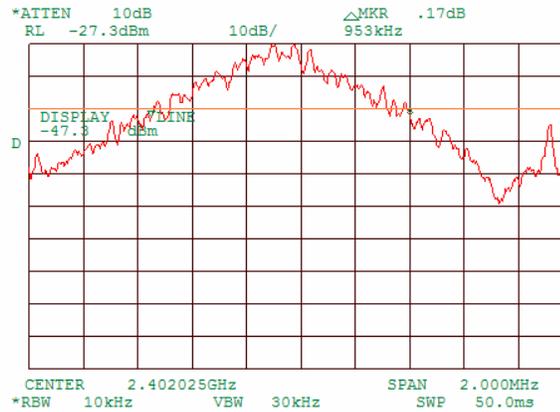
Reference numbers of test equipment used

HL 1424	1947	1984					
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Full description is given in Appendix A.

Test specification:	Section 15.247(a)1, 20 dB bandwidth		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/28/2004 2:55:55 PM		
Temperature: 22°C	Air Pressure: 1010 hPa	Relative Humidity: %	Power Supply: 3.6 V DC
Remarks:			

Plot 7.1.1 20 dB bandwidth test result at low frequency

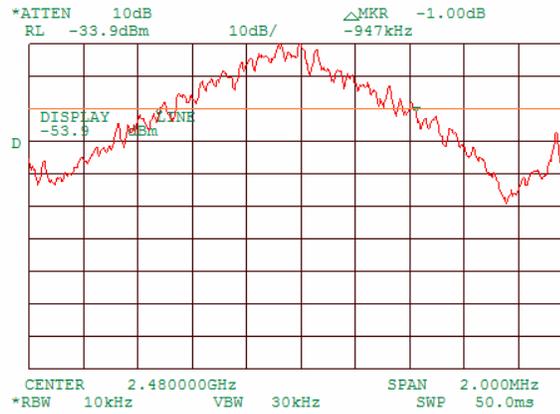


Plot 7.1.2 20 dB bandwidth test result at mid frequency



Test specification:	Section 15.247(a)1, 20 dB bandwidth		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/28/2004 2:55:55 PM		
Temperature: 22°C	Air Pressure: 1010 hPa	Relative Humidity: %	Power Supply: 3.6 V DC
Remarks:			

Plot 7.1.3 20 dB bandwidth test result at high frequency



Test specification: Section 15.247(a)1, Frequency separation	
Test procedure: Public notice DA 00-705	
Test mode: Compliance	Verdict: PASS
Date & Time: 11/30/2004 9:25:13 AM	
Temperature: 23 °C	Air Pressure: 1011 hPa
Relative Humidity: 40 %	
Power Supply: 3.6 V DC	
Remarks:	

7.2 Carrier frequency separation

7.2.1 General

This test was performed to measure frequency separation between the peaks of adjacent channels. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Carrier frequency separation limits

Assigned frequency range, MHz	Carrier frequency separation
2400.0 – 2483.5	20 dB bandwidth of the hopping channel, whichever is greater

7.2.2 Test procedure

- 7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized with frequency hopping function enabled and its proper operation was checked.
- 7.2.2.2 The spectrum analyzer span was set to capture the carrier frequency and both of adjacent channels, the lower and the higher. The resolution bandwidth was set wider than 1 % of the frequency span.
- 7.2.2.3 The spectrum analyzer was set in max hold mode and allowed trace to stabilize.
- 7.2.2.4 The frequency separation between the peaks of adjacent channels was measured as provided in Table 7.2.2 and associated plots.

Figure 7.2.1 Carrier frequency separation test setup



Test specification: Section 15.247(a)1, Frequency separation			
Test procedure: Public notice DA 00-705			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 9:25:13 AM			
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Table 7.2.2 Carrier frequency separation test results

ASSIGNED FREQUENCY: 2400 – 2483.5 MHz
 MODULATION: GFSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 1 Mbps
 DETECTOR USED: Peak
 FREQUENCY HOPPING: Enabled
 20 dB BANDWIDTH: 953 kHz

Carrier frequency separation, kHz	Limit, kHz	Margin*, kHz	Verdict
1040	1000	40	Pass

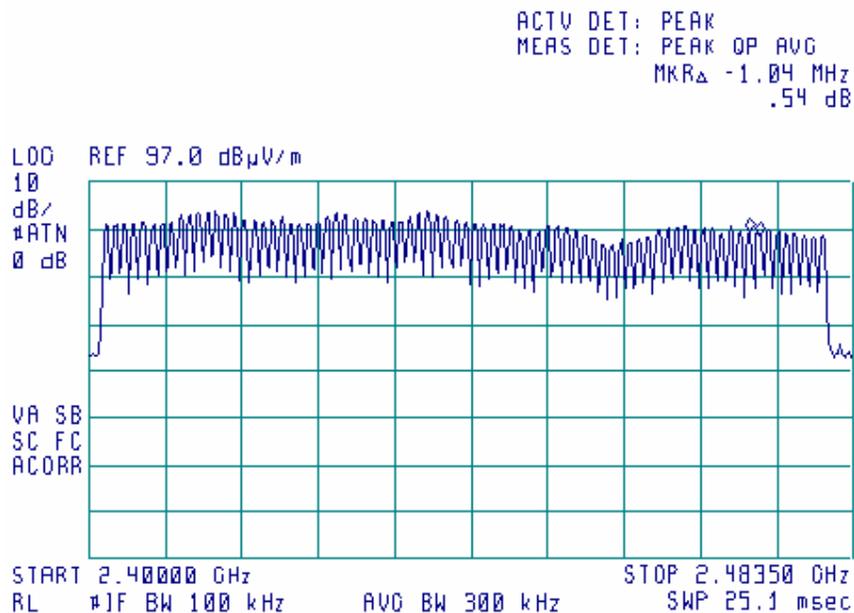
* - Margin = Carrier frequency separation – specification limit.

Reference numbers of test equipment used

HL 0467	HL 0521	HL 0589	HL 1947				
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Full description is given in Appendix A.

Plot 7.2.1 Carrier frequency separation



Test specification:	Section 15.247(a)1, Number of hopping frequencies		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/28/2004 6:22:38 PM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

7.3 Number of hopping frequencies

7.3.1 General

This test was performed to calculate the number of hopping frequencies used by the EUT. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Minimum number of hopping frequencies

Assigned frequency range, MHz	Number of hopping frequencies
2400.0 – 2483.5	15

7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized with frequency hopping function enabled and its proper operation was checked.

7.3.2.2 Initially the spectrum analyzer span was set equal to frequency band of operation and the resolution bandwidth was set wider than 1 % of the frequency span. If the separate hopping channels were not clearly resolved the frequency band of operation was broken to sections and the resolution bandwidth was set wider than 1 % of the frequency span of each section.

7.3.2.3 The spectrum analyzer was set in max hold mode and allowed trace to stabilize.

7.3.2.4 The number of frequency hopping channels was calculated as provided in Table 7.3.2 and associated plots.

Figure 7.3.1 Hopping frequencies test setup



Test specification: Section 15.247(a)1, Number of hopping frequencies			
Test procedure: Public notice DA 00-705			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/28/2004 6:22:38 PM			
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Table 7.3.2 Hopping frequencies test results

ASSIGNED FREQUENCY: 2400 – 2483.5 MHz
 MODULATION: GFSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 1 Mbps
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: ≥ 1% of the span
 VIDEO BANDWIDTH: ≥ RBW
 FREQUENCY HOPPING: Enabled

Number of hopping frequencies	Minimum number of hopping frequencies	Margin*	Verdict
79	15	64	Pass

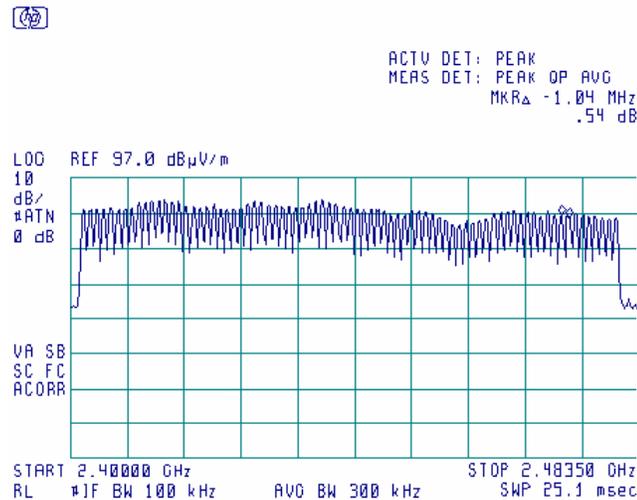
* - Margin = Number of hopping frequencies – Minimum number of hopping frequencies.

Reference numbers of test equipment used

HL 1424	HL 1947	HL 1984				
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Full description is given in Appendix A.

Plot 7.3.1 Number of hopping frequencies



Test specification:	Section 15.247(a)1, Average time of occupancy		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	12/2/2004 9:04:35 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

7.4 Average time of occupancy

7.4.1 General

This test was performed to calculate the average time of occupancy (dwell time) on any frequency channel of the EUT. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Average time of occupancy limits

Assigned frequency range, MHz	Maximum average time of occupancy, s	Investigated period, s	Number of hopping frequencies
2400.0 – 2483.5	0.4	$0.4 \times N$	$N (\geq 15)$

7.4.2 Test procedure

- 7.4.2.1 The EUT was set up as shown in Figure 7.4.1 , energized with frequency hopping function enabled and its proper operation was checked.
- 7.4.2.2 The spectrum analyzer span was set to zero centered on a hopping channel.
- 7.4.2.3 The single transmission duration and period were measured with oscilloscope.
- 7.4.2.4 The average time of occupancy was calculated as the single transmission time multiplied by the investigated period and divided by the single transmission period.
- 7.4.2.5 The test was repeated at each data rate and modulation type as provided in Table 7.4.2 and associated plots.

Figure 7.4.1 Average time of occupancy test setup



Test specification:		Section 15.247(a)1, Average time of occupancy	
Test procedure:		Public notice DA 00-705	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/2/2004 9:04:35 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Table 7.4.2 Average time of occupancy test results

ASSIGNED FREQUENCY: 2400 – 2483.5 MHz
 MODULATION: GFSK
 MODULATING SIGNAL: 1 PRBS
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1 MHz
 VIDEO BANDWIDTH: 3 MHz
 NUMBER OF HOPPING FREQUENCIES: 79
 INVESTIGATED PERIOD: 31.6 s
 FREQUENCY HOPPING: Enabled

Carrier frequency, MHz	Single transmission duration, ms	Single transmission period, ms	Symbol rate, Msymbol/s	Bit rate, Mbps	Average time of occupancy*, s	Limit, s	Margin, s**	Verdict
2440	2.967	3.76	1	1	0.310	0.4	-0.09	Pass

* - Average time of occupancy = (Single transmission duration × Investigated period) / Single transmission period.

** - Margin = Average time of occupancy – specification limit.

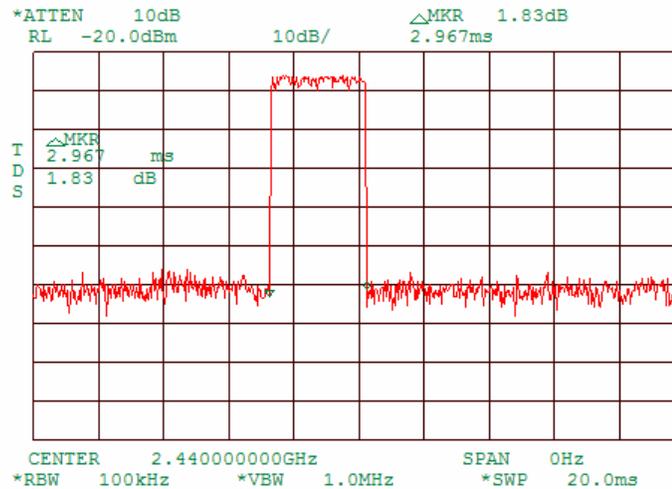
Reference numbers of test equipment used

HL 0467	HL 0604	HL 1424	HL 1984				
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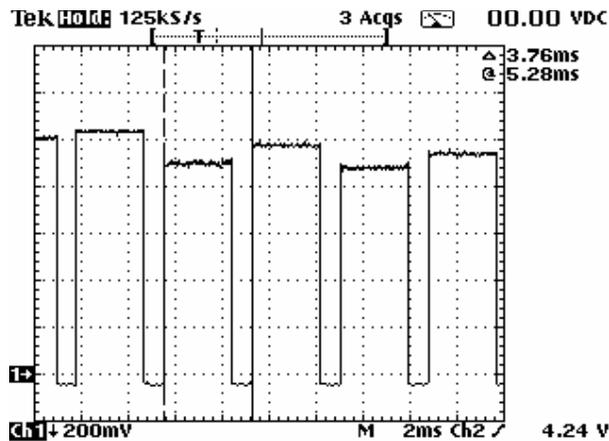
Full description is given in Appendix A.

Test specification:	Section 15.247(a)1, Average time of occupancy		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/2/2004 9:04:35 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Plot 7.4.1 Single transmission duration



Plot 7.4.2 Single transmission period



Test specification: Section 15.247(b), Peak output power			
Test procedure: Public notice DA 00-705			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 9:33:37 AM			
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

7.5 Peak output power

7.5.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Peak output power limits

Assigned frequency range, MHz	Peak output power*		Equivalent field strength limit @ 3m, dB(μV/m)*	Maximum antenna gain, dBi
	W	dBm		
2400.0 – 2483.5	1.0 (≥75 hopping channels)	30.0 (≥75 hopping channels)	131.2 (≥75 hopping channels)	6.0*

*- Equivalent field strength limit was calculated from the peak output power as follows: $E = \sqrt{30 \times P \times G} / r$, where P is peak output power in Watts, r is antenna to EUT distance in meters and G is transmitter antenna gain in dBi.

** - The limit is provided in terms of conducted RF power at the antenna connector. If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power limit shall be reduced below the stated value as follows:

- by 1 dB for every 3 dB that the directional gain of antenna exceeds 6 dBi for fixed point-to-point transmitters operate in 2400-2483.5 MHz band;
- without any corresponding reduction for fixed point-to-point transmitters operate in 5725-5850 MHz band;
- by the amount in dB that the directional gain of antenna exceeds 6 dBi for the rest of transmitters.

7.5.2 Test procedure

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.

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

7.5.2.3 The frequency span of spectrum analyzer was set approximately 5 times wider than 20 dB bandwidth of the EUT and the resolution bandwidth was set wider than 20 dB bandwidth of the EUT. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept in both vertical and horizontal polarizations.

7.5.2.4 The maximum field strength of the EUT carrier frequency was measured as provided in Table 7.5.2 and associated plots.

7.5.2.5 The maximum peak output power was calculated from the field strength of carrier as follows:

$$P = (E \times d)^2 / (30 \times G),$$

where P is the peak output power in W, E is the field strength in V/m, d is the test distance and G is the transmitter numeric antenna gain over an isotropic radiator.

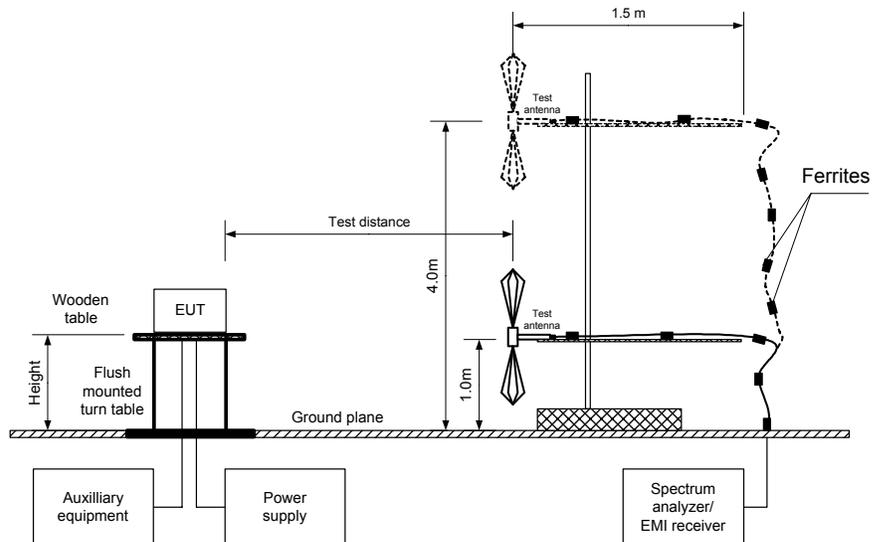
The above equation was converted in logarithmic units for 3 m test distance:

$$\text{Peak output power in dBm} = \text{Field strength in dB}(\mu\text{V/m}) - \text{Transmitter antenna gain in dBi} - 95.2 \text{ dB}$$

7.5.2.6 The worst test results (the lowest margins) were recorded in Table 7.5.2.

Test specification:	Section 15.247(b), Peak output power		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:33:37 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Figure 7.5.1 Setup for carrier field strength measurements



Test specification:		Section 15.247(b), Peak output power	
Test procedure:		Public notice DA 00-705	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:33:37 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Table 7.5.2 Peak output power test results

ASSIGNED FREQUENCY: 2400 – 2483.5 MHz
TEST DISTANCE: 3 m
TEST SITE: Semi anechoic chamber
EUT HEIGHT: 0.8 m
DETECTOR USED: Peak
TEST ANTENNA TYPE: Double ridged guide
MODULATION: GFSK
MODULATING SIGNAL: PRBS
BIT RATE: 1 Mbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: Peak
EUT 20 dB BANDWIDTH: 1 MHz
RESOLUTION BANDWIDTH: 3 MHz
VIDEO BANDWIDTH: 3 MHz
FREQUENCY HOPPING: Disabled
NUMBER OF FREQUENCY HOPPING CHANNELS: 79

Frequency, MHz	Field strength, dB(μV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	EUT antenna gain, dBi	Peak output power, dBm**	Limit, dBm	Margin, dB***	Verdict
2402	90.05	V	1.46	141	-6	0.82	30	-29.18	Pass
2402	89.43	H	1.00	21	-6	0.20	30	-29.80	Pass
2440	87.8	V	1.17	121	-6	-1.43	30	-31.43	Pass
2440	88.49	H	1.78	240	-6	-0.74	30	-30.74	Pass
2480	85.87	V	1.14	318	-6	-3.36	30	-33.36	Pass
2480	89.17	H	1.75	283	-6	-0.06	30	-30.06	Pass

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

** - Peak output power was calculated from the field strength of carrier as follows: $P = (E \times d)^2 / (30 \times G)$, where P is the peak output power in W, E is the field strength in V/m, d is the test distance in meters and G is the transmitter numeric antenna gain over an isotropic radiator. The above equation was converted in logarithmic units for 3 m test distance: *Peak output power in dBm = Field strength in dB(μV/m) - Transmitter antenna gain in dBi - 95.2 dB*

*** - Margin = Peak output power – specification limit.

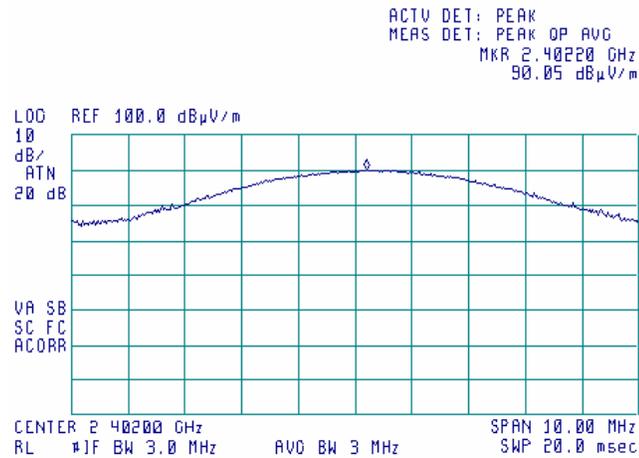
Reference numbers of test equipment used

HL 0465	HL 0521	HL 0589	HL 1947	HL 1984	HL 2009		
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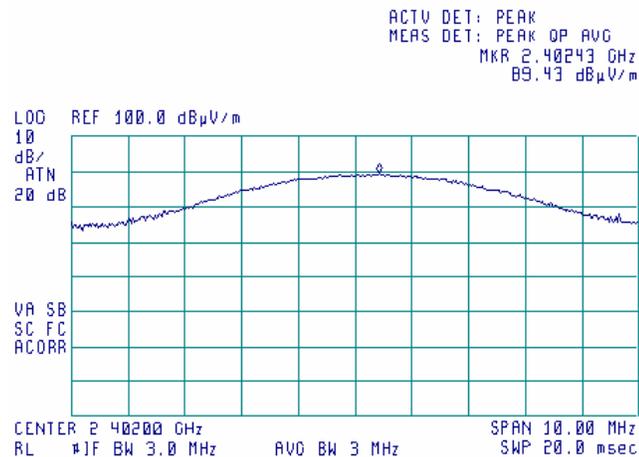
Full description is given in Appendix A.

Test specification:	Section 15.247(b), Peak output power		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:33:37 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Plot 7.5.1 Field strength of carrier at low frequency, vertical polarization

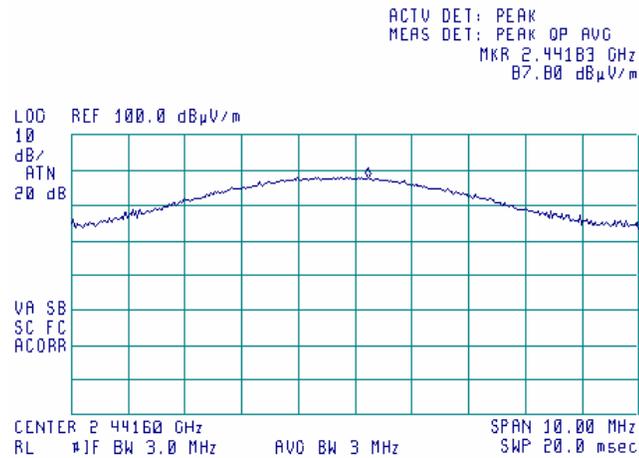


Plot 7.5.2 Field strength of carrier at low frequency, horizontal polarization

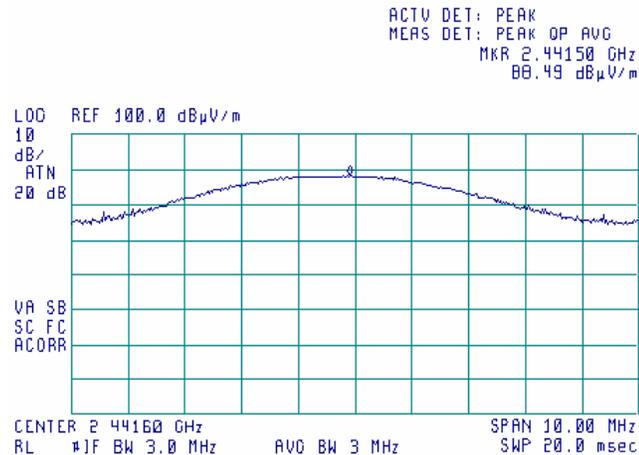


Test specification:	Section 15.247(b), Peak output power		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:33:37 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Plot 7.5.3 Field strength of carrier at mid frequency, vertical polarization

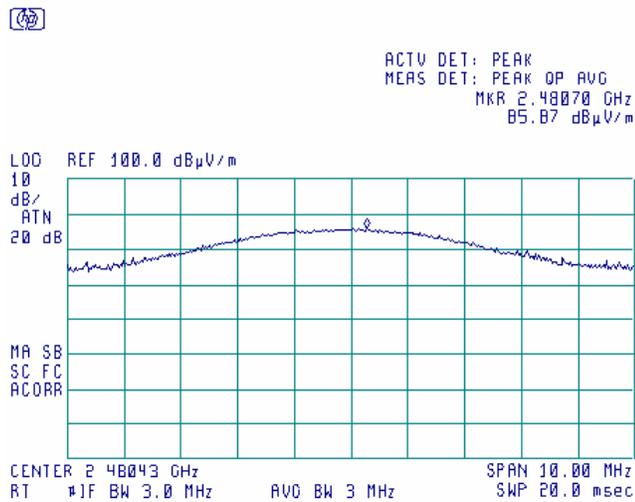


Plot 7.5.4 Field strength of carrier at mid frequency, horizontal polarization

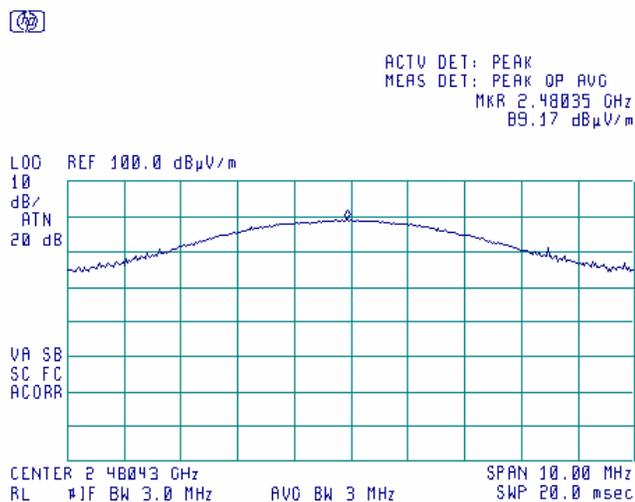


Test specification:	Section 15.247(b), Peak output power		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:33:37 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Plot 7.5.5 Field strength of carrier at high frequency, vertical polarization



Plot 7.5.6 Field strength of carrier at high frequency, horizontal polarization



Test specification: Section 15.247(c), Emissions at band edges			
Test procedure: Public notice DA 00-705			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 9:35:20 AM			
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

7.6 Band edge radiated emissions

7.6.1 General

This test was performed to measure emissions, radiated from the EUT at the assigned frequency band edges. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Band edge emission limits

Assigned frequency, MHz	Attenuation below carrier*, dBc
902.0 – 928.0	20.0
2400.0 – 2483.5	
5725.0 – 5850.0	

* - Band edge emission limit is provided in terms of attenuation below the peak of modulated carrier measured with the same resolution bandwidth.

7.6.2 Test procedure

- 7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized normally modulated at the maximum data rate with its hopping function disabled and its proper operation was checked.
- 7.6.2.2 The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.
- 7.6.2.3 The spectrum analyzer span was set to capture the carrier frequency and associated modulation products. The resolution bandwidth was set wider than 1 % of the frequency span.
- 7.6.2.4 The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.
- 7.6.2.5 The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.6.2 and associated plots and referenced to the highest emission level measured within the authorized band.
- 7.6.2.6 The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.
- 7.6.2.7 The above procedure was repeated with the frequency hopping function enabled.

Figure 7.6.1 Band edge emission test setup



Test specification:		Section 15.247(c), Emissions at band edges	
Test procedure:		Public notice DA 00-705	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:35:20 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Table 7.6.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 2400 – 2483.5 MHz
DETECTOR USED: Peak
MODULATION: GFSK
MODULATING SIGNAL: PRBS
BIT RATE: 1 Mbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
RESOLUTION BANDWIDTH: ≥ 1% of the span
VIDEO BANDWIDTH: ≥ RBW

Frequency, MHz	Band edge emission, dBm	Emission at carrier, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Frequency hopping disabled						
2400.0	60.65	85.9	25.25	20.0	5.25	Pass
2483.5	61.82	88.0	26.18		6.18	
Frequency hopping enabled						
2400.0	60.36	27.64	27.64	20.0	7.64	Pass
2483.5	62.41	22.89	22.89		2.89	

*- Margin = Attenuation below carrier – specification limit.

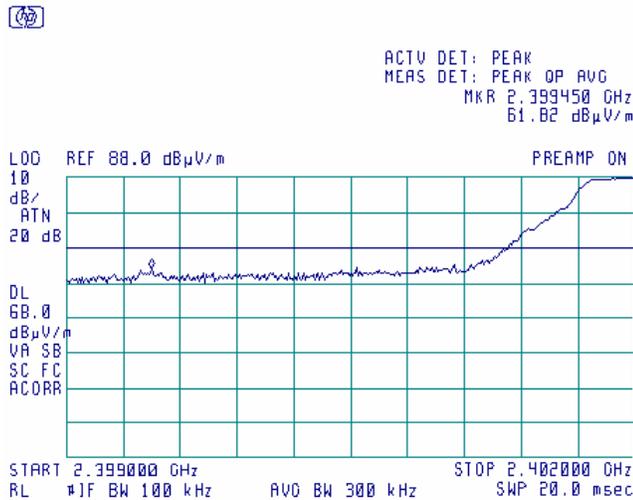
Reference numbers of test equipment used

HL 0521	HL 1942	HL 1984				
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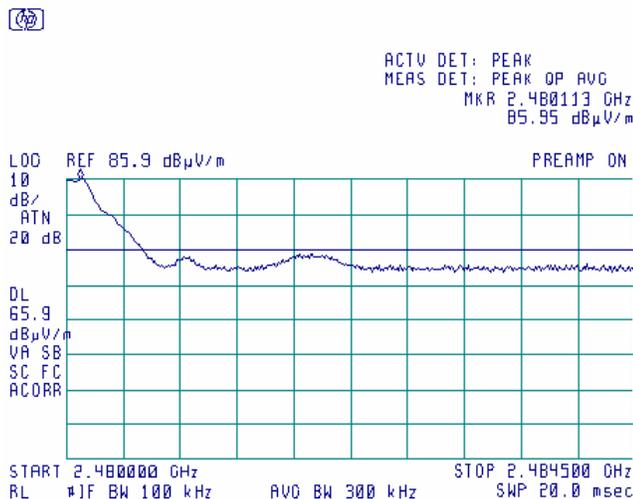
Full description is given in Appendix A.

Test specification:	Section 15.247(c), Emissions at band edges		
Test procedure:	Public notice DA 00-705		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:35:20 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Plot 7.6.1 The highest emission level within the assigned band at low carrier frequency with hopping disabled

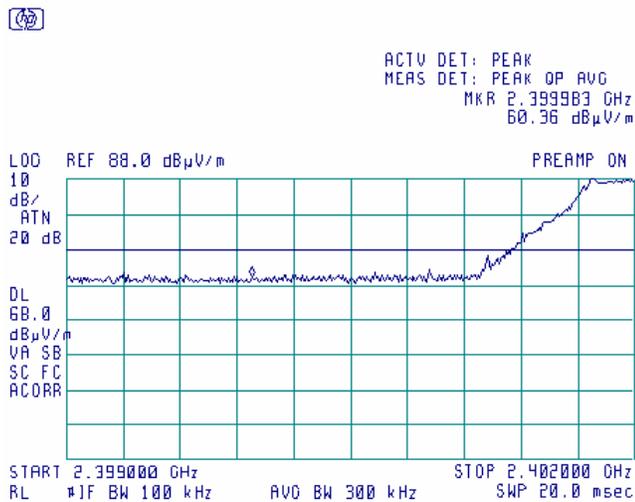


Plot 7.6.2 The highest emission level within the assigned band at high carrier frequency with hopping disabled

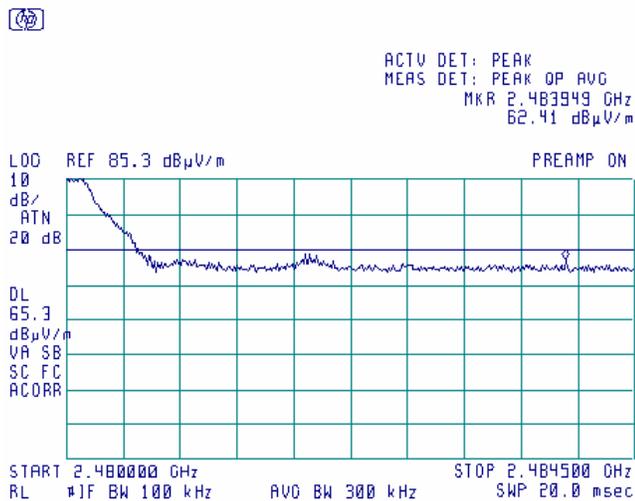


Test specification:		Section 15.247(c), Emissions at band edges	
Test procedure:		Public notice DA 00-705	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:35:20 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Plot 7.6.3 The highest band edge emission at low carrier frequency with hopping enabled



Plot 7.6.4 The highest band edge emission at high carrier frequency with hopping enabled



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

7.7 Field strength of spurious emissions

7.7.1 General

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

Table 7.7.1 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m within restricted bands, dB(μV/m)***			Attenuation of field strength of spurious versus carrier outside restricted bands, dBc***
	Peak	Quasi Peak	Average	
0.009 – 0.490*	NA	128.5 – 93.8**	NA	20.0
0.490 – 1.705*		73.8 – 63.0**		
1.705 – 30.0*		69.5**		
30 – 88		40.0		
88 – 216		43.5		
216 – 960		46.0		
960 - 1000		54.0		
Above 1000		74.0		

* - The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$\text{Lims}_2 = \text{Lims}_1 + 40 \log(S_1/S_2),$$

where S_1 and S_2 – standard defined and test distance respectively in meters.

** - The limit decreases linearly with the logarithm of frequency.

*** - The field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.

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/ EMI receiver. 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 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/ 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.

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

Test specification: Section 15.247(c), Radiated spurious emissions			
Test procedure: Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 10:06:13 AM			
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Figure 7.7.1 Setup for spurious emission field strength measurements below 30 MHz

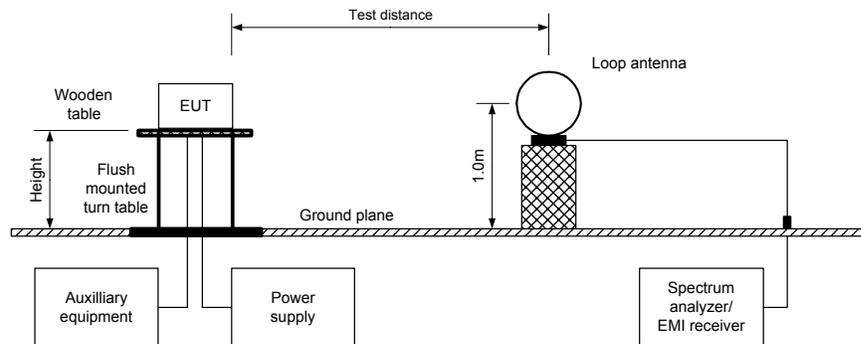
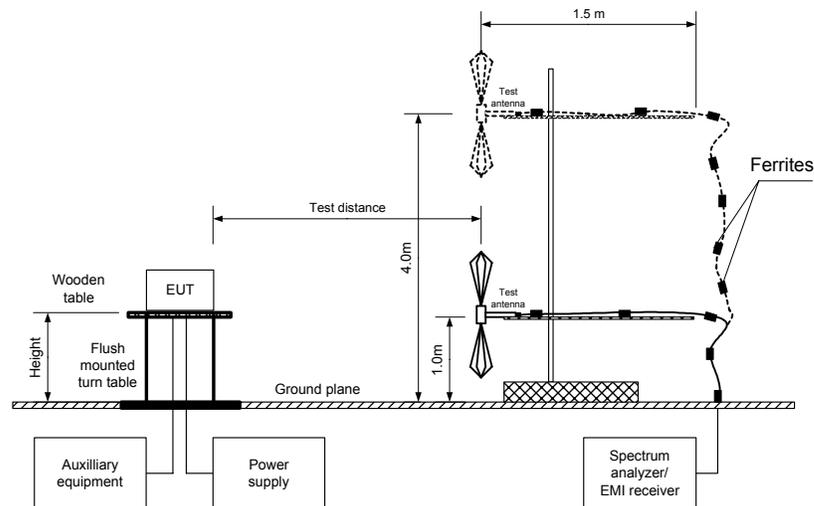


Figure 7.7.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:		Section 15.247(c), Radiated spurious emissions	
Test procedure:		Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Table 7.7.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 2400 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 - 26000 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 1 Mbps
 DUTY CYCLE: 100 %
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 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)
 FREQUENCY HOPPING: Disabled

Frequency, MHz	Field strength of spurious, dB(μV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	Field strength of carrier, dB(μV/m)	Attenuation below carrier, dBc	Limit, dBc	Margin, dB**	Verdict
No spurious were found									

Table 7.7.3 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY: 2400 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 1000 -26000 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 1 Mbps
 DUTY CYCLE: 100 %
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1000 kHz
 TEST ANTENNA TYPE: Double ridged guide
 FREQUENCY HOPPING: Disabled

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength(VBW=3 MHz)			Average field strength(VBW=10 Hz)				Verdict
	Polarization	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB***	
No spurious were found											

Test specification:		Section 15.247(c), Radiated spurious emissions	
Test procedure:		Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Table 7.7.4 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY: 2400 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
 TEST DISTANCE: 3 m
 MODULATION: GFSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 1 Mbps
 DUTY CYCLE: 100 %
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 RESOLUTION BANDWIDTH: 1 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 120 kHz (30 MHz – 1000 MHz)
 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)
 FREQUENCY HOPPING: Disabled

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

Table 7.7.5 Restricted bands

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2655 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.29 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.42 - 16.423	156.7 - 156.9	1660 - 1710	5350 - 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 - 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

Reference numbers of test equipment used

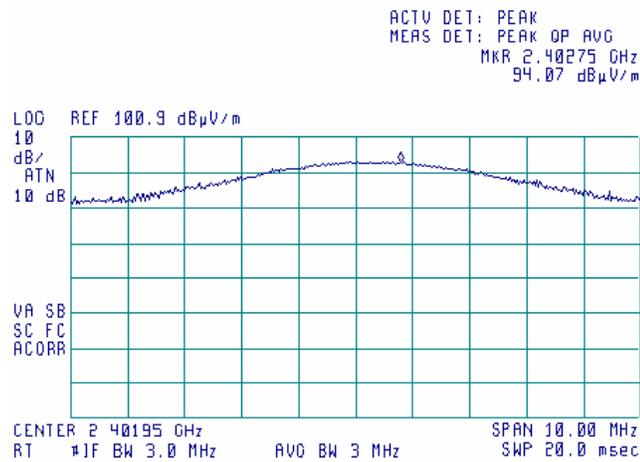
HL 0467	HL 0446	HL 0410	HL 0521	HL 0589	HL 0768	HL 1424	HL 1942
HL 1947	HL 1984	HL 2009	HL 2259	HL 2260	HL 2387		

Full description is given in Appendix A.

Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

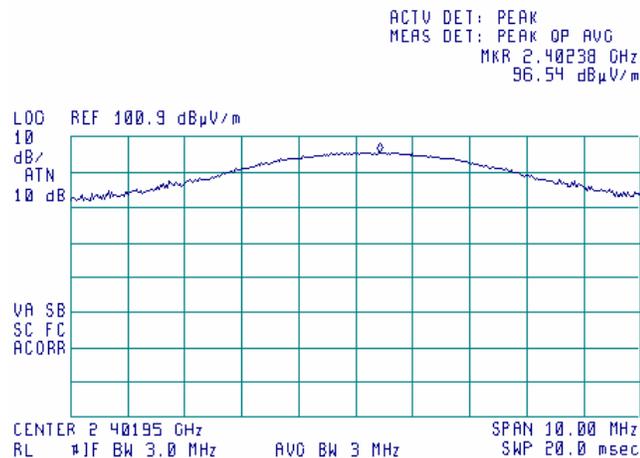
Plot 7.7.1 Radiated emission measurements at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.2 Radiated emission measurements at the low carrier frequency

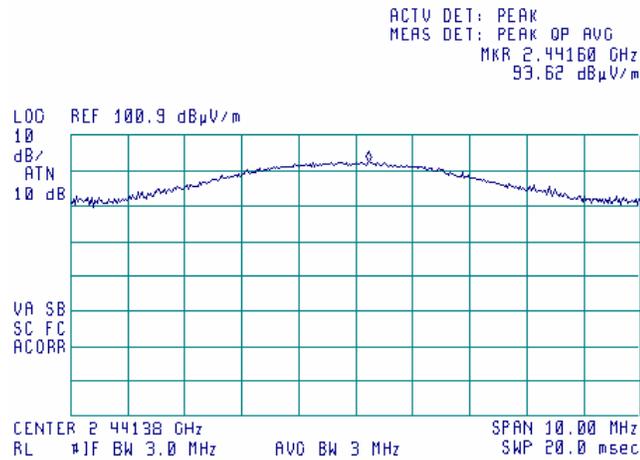
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

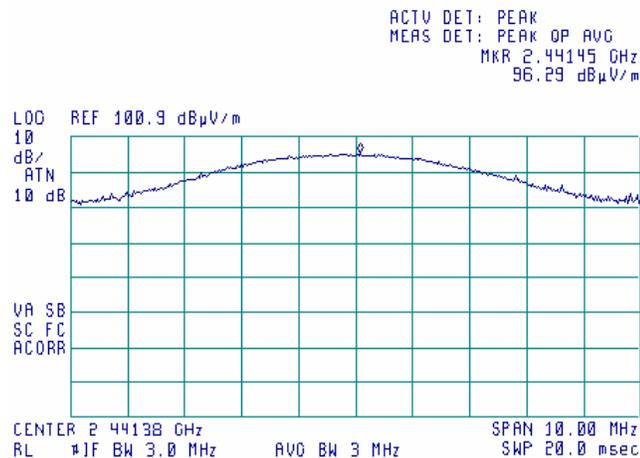
Plot 7.7.3 Radiated emission measurements at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.4 Radiated emission measurements at the mid carrier frequency

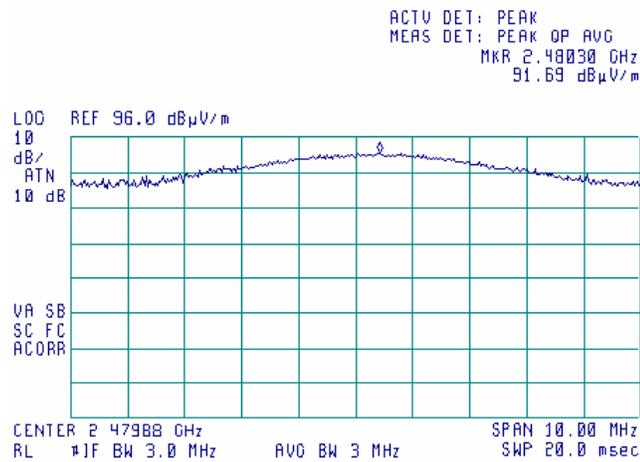
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification: Section 15.247(c), Radiated spurious emissions			
Test procedure: Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 10:06:13 AM			
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

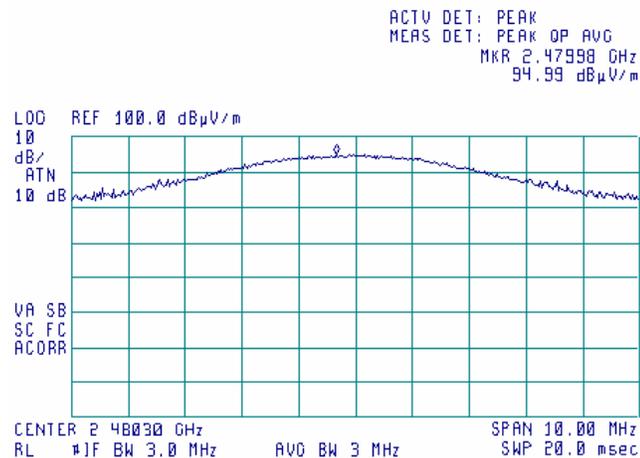
Plot 7.7.5 Radiated emission measurements at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.6 Radiated emission measurements at the high carrier frequency

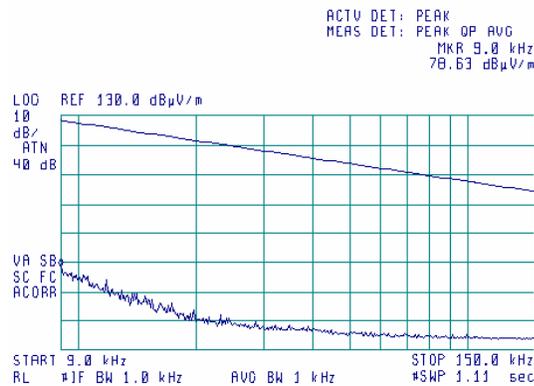
TEST SITE: anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:		Section 15.247(c), Radiated spurious emissions	
Test procedure:		Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

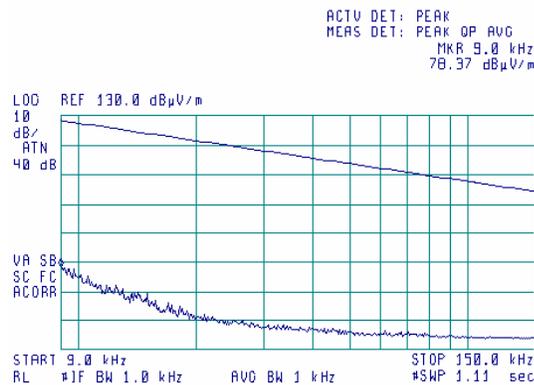
Plot 7.7.7 Radiated emission measurements from 9 to 150 kHz at the low carrier frequency

TEST SITE: anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.8 Radiated emission measurements from 9 to 150 kHz at the mid carrier frequency

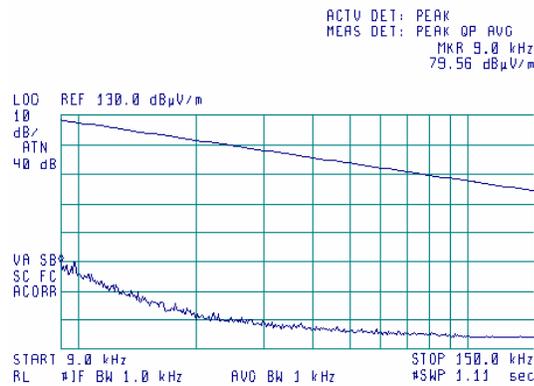
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

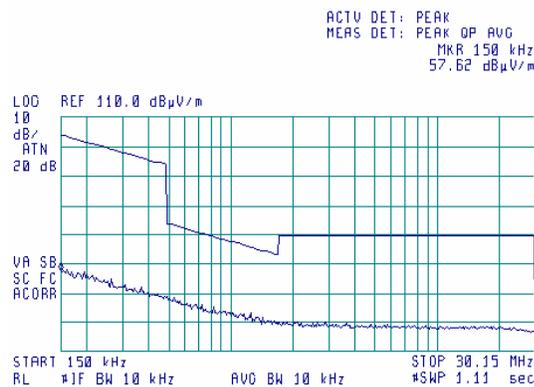
Plot 7.7.9 Radiated emission measurements from 9 to 150 kHz at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.10 Radiated emission measurements from 0.15 to 30 MHz at the low carrier frequency

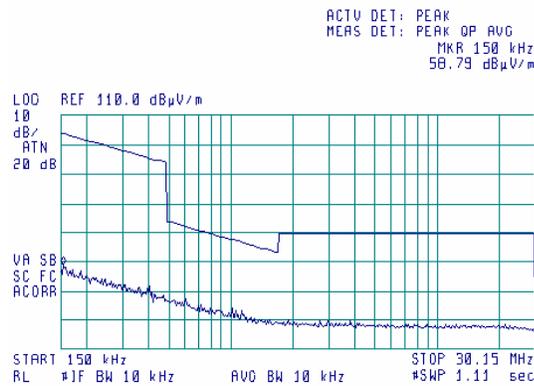
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

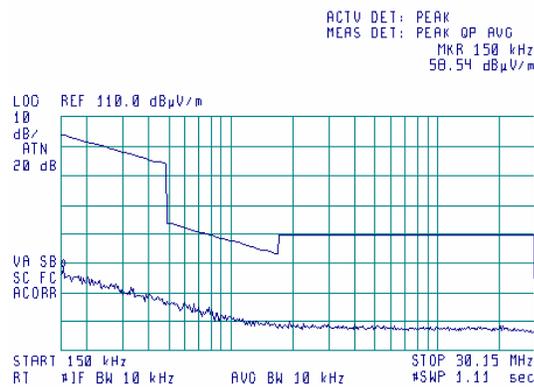
Plot 7.7.11 Radiated emission measurements from 0.15 to 30 MHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.7.12 Radiated emission measurements from 0.15 to 30 MHz at the high carrier frequency

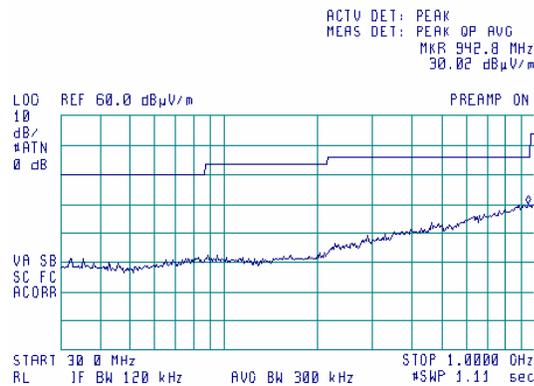
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Test specification:		Section 15.247(c), Radiated spurious emissions	
Test procedure:		Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

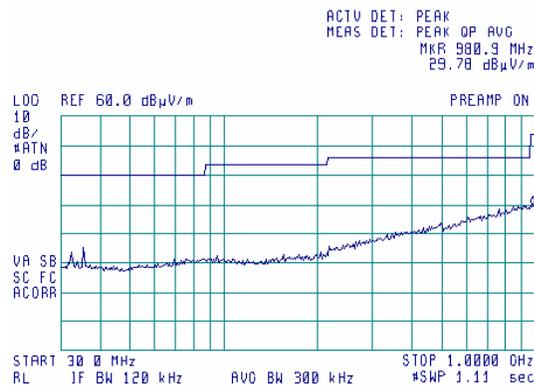
Plot 7.7.13 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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



Plot 7.7.14 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

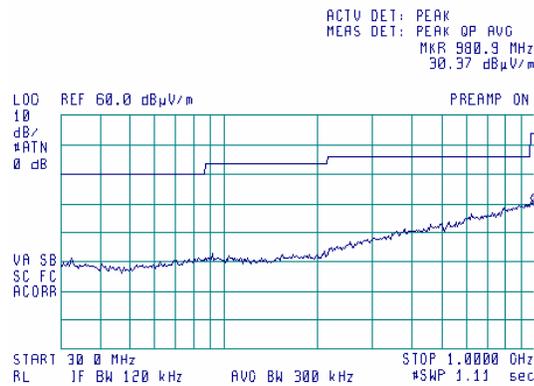
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(c), Radiated spurious emissions			
Test procedure: Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 10:06:13 AM			
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

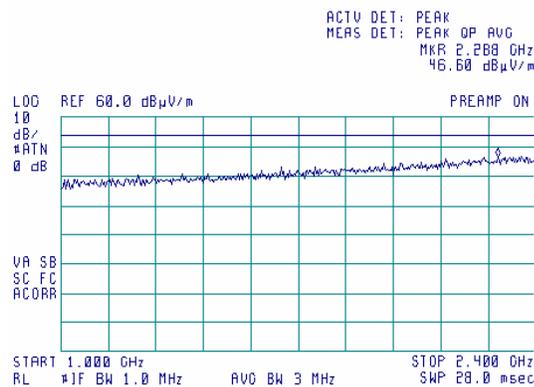
Plot 7.7.15 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

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



Plot 7.7.16 Radiated emission measurements from 1000 to 2400 MHz at the low carrier frequency

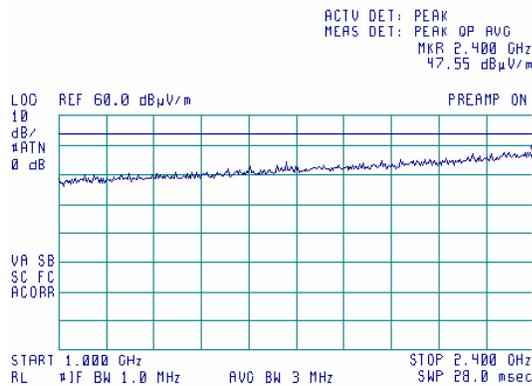
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

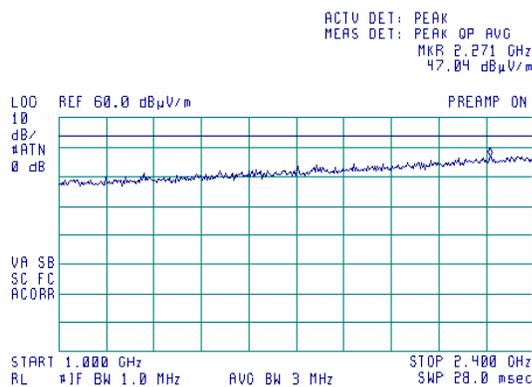
Plot 7.7.17 Radiated emission measurements from 1000 to 2400 MHz at the mid carrier frequency

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



Plot 7.7.18 Radiated emission measurements from 1000 to 2400 MHz at the high carrier frequency

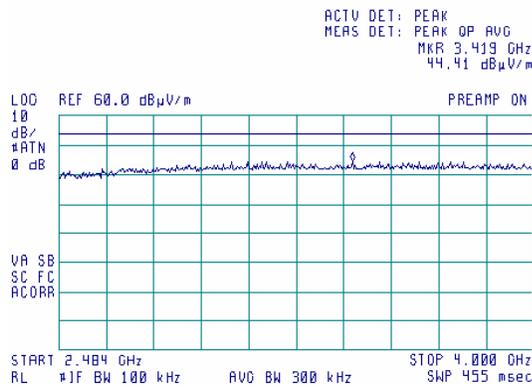
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(c), Radiated spurious emissions			
Test procedure: Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 10:06:13 AM			
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

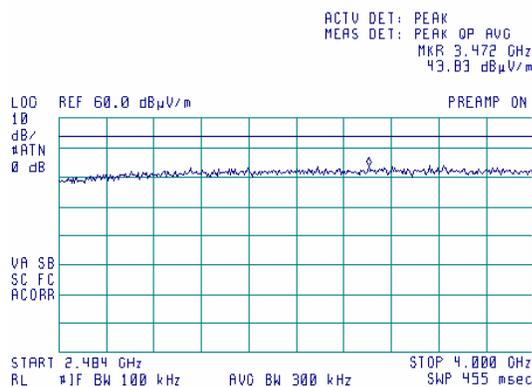
Plot 7.7.19 Radiated emission measurements from 2483.5 to 4000 MHz at the low carrier frequency

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



Plot 7.7.20 Radiated emission measurements from 2483.5 to 4000 MHz at the mid carrier frequency

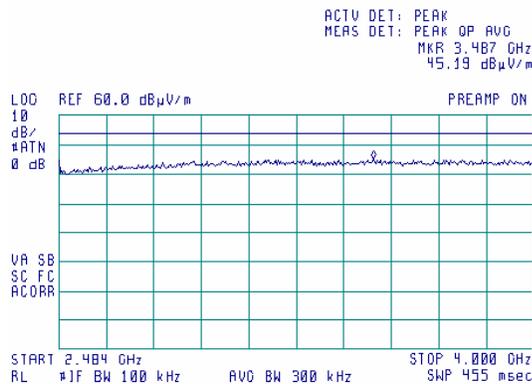
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

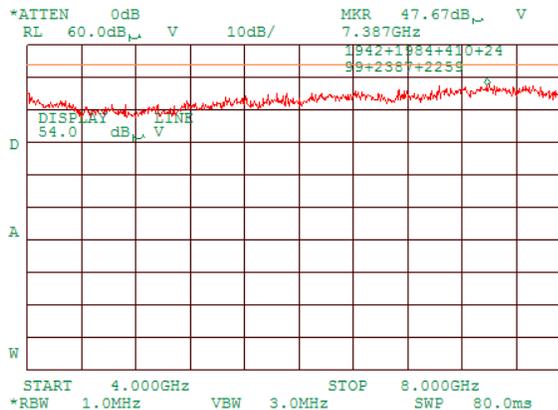
Plot 7.7.21 Radiated emission measurements from 2483.5 to 4000 MHz at the high carrier frequency

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



Plot 7.7.22 Radiated emission measurements from 4000 to 8000 MHz at the low carrier frequency

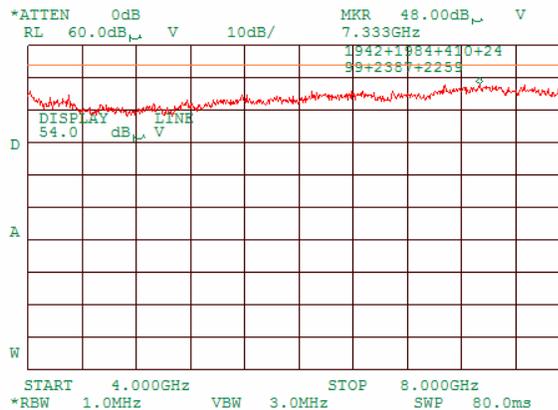
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

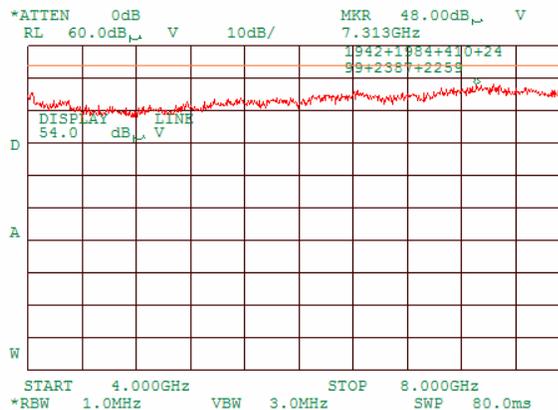
Plot 7.7.23 Radiated emission measurements from 4000 to 8000 MHz at the mid carrier frequency

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



Plot 7.7.24 Radiated emission measurements from 4000 to 8000 MHz at the high carrier frequency

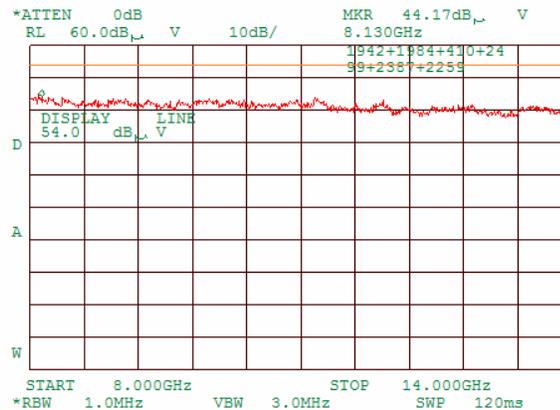
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

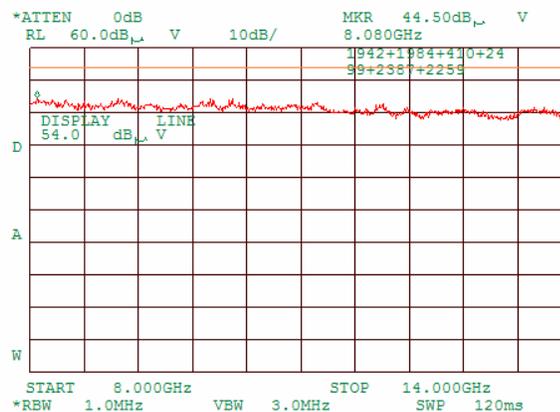
Plot 7.7.25 Radiated emission measurements from 8000 to 14000 MHz at the low carrier frequency

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



Plot 7.7.26 Radiated emission measurements from 8000 to 14000 MHz at the mid carrier frequency

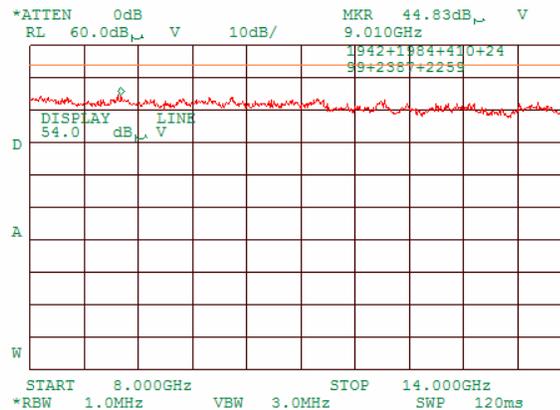
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

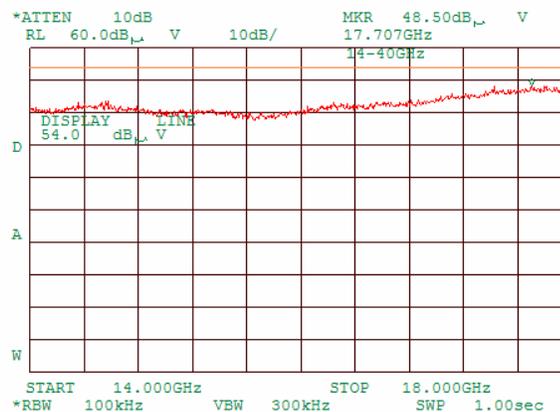
Plot 7.7.27 Radiated emission measurements from 8000 to 14000 MHz at the high carrier frequency

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



Plot 7.7.28 Radiated emission measurements from 14000 to 18000 MHz at the low carrier frequency

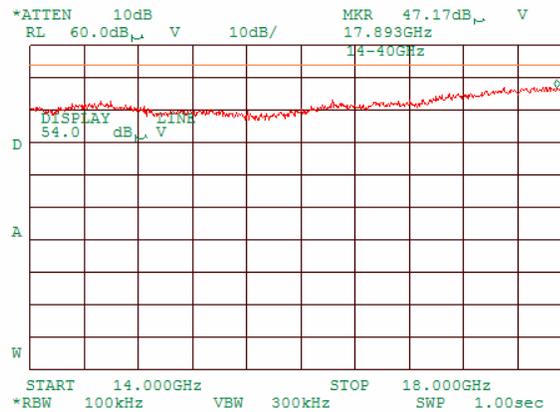
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:		Section 15.247(c), Radiated spurious emissions	
Test procedure:		Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

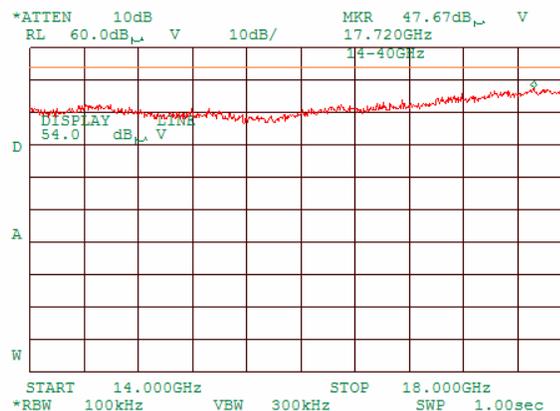
Plot 7.7.29 Radiated emission measurements from 14000 to 18000 MHz at the mid carrier frequency

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



Plot 7.7.30 Radiated emission measurements from 14000 to 18000 MHz at the high carrier frequency

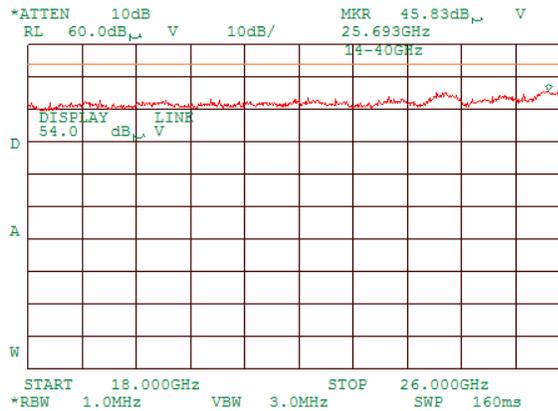
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

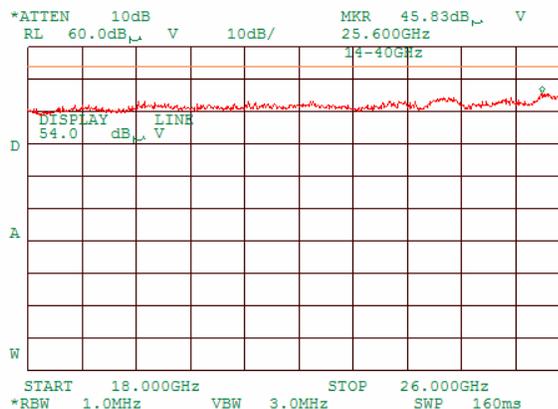
Plot 7.7.31 Radiated emission measurements from 18000 to 26000 MHz at the low carrier frequency

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



Plot 7.7.32 Radiated emission measurements from 18000 to 26000 MHz at the mid carrier frequency

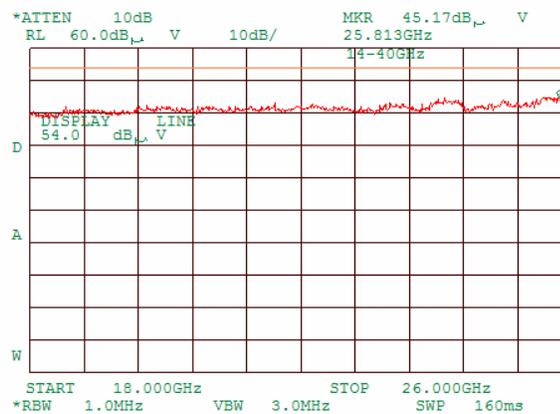
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Test specification: Section 15.247(c), Radiated spurious emissions			
Test procedure: Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 10:06:13 AM			
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

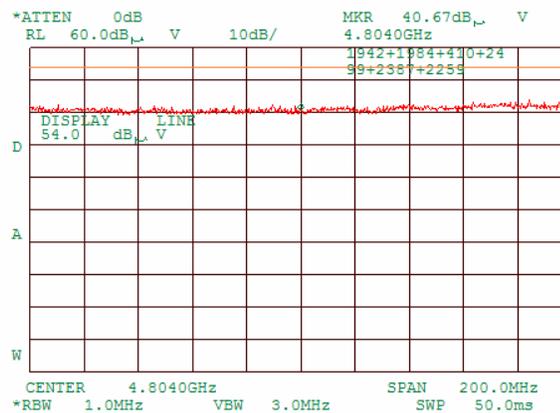
Plot 7.7.33 Radiated emission measurements from 18000 to 26000 MHz at the high carrier frequency

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



Plot 7.7.34 Radiated emission measurements at the second harmonic of low carrier frequency

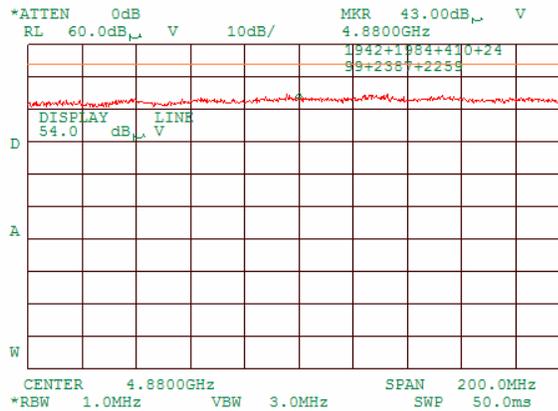
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Test specification:	Section 15.247(c), Radiated spurious emissions		
Test procedure:	Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 10:06:13 AM		
Temperature: 23°C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

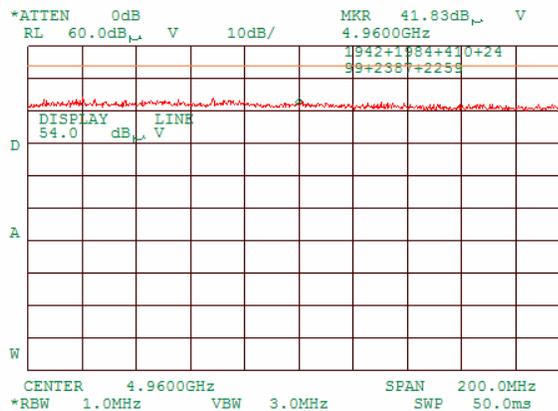
Plot 7.7.35 Radiated emission measurements at the second harmonic of mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.7.36 Radiated emission measurements at the second harmonic of high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:59:10 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

7.8 Radiated emission measurements according to Part 15 subpart B

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.

Test specification: Section 15.109, Radiated emission			
Test procedure: ANSI C63.4, Sections 11.6 and 12.1.4			
Test mode: Compliance		Verdict: PASS	
Date & Time: 11/30/2004 9:59:10 AM			
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

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

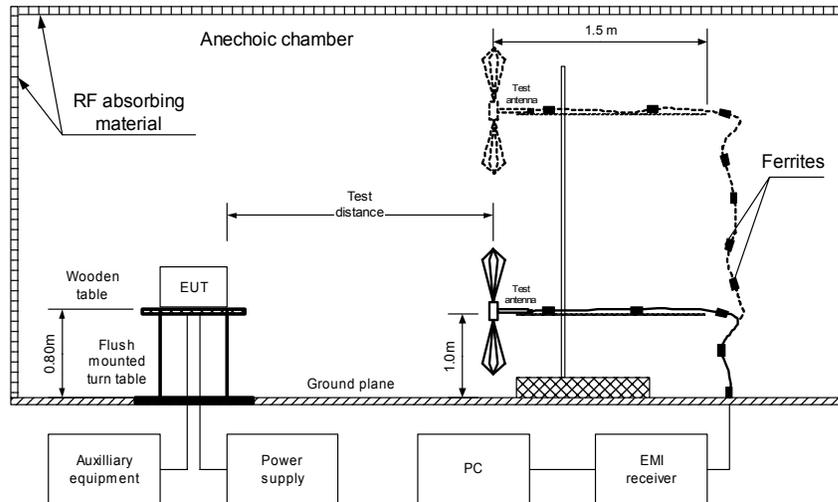
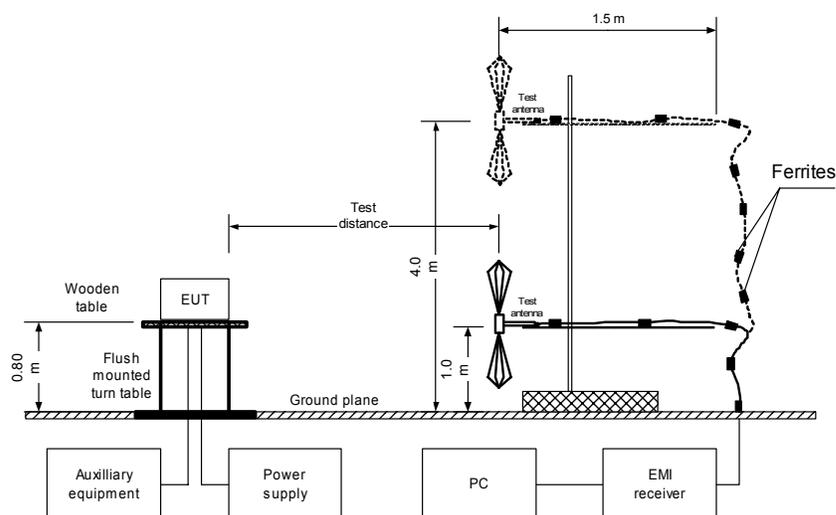


Figure 7.8.2 Setup for radiated emission measurements at OATS, table-top equipment



Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:59:10 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

Table 7.8.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Receive & Stand-by
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

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

TEST SITE: OATS & SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz -
RESOLUTION BANDWIDTH: 1000 kHz

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

Reference numbers of test equipment used

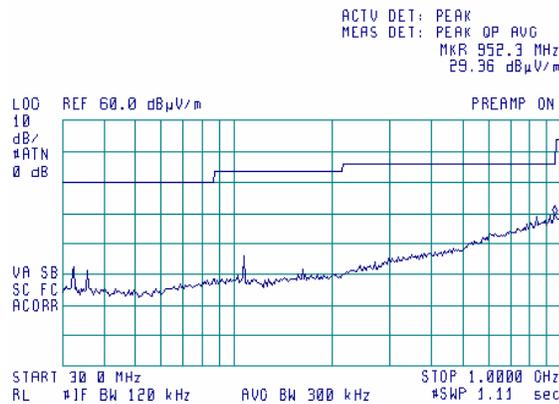
HL 0446	HL 0467	HL 0521	HL 0589	HL 0604	HL 1424	HL 1947	HL 1984
HL 2009	HL 2259						

Full description is given in Appendix A.

Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:59:10 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

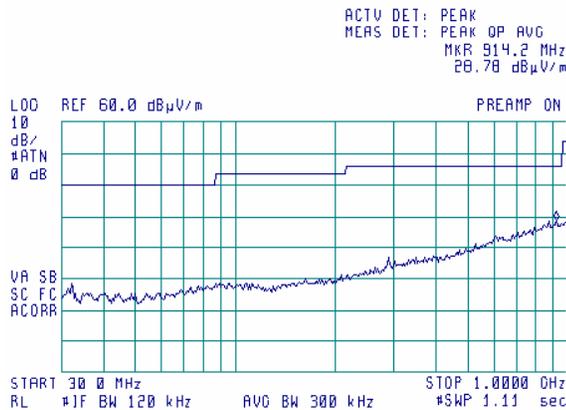
Plot 7.8.1 Radiated emission measurements in 30- 1000 MHz range, vertical antenna polarization

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



Plot 7.8.2 Radiated emission measurements in 30- 1000 MHz range, horizontal antenna polarization

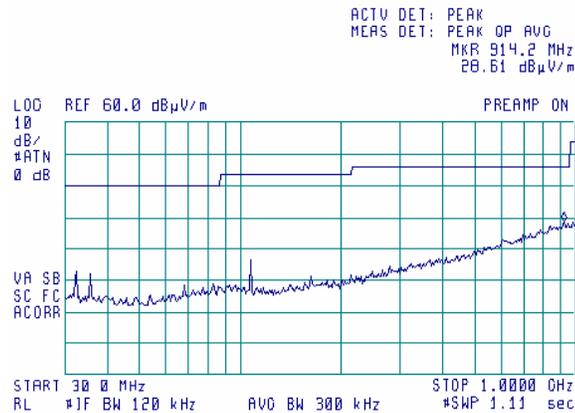
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive



Test specification:		Section 15.109, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4	
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:59:10 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

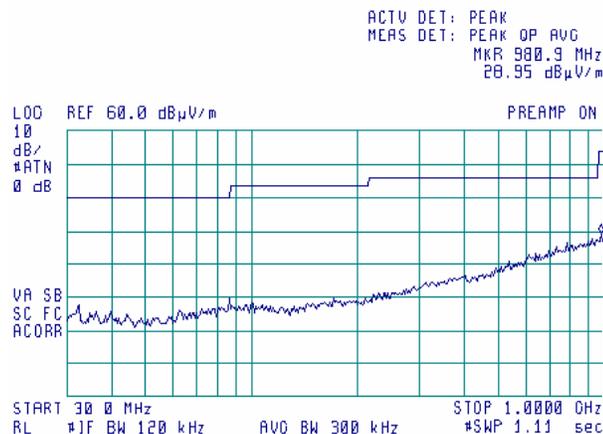
Plot 7.8.3 Radiated emission measurements in 30- 1000 MHz range, vertical antenna polarization

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



Plot 7.8.4 Radiated emission measurements in 30- 1000 MHz range, horizontal antenna polarization

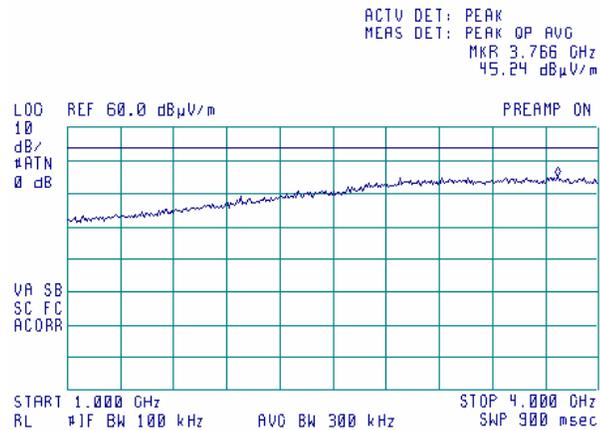
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Stand-by



Test specification: Section 15.109, Radiated emission			
Test procedure: ANSI C63.4, Sections 11.6 and 12.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 9:59:10 AM			
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

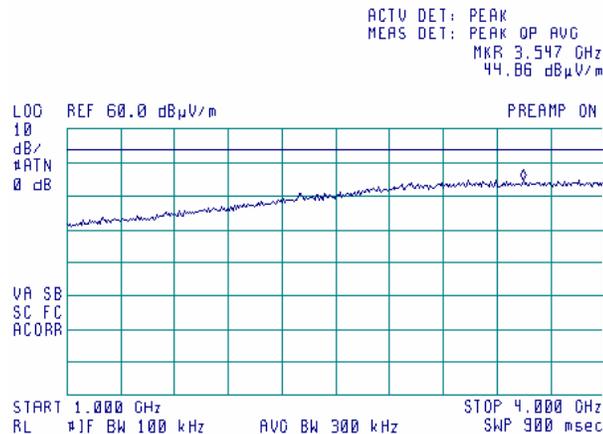
Plot 7.8.5 Radiated emission measurements in 1000 – 4000 MHz, vertical antenna polarization

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



Plot 7.8.6 Radiated emission measurements in 1000 – 4000 MHz, horizontal antenna polarization

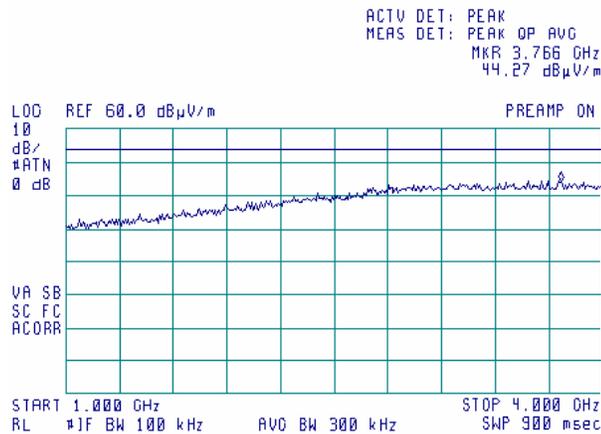
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive



Test specification: Section 15.109, Radiated emission			
Test procedure: ANSI C63.4, Sections 11.6 and 12.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 9:59:10 AM			
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

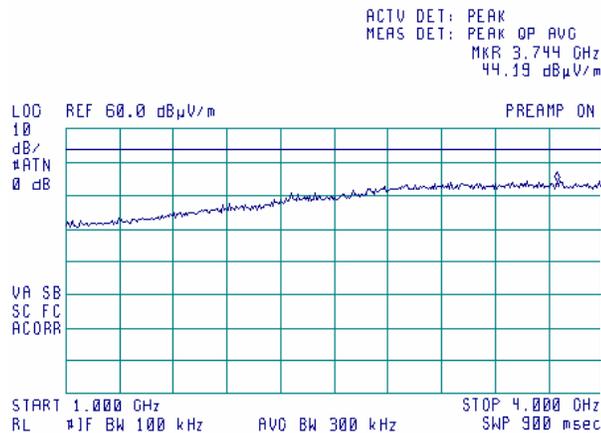
Plot 7.8.7 Radiated emission measurements in 1000 – 4000 MHz, vertical antenna polarization

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



Plot 7.8.8 Radiated emission measurements in 1000 – 4000 MHz, horizontal antenna polarization

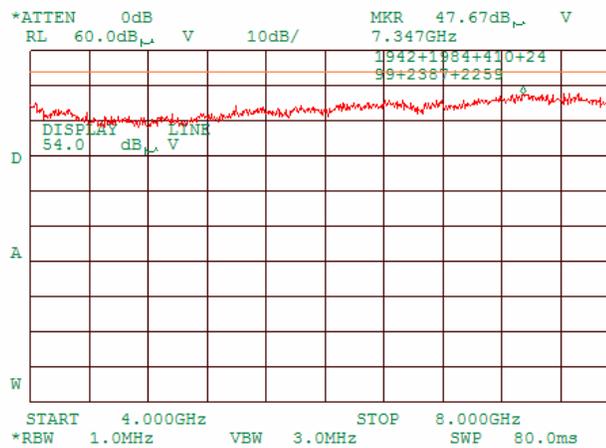
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Stand-by



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:59:10 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

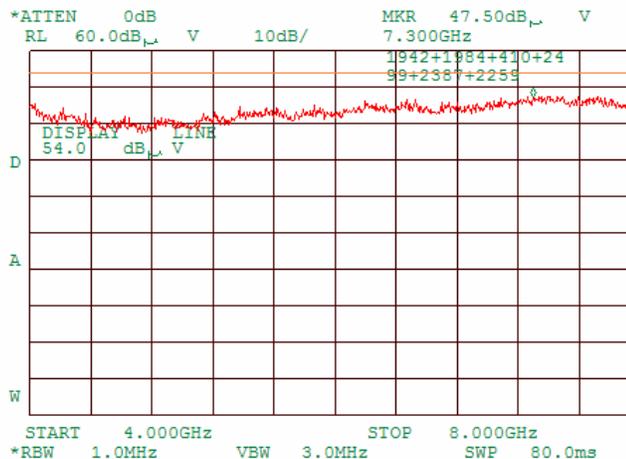
Plot 7.8.9 Radiated emission measurements in 4000 – 8000 MHz, vertical antenna polarization

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



Plot 7.8.10 Radiated emission measurements in 4000 – 8000 MHz, horizontal antenna polarization

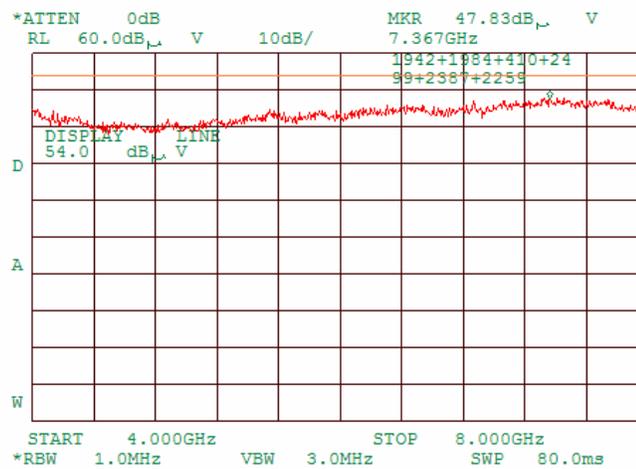
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:59:10 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

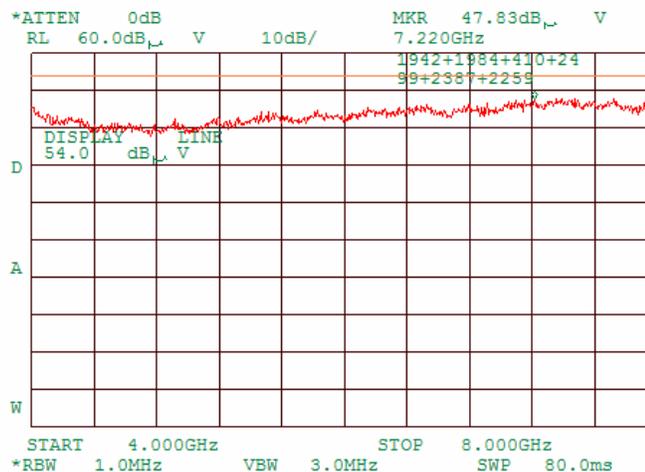
Plot 7.8.11 Radiated emission measurements in 4000 – 8000 MHz, vertical antenna polarization

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



Plot 7.8.12 Radiated emission measurements in 4000 – 8000 MHz, horizontal antenna polarization

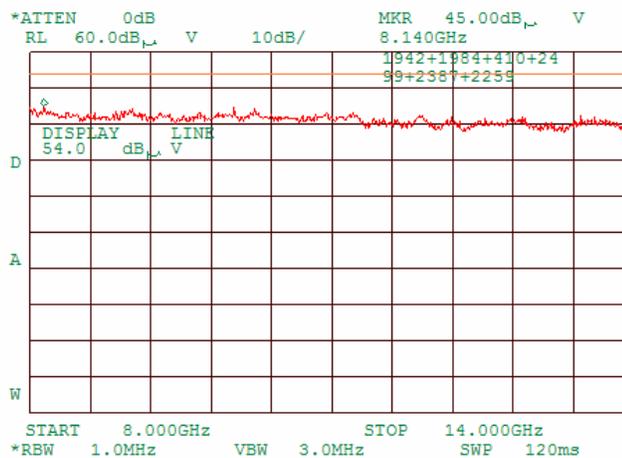
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Stand-by



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2004 9:59:10 AM		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

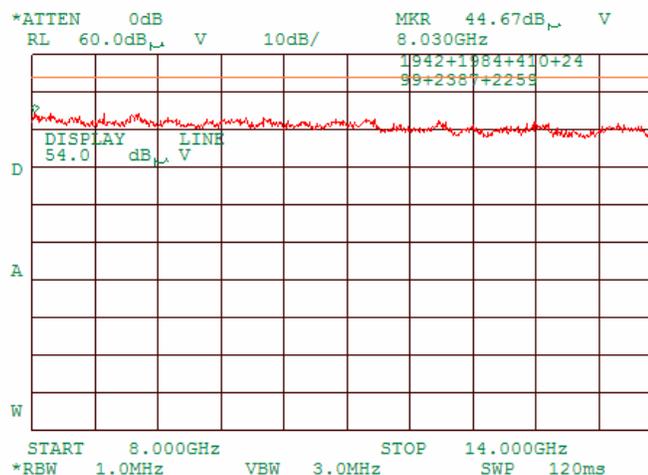
Plot 7.8.13 Radiated emission measurements in 8000 – 14000 MHz, vertical antenna polarization

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



Plot 7.8.14 Radiated emission measurements in 8000 – 14000 MHz, horizontal antenna polarization

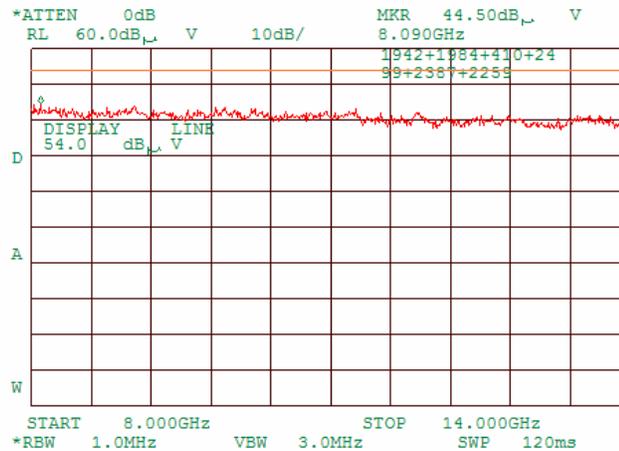
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive



Test specification: Section 15.109, Radiated emission			
Test procedure: ANSI C63.4, Sections 11.6 and 12.1.4			
Test mode: Compliance	Verdict: PASS		
Date & Time: 11/30/2004 9:59:10 AM			
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 40 %	Power Supply: 3.6 V DC
Remarks:			

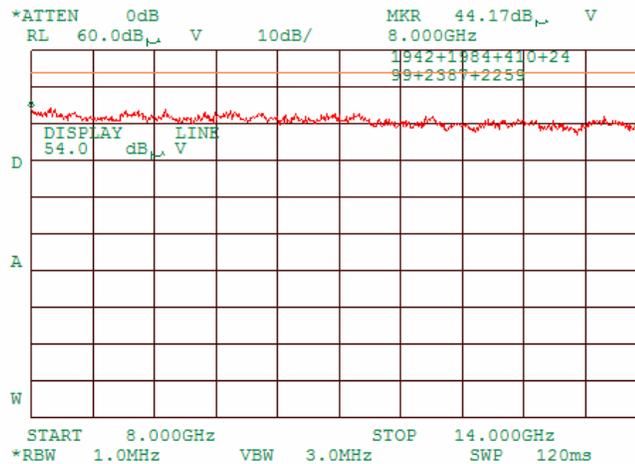
Plot 7.8.15 Radiated emission measurements in 8000 – 14000 MHz, vertical antenna polarization

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



Plot 7.8.16 Radiated emission measurements in 8000 – 14000 MHz, horizontal antenna polarization

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



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0410	Cable, Coax, Microwave, DC-18 GHz, N-N, 1 m	Gore	PFP01P0 1039.4	9338767	17-Oct-04	17-Oct-05
0446	Antenna, Loop active, 10kHz-30MHz	EMCO	6502	2857	28-Jun-04	28-Jun-05
0465	Anechoic Chamber 9(L) x 6,5(W) x 5,5(H) m	HL	AC - 1	023	10-Oct-04	10-Oct-05
0467	Shielded Room 3(L) x 3(W) x 2,4(H) m	HL	SR - 2	025	11-Nov-04	11-Nov-05
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-2.9 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	11-Nov-04	11-Nov-05
0589	Cable Coaxial, GORE A2P01POL118, 2.3 m	HL	GORE-3	176	11-Nov-04	11-Nov-05
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE 26 - 2000 MHz	EMCO	3141	9611-1011	11-Nov-04	11-Nov-05
0768	Antenna Standard Gain Horn, 18-26.5 GHz, WR-42, K-band, Gain - 25 dB	Quinstar Technology	QWH-4200-BA	110	21-Jul-04	21-Jul-07
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies (HP)	8564EC	3946A002 19	30-Aug-04	30-Aug-05
1942	Cable 18GHz, 4 m, blue	Rhophase Microwave Limited	SPS-1803A-4000-NPS	T4658	17-Oct-04	17-Oct-05
1947	Cable 18GHz, 6.5 m, blue	Rhophase Microwave Limited	NPS-1803A-6500-NPS	T4974	17-Oct-04	17-Oct-05
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W, N-type	EMC Test Systems	3115	9911-5964	21-Jul-04	21-Jul-05
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	02-Dec-04	02-Dec-05
2259	Amplifier Low Noise 2-20 GHz	Sophia Wireless	LNA0220-C	0223	21-Jul-04	21-Jul-05
2260	Amplifier Low Noise 14-33 GHz	Sophia Wireless	LNA28-B	0233	21-Jul-04	21-Jul-05
2387	Filter Bandpass, 8-14 GHz	HL	FBP8-14	2387	21-Jul-04	21-Jul-05

9 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted carrier power at RF antenna connector	Below 12.4 GHz: ± 1.7 dB 12.4 GHz to 40 GHz: ± 2.3 dB
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
Occupied bandwidth	± 8.0 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
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/NC SL 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. Person for contact: Mr. Alex Usoskin, QA manager.

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).

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Person for contact: Mr. Alex Usoskin, CEO.

11 APPENDIX D Specification references

47CFR part 15: 2004	Radio Frequency Devices.
Public notice DA 00- 705: 2000	Filing and measurement guidelines for frequency hopping spread spectrum systems.
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.

12 APPENDIX E Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	decibel referred to one microampere
dB Ω	decibel referred to one Ohm
DC	direct current
DTS	digital transmission system
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
FHSS	frequency hopping spread spectrum
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
μ s	microsecond
NA	not applicable
NT	not tested
OATS	open area test site
Ω	Ohm
PCB	printed circuit board
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
VA	volt-ampere

13 APPENDIX F Test equipment correction factors

Antenna factor
Biconilog antenna EMCO, model 3141, serial number 1011

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

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

Antenna factor
Double-ridged wave guide horn antenna
EMC Test Systems, model 3115, serial no: 9911-5964

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

Antenna factor is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

Antenna Factor
Active Loop Antenna
EMC Test Systems, model 6502, serial number 2857

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(μ V) to convert it into field intensity in dB(μ A/m).
Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

Antenna factor
Standard gain horn antenna
Quinstar Technology
Model QWH
Ser.No.112, HL 0768, 0769, 0770

Frequency min, GHz	Frequency max, GHz	Antenna factor, dB(1/m)
18.000	26.500	32.01
26.500	40.000	35.48
40.000	60.000	39.03
60.000	90.000	42.55
90.000	140.000	46.23
140.000	220.000	50.11

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

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

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

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

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

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

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

Cable loss
RF cable 8 m, model RG-214, HL 2009

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	1	0.10	NA	±0.12
2	10	0.14		
3	30	0.25		
4	50	0.34		
5	100	0.53		
6	300	0.99		
7	500	1.31		
8	800	1.73		
9	1000	1.98		
10	1100	2.11		
11	1200	2.21		
12	1300	2.35		
13	1400	2.46		
14	1500	2.55		
15	1600	2.68		
16	1700	2.78		
17	1800	2.88		
18	1900	2.98		
19	2000	3.09		