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Electrical

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TEST REPORT

ACCORDING TO: FCC CFR 47 PART 90 AND PART 15 SUBPART B

FOR:

Miltel Communications Ltd.

Wireless transmitter for data collection

Model:Galaxy Remote 2

Report ID: MILRAD_FCC.16301_rev2.doc
Date of Issue: July 2005

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1 Applicant information

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

2 Equipment under test attributes

Product name:	Wireless transmitter for data collection
Model(s):	Galaxy Remote 2
Serial number:	101
Receipt date	2/16/2005

3 Manufacturer information

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

4 Test details

Project ID:	16301
Location:	Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel
Test started:	2/16/2005
Test completed:	6/28/2005
Test specification(s):	47CFR part 90; part 15, subpart B
Test suite:	FCC_90_HH_without_RF_connector (7/15/2004 12:13:47 AM, modified)

5 Tests summary

Test	Status
Transmitter characteristics	
Section 90.205, Maximum output power	Pass
Section 90.209, Occupied bandwidth	Pass
Section 90.210, Emission mask	Pass
Section 90.210, Radiated spurious emissions	Pass
Section 90.213, Frequency stability	Pass
Section 90.214, Transient frequency behaviour	Pass
Section 2.1091, RF radiation exposure evaluation	Pass
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Not required
Section 15.109, Radiated emission	Pass
Section 15.111, Conducted emission at receiver antenna port	Not required

Testing was completed against all relevant requirements of the test standard. 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. A. Adelberg, test engineer	June 28, 2005;	
	Mr. A. Lane	July 27, 2007	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	July 28, 2005	
	Mr. M. Nikishin, EMC group leader	July 28, 2005	
Approved by:	Mr. A. Usoskin, CEO	July 28, 2005	

6 EUT description

6.1 General information

The EUT is a data link transmitter that is used for data acquisition in Miltel's telemetric data collection system. The Miltel data collection system is a fully computerized system incorporating one-way transmitters that automatically collect data from utility meters and/or other sensors.

6.2 Ports and lines

Port type	Port description	Connected		Connector type	Qty.	Cable type	Cable length	Indoor / outdoor
		From	To					
Power	DC power	EUT	DC power supply	Terminal block	1	unshielded	2 m	indoor
Signal	RS-232	EUT	PC	D-type 9	1	unshielded	3 m	indoor
Signal	Meter	EUT	Open circuit	Terminal block	3	22AWG	1.5 m	outdoor

6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Laptop	Compaq	Presario 2500	CNF4021NBF
DC power supply	Horizon Electronics	SR 60-25	72-7137

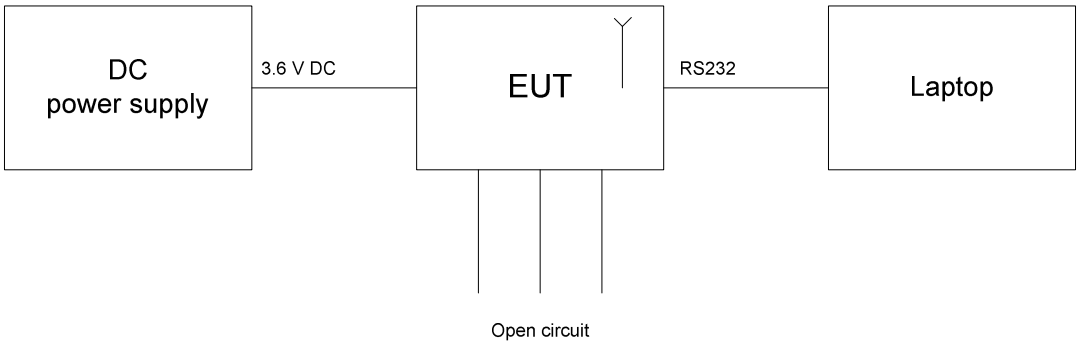
6.4 Operating frequencies

Source	Frequency, MHz	
Digital portion	4	20
Transmitter	450 - 470	NA

6.5 Changes made in the EUT

No changes were implemented.

6.6 Test configuration



6.7 Transmitter characteristics

Type of equipment	
X	Stand-alone (Equipment with or without its own control provisions)
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)
	Plug-in card (Equipment intended for a variety of host systems)

Intended use		**Condition of use**
	fixed	Always at a distance more than 2 m from all people
X	mobile	Always at a distance more than 20 cm from all people
	portable	May operate at a distance closer than 20 cm to human body

Assigned frequency range	450-470 MHz
Operating frequency range	450.00625 – 469.99375 MHz
RF channel spacing	12.5 kHz

Maximum rated output power	At transmitter 50 Ω RF output connector	dBm
	Effective radiated power (for equipment with no RF connector)	29.92 dBm

Is transmitter output power variable?	X	No		
			continuous variable	
			stepped variable with stepsize	dB
			minimum RF power	dBm
			maximum RF power	dBm

Antenna connection			
unique coupling	standard connector	X integral	with temporary RF connector
			X without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Monopole	Miltel	2.1	-3 dBi

Transmitter 99% power bandwidth	10.5 kHz					
Transmitter aggregate data rate/s	600 baud					
Transmitter aggregate symbol (baud) rate/s	600 baud					
Type of modulation	FSK					
Type of multiplexing	NA					
Modulating test signal (baseband)	PRBS					
Transmitter duty cycle supplied for test	100%	**Tx ON time**	msec	**Period**	msec	

Transmitter power source						
	Battery	**Nominal rated voltage**	3.6 VDC	Battery type	Lithium	
	DC	**Nominal rated voltage**	VDC			
	AC mains	**Nominal rated voltage**	VAC	Frequency	Hz	

Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	Air Pressure: 1015 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

7 Transmitter tests according to 47CFR part 90 requirements

7.1 Effective radiated power of carrier

7.1.1 General

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

Table 7.1.1 Effective radiated power limit

Assigned frequency band, MHz	ERP		Equivalent field strength limit @ 3m, dB(µV/m)*
	mW	dBm	
450-470	2000	33.0	128.23

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

7.1.2 Test procedure for field strength measurements

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and the performance check was conducted.

7.1.2.2 The field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was swept throughout the range, specified in Table 7.1.2, in both vertical and horizontal polarizations.

7.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.

7.1.3 Test procedure for substitution ERP measurements

7.1.3.1 The test equipment was set up as shown in Figure 7.1.2 and energized.

7.1.3.2 RF signal generator was set to the EUT carrier frequency and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

7.1.3.3 The test antenna height was swept throughout the specified in Table 7.1.2 range to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

7.1.3.4 The ERP was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

7.1.3.5 The above procedure was performed in both horizontal and vertical polarizations of the test antenna.

7.1.3.6 The worst test results (the lowest margins) were recorded in Table 7.1.3 and shown in the associated plots.

Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	Air Pressure: 1015 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

Figure 7.1.1 Setup for carrier field strength measurements

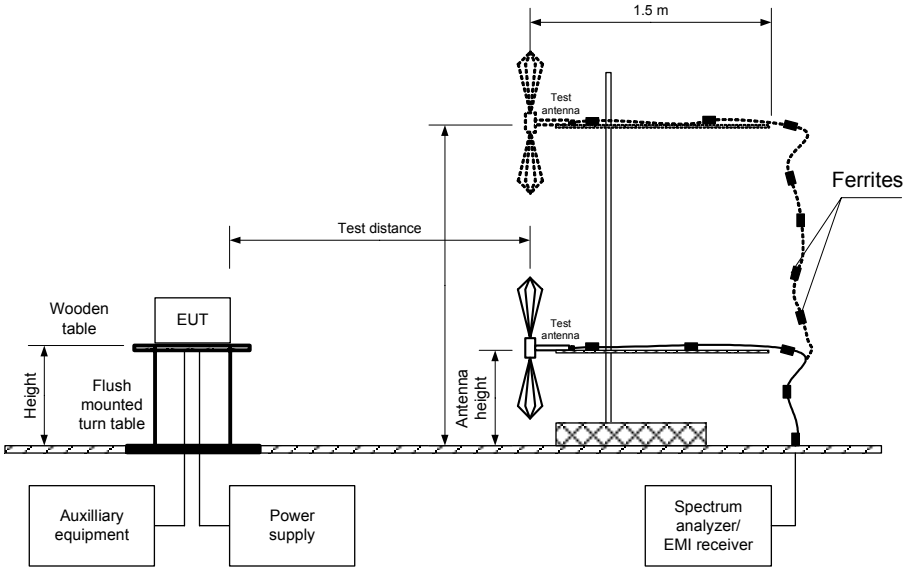
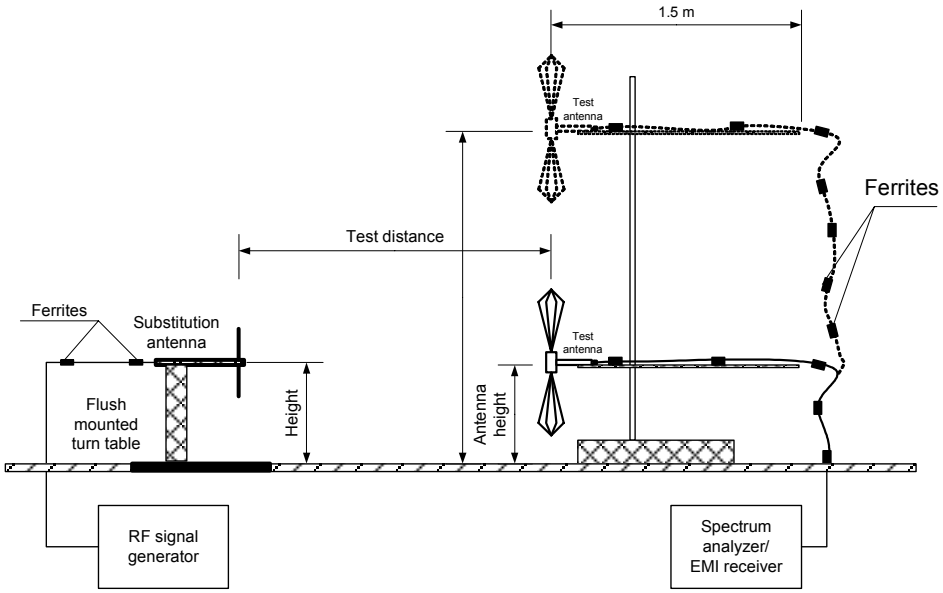


Figure 7.1.2 Setup for substitution ERP measurements



Test specification:	**Section 90.209, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 40 %	**Power Supply:** 3.6 Vdc
Remarks:			

Table 7.1.2 Transmitter carrier field strength

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

Frequency, MHz	Field strength, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
450.003	125.20	128.23	-3.03	120	Vertical	1.1	128
459.998	127.20	128.23	-1.03		Vertical	1.1	131
469.991	124.30	128.23	-3.93		Vertical	1.0	97

*- Margin = Field strength – calculated field strength limit.
**- EUT front panel refers to 0 degrees position of turntable.

Table 7.1.3 Transmitter carrier ERP

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

Frequency, MHz	Field strength, dB(µV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
450.004	125.20	120	Vertical	25.00	1.00	3.00	27.00	33.00	-6.00	Pass
459.998	127.20		Vertical	28.10	1.18	3.00	29.92	33.00	-3.08	Pass
469.989	124.30		Vertical	26.00	1.36	2.44	27.08	33.00	-5.92	Pass

*- Margin = ERP – specification limit.

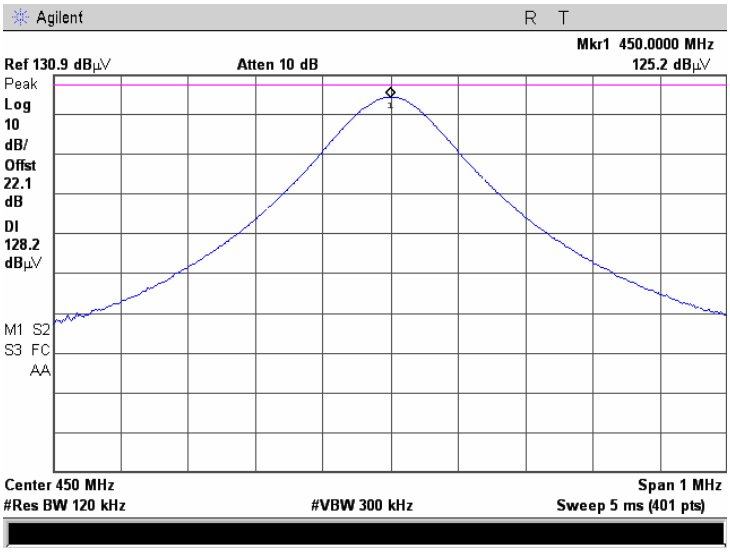
Reference numbers of test equipment used

HL 0029	HL 0034	HL 0415	HL 0661	HL 1365	HL 1430	HL 1947	HL 2400

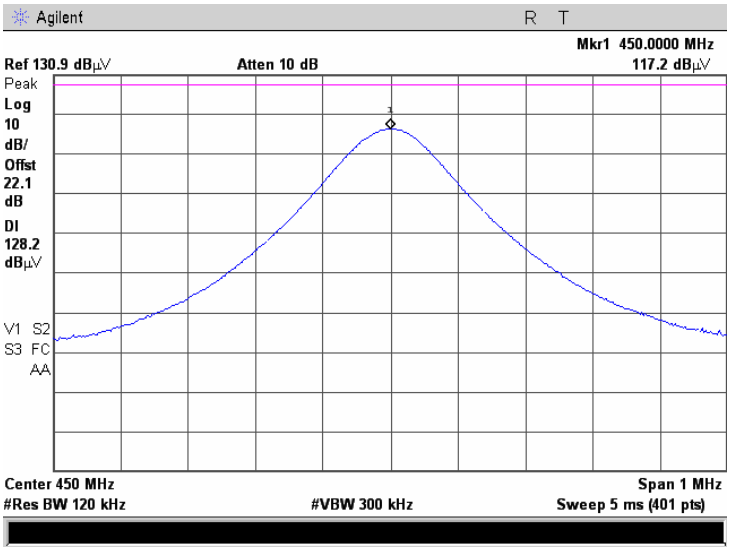
Full description is given in Appendix A.

Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	Air Pressure: 1015 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

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

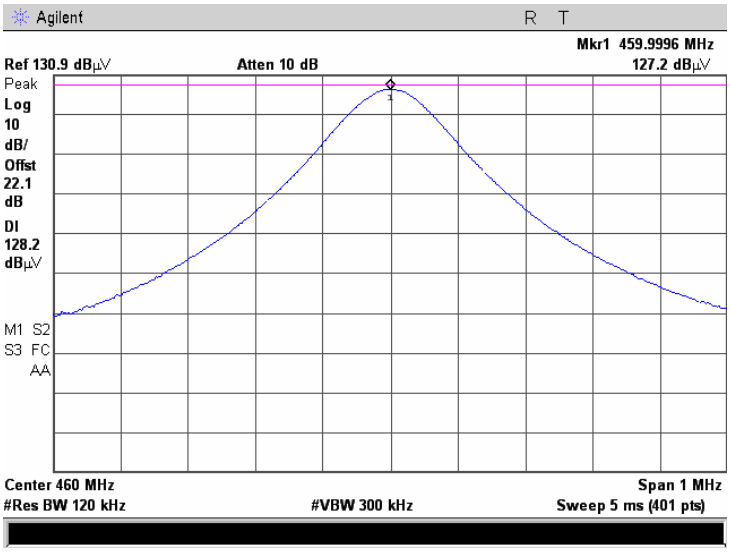


Plot 7.1.2 Transmitter carrier field strength at low frequency in horizontal antenna polarization

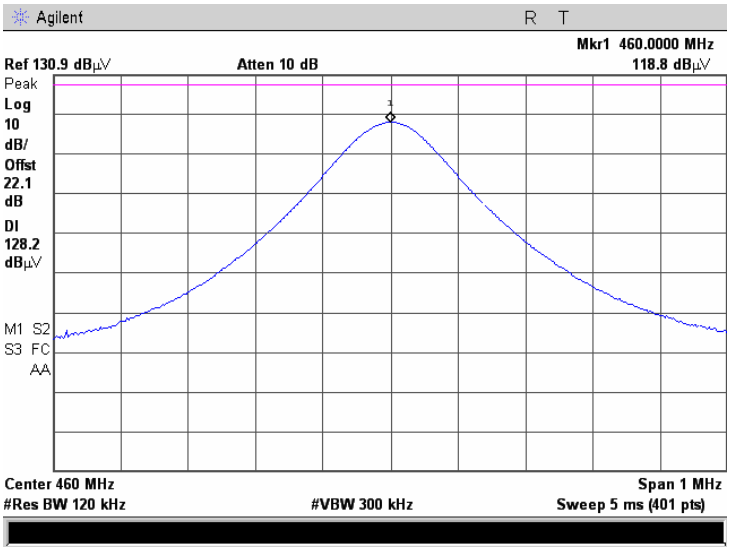


Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	Air Pressure: 1015 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

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

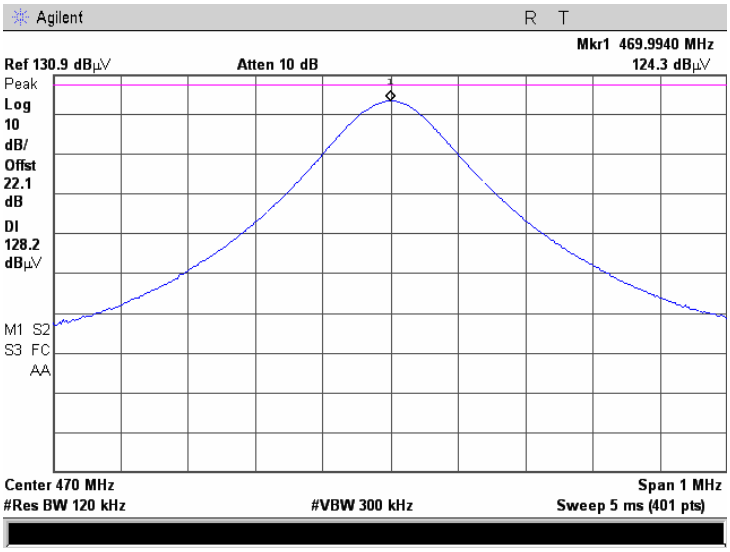


Plot 7.1.4 Transmitter carrier field strength at mid frequency in horizontal antenna polarization

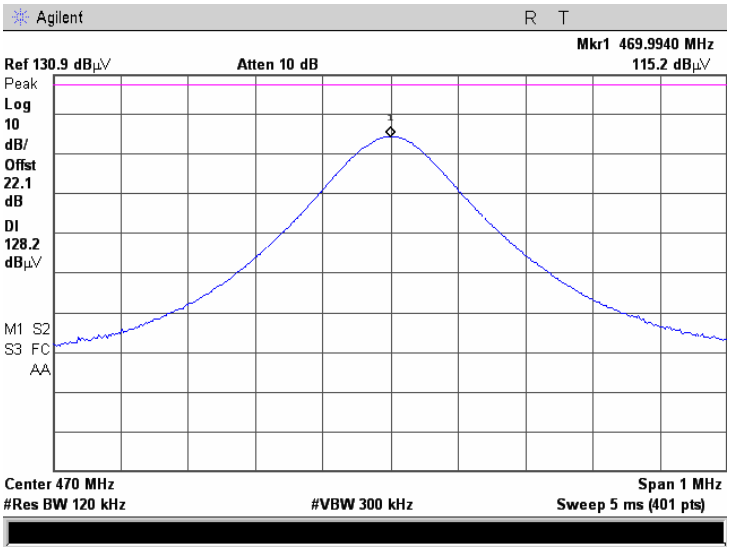


Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	Air Pressure: 1015 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

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



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



Test specification:	**Section 90.209, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 40 %	**Power Supply:** 3.6 Vdc
Remarks:			

7.2 Occupied bandwidth test

7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1. The test results are provided in Table 7.2.2 and the 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 are provided in terms of attenuation below the unmodulated carrier.

7.2.2 Test procedure

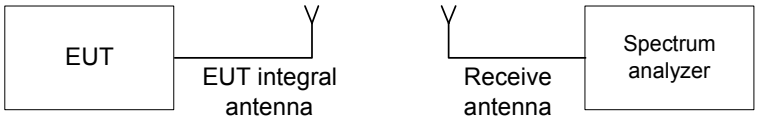
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.

7.2.2.3 The EUT was set to transmit the normally modulated carrier.

7.2.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	Air Pressure: 1015 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

Table 7.2.2 Occupied bandwidth test results

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

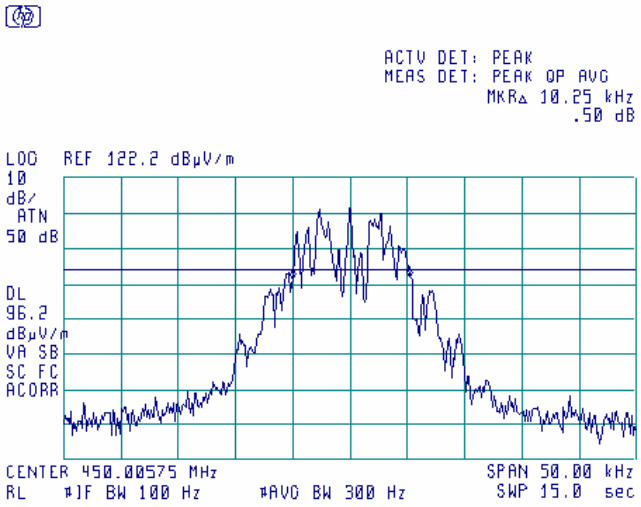
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450.00575	10.25	11.25	-1.00	Pass
459.99963	10.38	11.25	-0.87	Pass
469.99338	10.50	11.25	-0.75	Pass

Reference numbers of test equipment used

HL 0034	HL 1365	HL 1430	HL 1947				

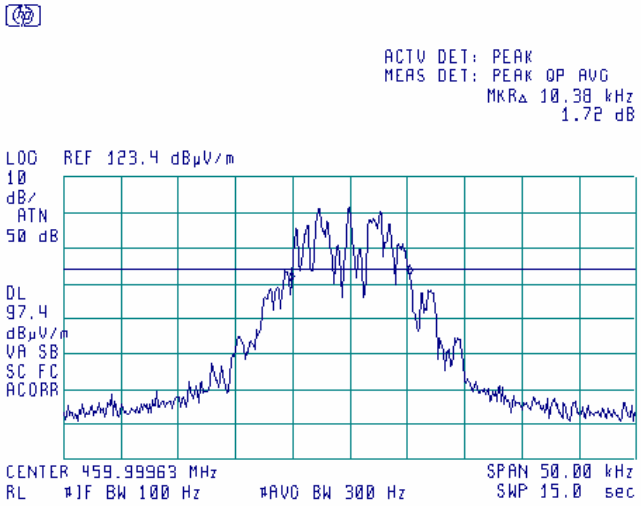
Full description is given in Appendix A.

Plot 7.2.1 Occupied bandwidth test result at low frequency

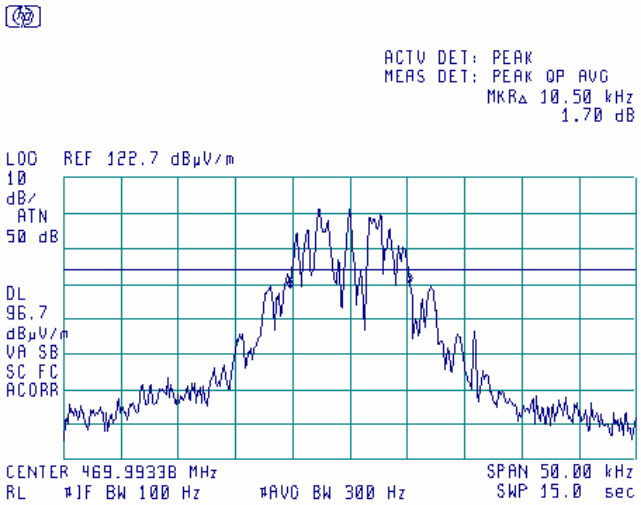


Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 3:45:32 PM		
Temperature: 26 ºC	Air Pressure: 1015 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

Plot 7.2.2 Occupied bandwidth test result at mid frequency



Plot 7.2.3 Occupied bandwidth test result at high frequency



Test specification:	Section 90.210, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/28/2005 5:35:39 PM		
Temperature: 24 ºC	Air Pressure: 1011 hPa	Relative Humidity: 46 %	Power Supply: 3.6 VDC
Remarks:			

7.3 Emission mask test

7.3.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.3.1. The test results are provided in the associated plots.

Table 7.3.1 Emission mask limits

Frequency displacement from carrier	Attenuation below carrier, dBc
Emission mask D (Channel bandwidth 12.5 kHz, authorized bandwidth 11.25 kHz)	
0 – 5.625 kHz	0
5.625 – 12.5 kHz	20.0 – 70.0*
More than 12.5 kHz	50+10logP(W) or 70.0 whichever is the lesser

* - linearly increase with frequency
** - emission mask includes carrier modulation envelope within ± 250 % of the authorized bandwidth; the frequency range removed beyond ± 250 % of the authorized bandwidth from carrier was investigated as spurious emission

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 emission mask was measured with spectrum analyzer as provided in the associated plots.

Table 7.3.2 Emission mask test results

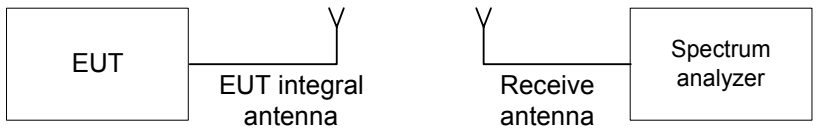
Carrier frequency, MHz	Limit	Verdict
450.00625	Emission mask D	Pass
460.00000		
469.99375		

Reference numbers of test equipment used

HL 1424						

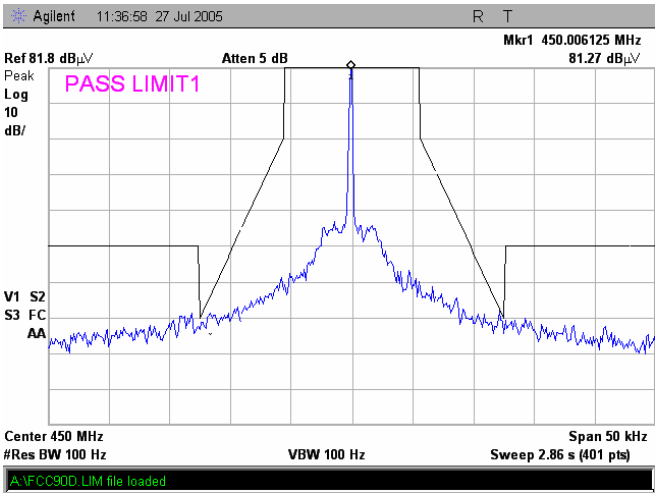
Full description is given in Appendix A.

Figure 7.3.1 Emission mask test setup



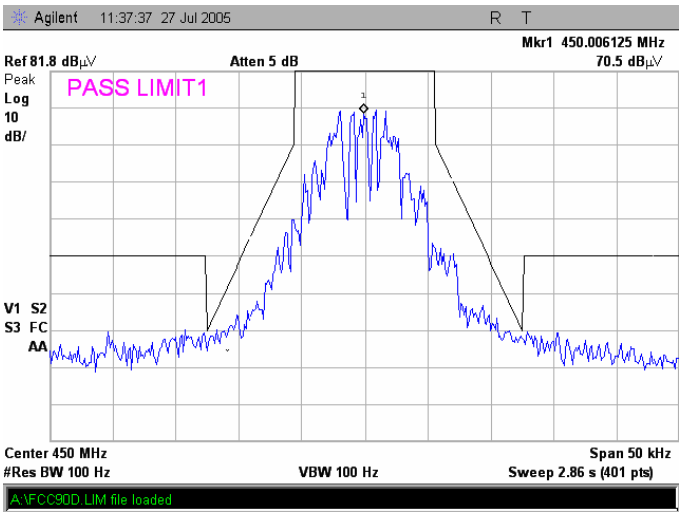
Test specification:	Section 90.210, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/28/2005 5:35:39 PM		
Temperature: 24 °C	Air Pressure: 1011 hPa	Relative Humidity: 46 %	Power Supply: 3.6 VDC
Remarks:			

Plot 7.3.1 Unmodulated reference at low carrier frequency



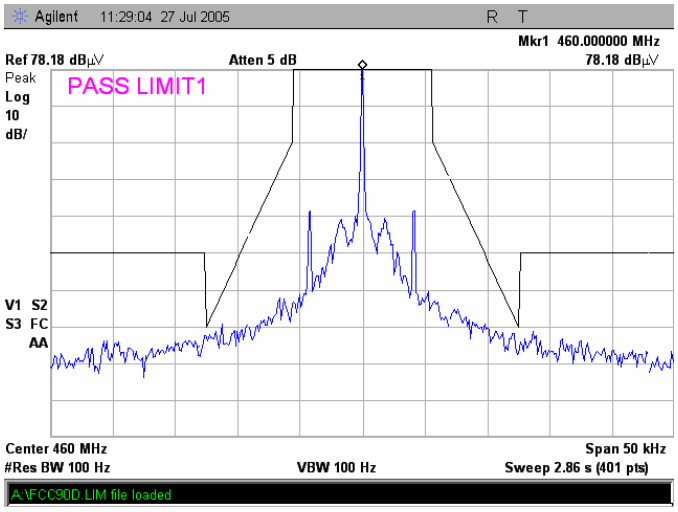
Plot 7.3.2 Emission mask test results at low carrier frequency

OPERATING FREQUENCY RANGE:	450 – 470 MHz
DETECTOR USED:	Peak
MODULATION:	FSK
MODULATING SIGNAL:	Alternative sequence (“1” and “0”)
BIT RATE:	600 baud
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum



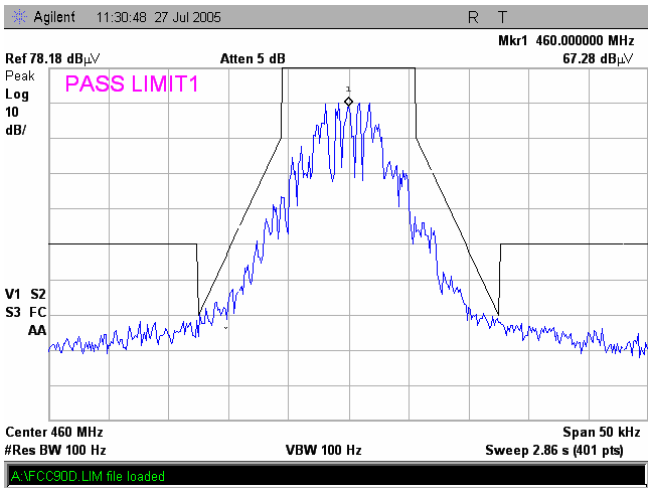
Test specification:	Section 90.210, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/28/2005 5:35:39 PM		
Temperature: 24 °C	Air Pressure: 1011 hPa	Relative Humidity: 46 %	Power Supply: 3.6 VDC
Remarks:			

Plot 7.3.3 Unmodulated reference at mid carrier frequency



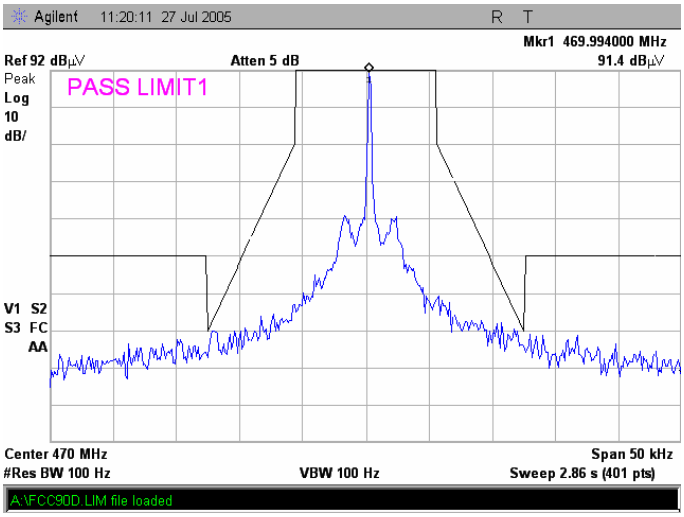
Plot 7.3.4 Emission mask test results at mid carrier frequency

OPERATING FREQUENCY RANGE:	450 – 470 MHz
DETECTOR USED:	Peak
MODULATION:	FSK
MODULATING SIGNAL:	Alternative sequence (“1” and “0”)
BIT RATE:	600 baud
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum



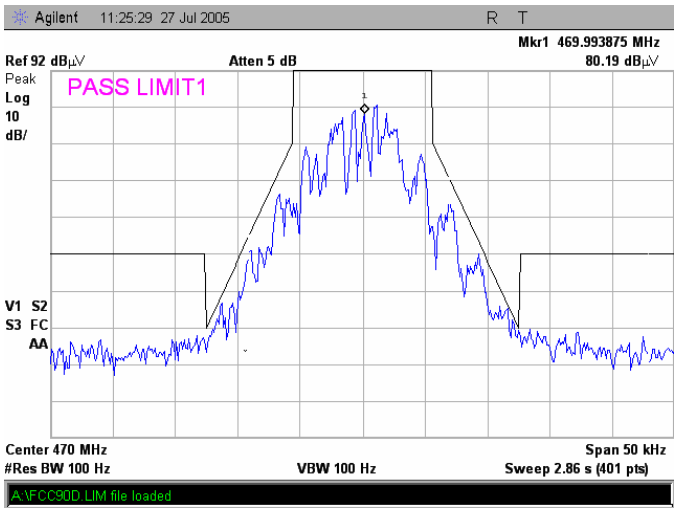
Test specification:	Section 90.210, Emission mask		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.210(m); TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/28/2005 5:35:39 PM		
Temperature: 24 °C	Air Pressure: 1011 hPa	Relative Humidity: 46 %	Power Supply: 3.6 VDC
Remarks:			

Plot 7.3.5 Unmodulated reference at high carrier frequency



Plot 7.3.6 Emission mask test results at high carrier frequency

OPERATING FREQUENCY RANGE:	450 – 470 MHz
DETECTOR USED:	Peak
MODULATION:	FSK
MODULATING SIGNAL:	Alternative sequence (“1” and “0”)
BIT RATE:	600 baud
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

7.4 Radiated spurious emission measurements

7.4.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.4.1.

Table 7.4.1 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 – 10th harmonic*	50+10logP**	-20	77.4

* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier
** - P is transmitter output power in Watts
*** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: E=sqrt(30×P×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

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

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and the performance check was conducted.

7.4.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna was rotated around its vertical axis.

7.4.2.3 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.

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

7.4.3.1 The EUT was set up as shown in Figure 7.4.2, energized and the performance check was conducted.

7.4.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.4.3.3 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.

7.4.4 Test procedure for substitution ERP measurements of spurious

7.4.4.1 The test equipment was set up as shown in Figure 7.4.3 and energized.

7.4.4.2 RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

7.4.4.3 The test antenna height was swept from 1 to 4 m to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

7.4.4.4 The above procedure was performed in both, horizontal and vertical, polarizations of the test and substitution antennas.

7.4.4.5 The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

7.4.4.6 The above procedure was repeated at the rest of investigated frequencies.

7.4.4.7 The worst test results (the lowest margins) were recorded in Table 7.4.3 and shown in the associated plots.

Test specification:	**Section 90.210, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	**Air Pressure:** 1013 hPa	**Relative Humidity:** 40 %	**Power Supply:** 3.6 Vdc
Remarks:			

Figure 7.4.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

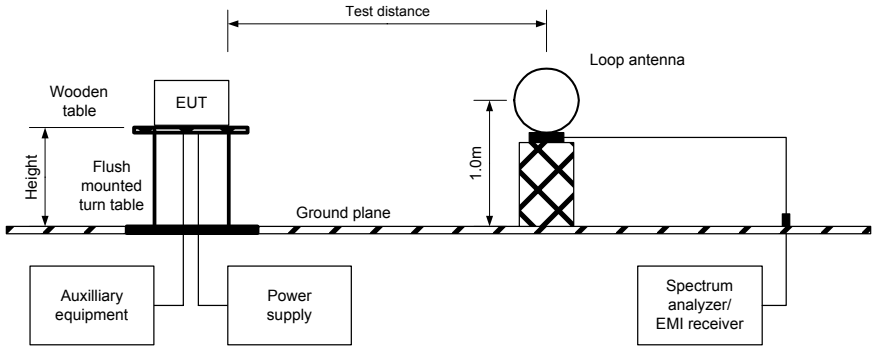
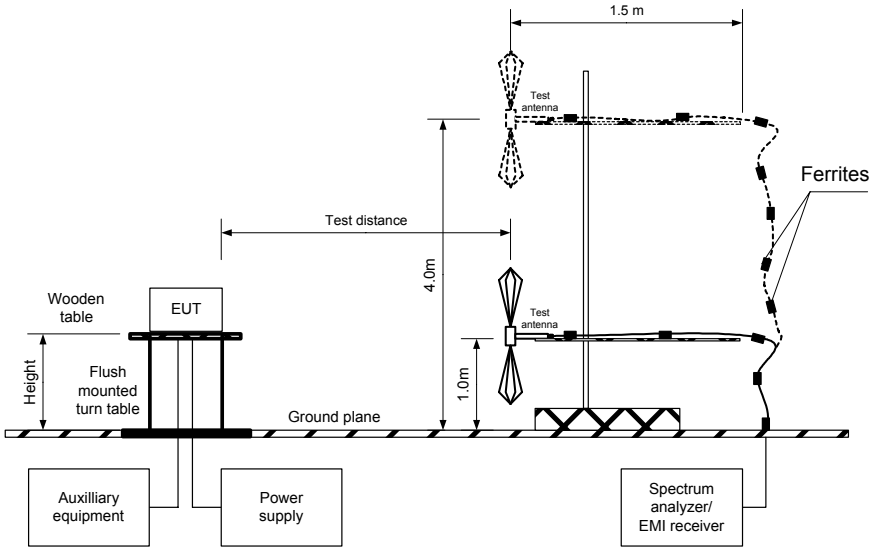
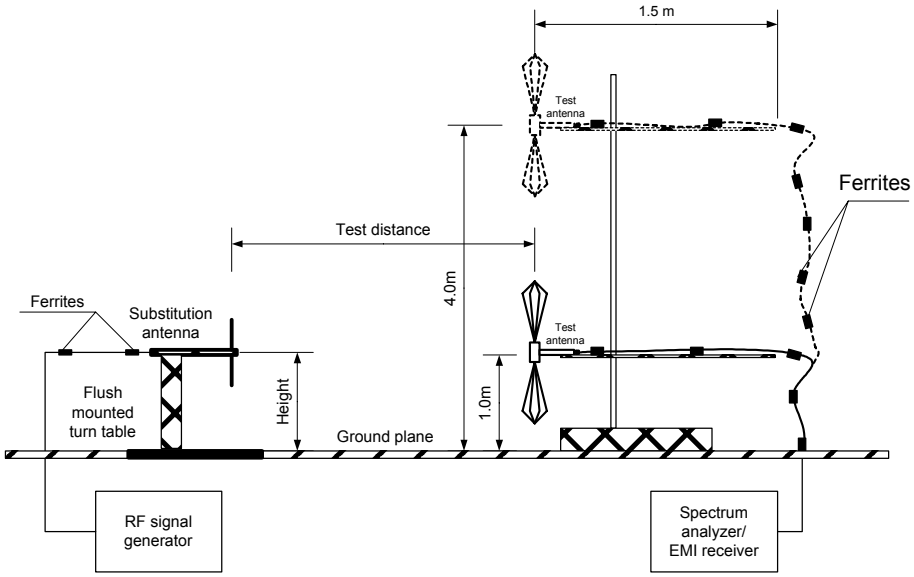


Figure 7.4.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 90.210, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	**Air Pressure:** 1013 hPa	**Relative Humidity:** 40 %	**Power Supply:** 3.6 Vdc
Remarks:			

Figure 7.4.3 Setup for substitution ERP measurements of spurious



Test specification:	**Section 90.210, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	**Air Pressure:** 1013 hPa	**Relative Humidity:** 40 %	**Power Supply:** 3.6 Vdc
Remarks:			

Table 7.4.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
TEST DISTANCE: 3 m
TEST SITE: Semi anechoic chamber / OATS
EUT HEIGHT: 0.8 m
INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: > Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
MODULATION: FSK
MODULATING SIGNAL: PRBS
BIT RATE: 600 baud
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
Low carrier frequency MHz							
900.0100	66.24	77.4	-11.16	120	V	1.0	145
1350.0680	70.49	77.4	-6.91	1000	V	1.0	129
1800.0480	60.42	77.4	-16.98	1000	V	1.0	172
2249.9790	59.04	77.4	-18.36	1000	V	1.0	133
2699.9030	58.00	77.4	-19.40	1000	V	1.0	145
3150.0800	60.83	77.4	-16.57	1000	H	1.0	133
Mid carrier frequency MHz							
919.9938	62.93	77.4	-14.47	120	V	1.0	140
1379.9380	65.02	77.4	-12.38	1000	V	1.0	133
1839.9780	66.13	77.4	-11.27	1000	V	1.0	155
2250.0900	59.00	77.4	-18.40	1000	V	1.0	156
2760.0680	58.32	77.4	-19.08	1000	V	1.0	149
High carrier frequency MHz							
939.9775	73.15	77.4	-4.25	120	V	1.1	153
1409.9250	62.47	77.4	-14.93	1000	V	1.0	119
1879.9600	63.67	77.4	-13.73	1000	V	1.0	201
2350.0220	60.04	77.4	-17.36	1000	V	1.0	177
2819.8580	58.11	77.4	-19.29	1000	V	1.0	151
3289.8600	58.33	77.4	-19.07	1000	H	1.0	130
4229.9300	57.50	77.4	-19.90	1000	V	1.0	119

*- Margin = Field strength of spurious – calculated field strength limit.
**- EUT front panel refers to 0 degrees position of turntable.

Test specification:	**Section 90.210, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	**Air Pressure:** 1013 hPa	**Relative Humidity:** 40 %	**Power Supply:** 3.6 Vdc
Remarks:			

Table 7.4.3 Substitution ERP of spurious test results

ASSIGNED FREQUENCY RANGE: 450 -470 MHz
TRANSMITTER CARRIER ERP: 25.95 dBm at low frequency
26.88 dBm at mid frequency
29.07 dBm at high frequency
TEST SITE: Semi anechoic chamber / OATS
TEST DISTANCE: 3 m
SUBSTITUTION ANTENNA HEIGHT: 0.8 m
DETECTOR USED: Peak
VIDEO BANDWIDTH: > Resolution bandwidth
SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(µV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency										
900.0100	66.24	120	V	-27.63	3.83	2.98	-31.20	-20.00	-11.20	Pass
1350.0680	70.49	1000	V	-31.11	8.94	3.25	-24.55	-20.00	-4.55	Pass
1800.0480	60.42	1000	V	-40.56	8.35	3.88	-33.53	-20.00	-13.53	Pass
2249.9790	59.04	1000	V	-40.98	8.70	-0.04	-39.10	-20.00	-19.10	Pass
2699.9030	58.00	1000	V	-42.02	9.69	3.22	-39.74	-20.00	-19.74	Pass
3150.0800	60.83	1000	H	-37.11	10.41	5.59	-36.70	-20.00	-16.70	Pass
Mid carrier frequency										
919.9938	62.93	120	V	-30.94	4.61	2.93	-33.80	-20.00	-13.80	Pass
1379.9380	65.02	1000	V	-35.88	9.64	3.33	-30.57	-20.00	-10.57	Pass
1839.9780	66.13	1000	V	-34.85	8.40	3.76	-28.05	-20.00	-8.05	Pass
2250.0900	59.00	1000	V	-40.70	8.95	2.94	-37.61	-20.00	-17.61	Pass
2760.0680	58.32	1000	V	-41.70	9.82	3.65	-39.37	-20.00	-19.37	Pass
High carrier frequency										
939.9775	73.15	120	V	-20.72	5.40	2.88	-22.87	-20.00	-2.87	Pass
1409.9250	62.47	1000	V	-38.43	9.59	3.36	-33.10	-20.00	-13.10	Pass
1879.9600	63.67	1000	V	-37.31	8.45	3.64	-30.73	-20.00	-10.73	Pass
2350.0220	60.04	1000	V	-39.98	8.92	0.68	-38.01	-20.00	-18.01	Pass
2819.8580	58.11	1000	V	-39.83	10.28	5.16	-39.31	-20.00	-19.31	Pass
3289.8600	58.33	1000	H	-38.99	11.52	5.82	-39.29	-20.00	-19.29	Pass
4229.9300	57.50	1000	V	-36.92	12.13	6.94	-40.23	-20.00	-20.23	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

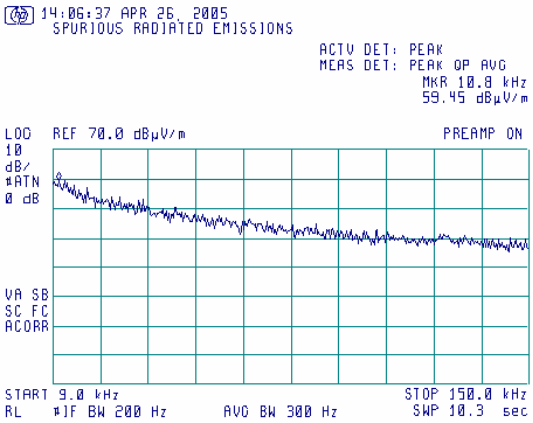
HL 0029	HL 0415	HL 0446	HL 0521	HL 0589	HL 0604	HL 0661	HL 1424
HL 1947	HL 1984	HL 2009	HL 2259	HL 2400			

Full description is given in Appendix A.

Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

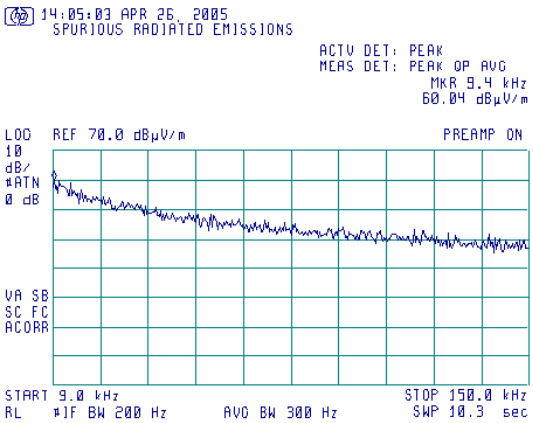
Plot 7.4.1 Radiated emission measurements in 9 - 150 kHz range

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



Plot 7.4.2 Radiated emission measurements in 9 - 150 kHz range

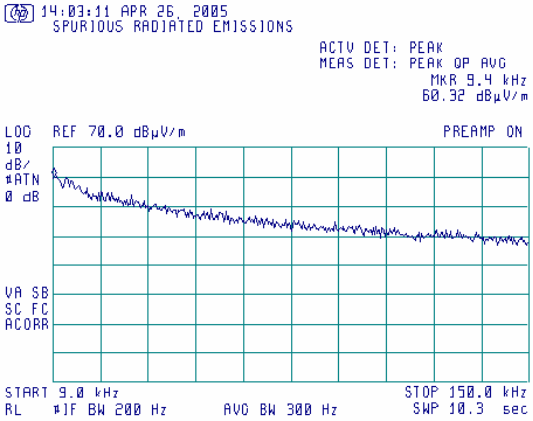
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

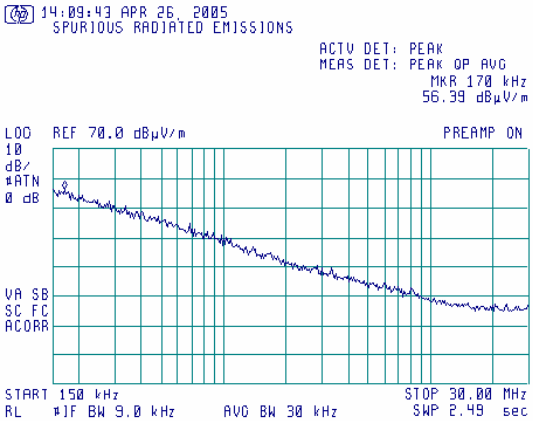
Plot 7.4.3 Radiated emission measurements in 9 - 150 kHz range

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



Plot 7.4.4 Radiated emission measurements in 0.15 - 30 MHz range

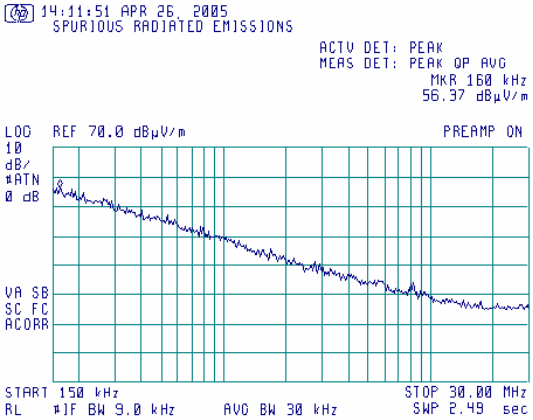
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

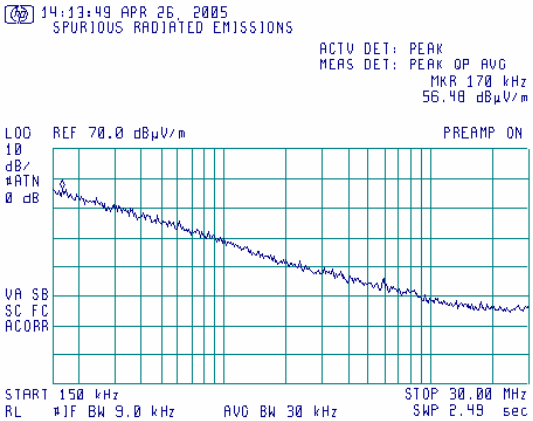
Plot 7.4.5 Radiated emission measurements in 0.15 - 30 MHz range

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



Plot 7.4.6 Radiated emission measurements in 0.15 - 30 MHz range

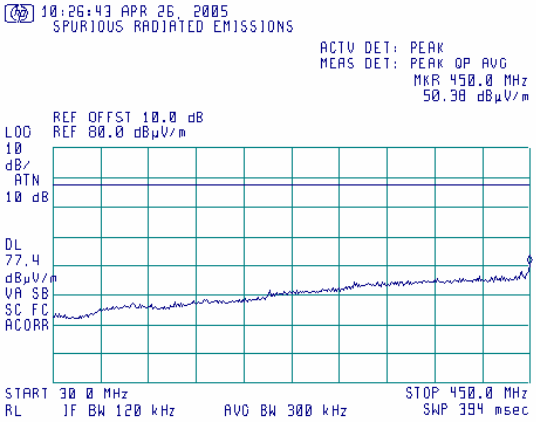
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

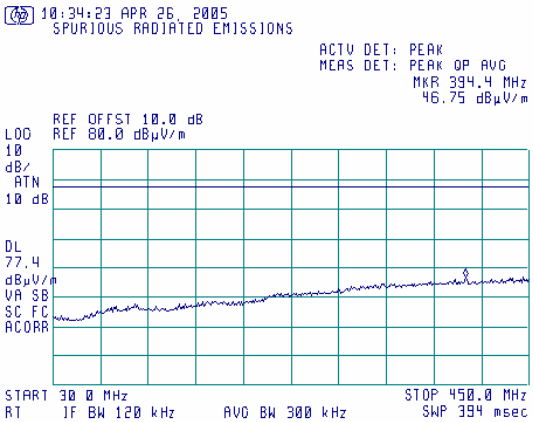
Plot 7.4.7 Radiated emission measurements in 30 - 450 MHz range

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



Plot 7.4.8 Radiated emission measurements in 30 - 450 MHz range

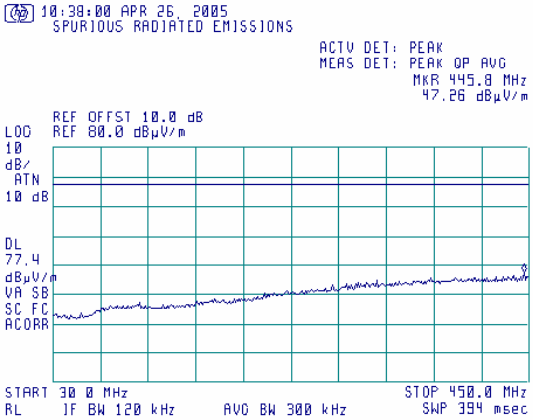
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

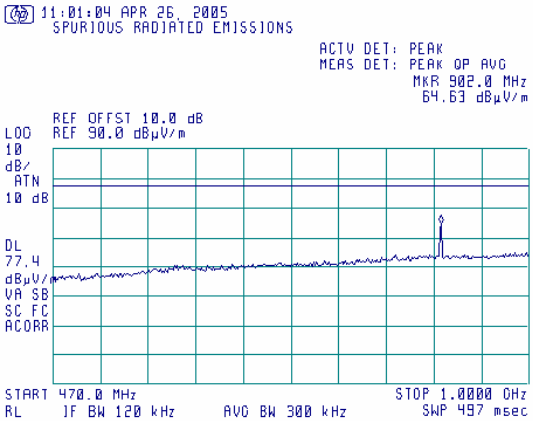
Plot 7.4.9 Radiated emission measurements in 30 - 450 MHz range

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



Plot 7.4.10 Radiated emission measurements in 470 – 1000 MHz range

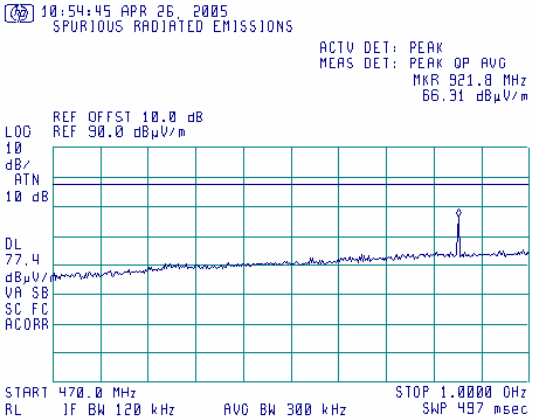
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

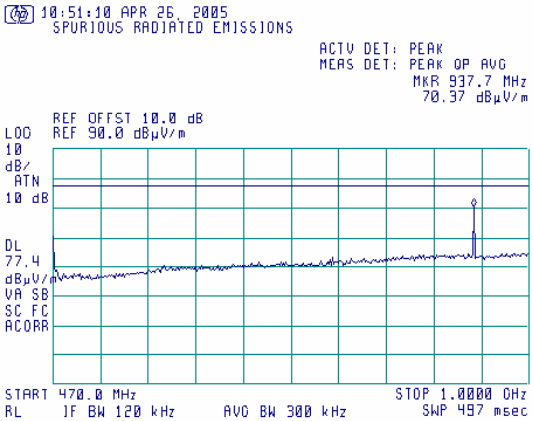
Plot 7.4.11 Radiated emission measurements in 470 – 1000 MHz range

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



Plot 7.4.12 Radiated emission measurements in 470 – 1000 MHz range

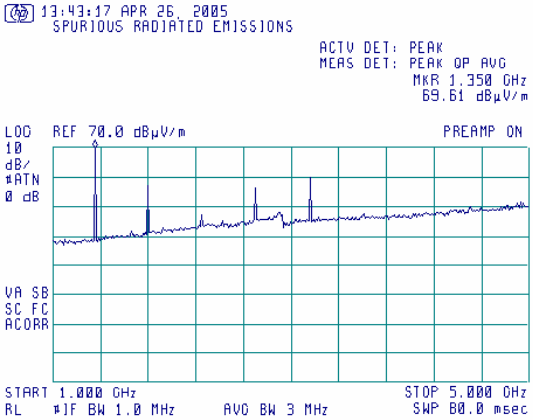
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

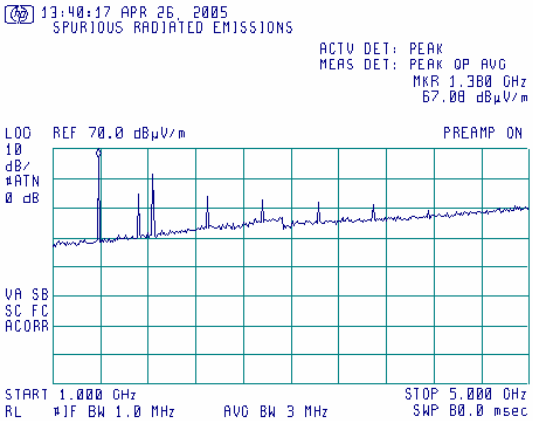
Plot 7.4.13 Radiated emission measurements in 1000 – 5000 MHz range

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



Plot 7.4.14 Radiated emission measurements in 1000 – 5000 MHz range

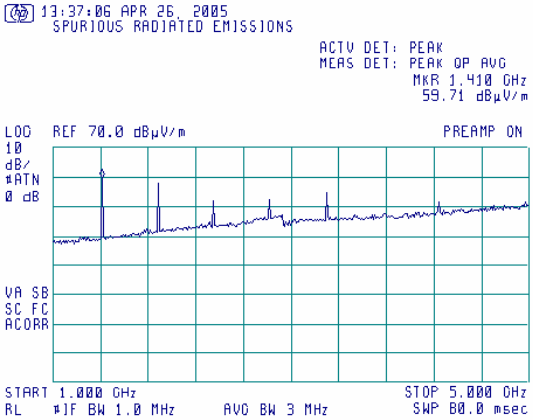
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

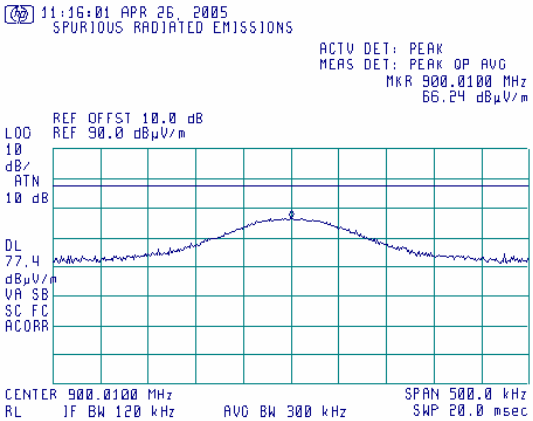
Plot 7.4.15 Radiated emission measurements in 1000 – 5000 MHz range

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



Plot 7.4.16 Radiated emission measurements at the 2nd harmonic

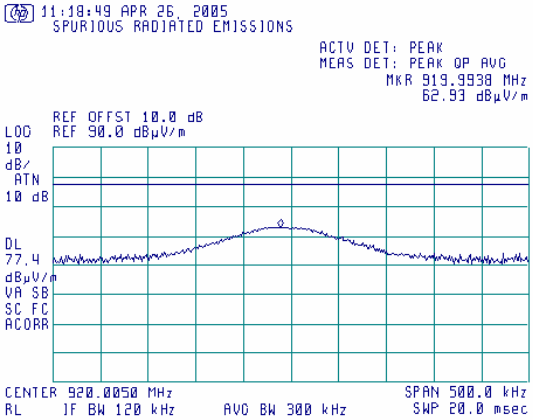
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

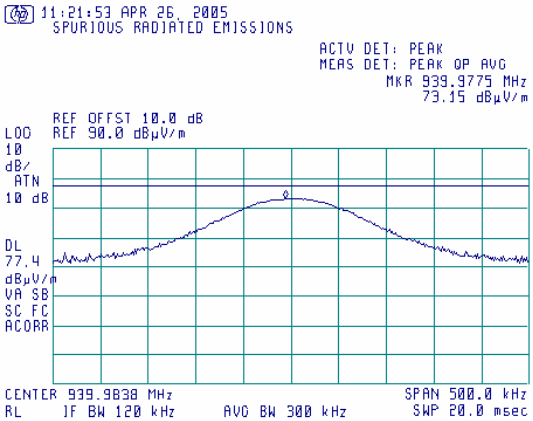
Plot 7.4.17 Radiated emission measurements at the 2nd harmonic

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



Plot 7.4.18 Radiated emission measurements at the 2nd harmonic

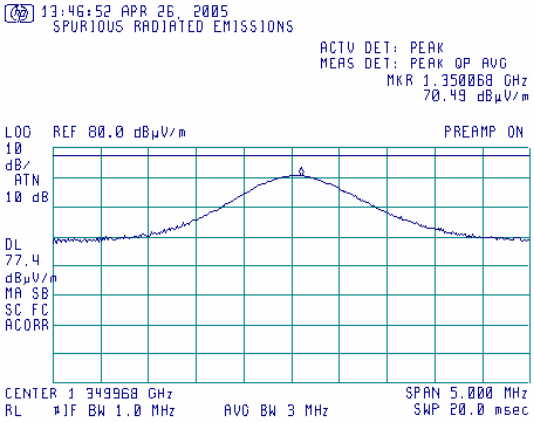
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

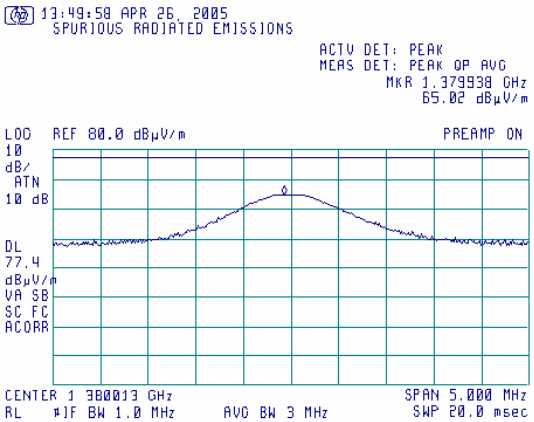
Plot 7.4.19 Radiated emission measurements at the 3rd harmonic

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



Plot 7.4.20 Radiated emission measurements at the 3rd harmonic

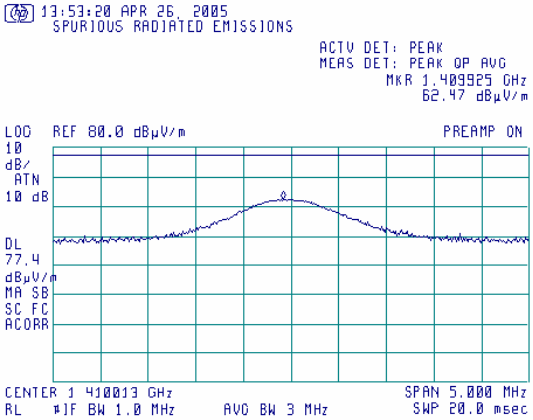
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

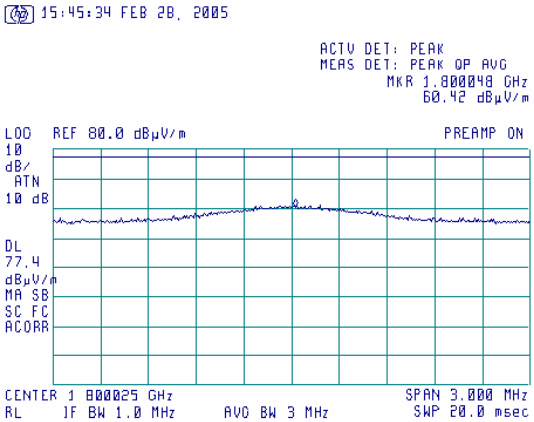
Plot 7.4.21 Radiated emission measurements at the 3rd harmonic

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



Plot 7.4.22 Radiated emission measurements at the 4th harmonic

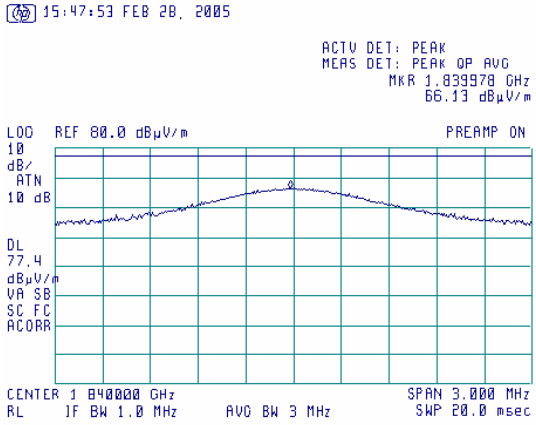
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

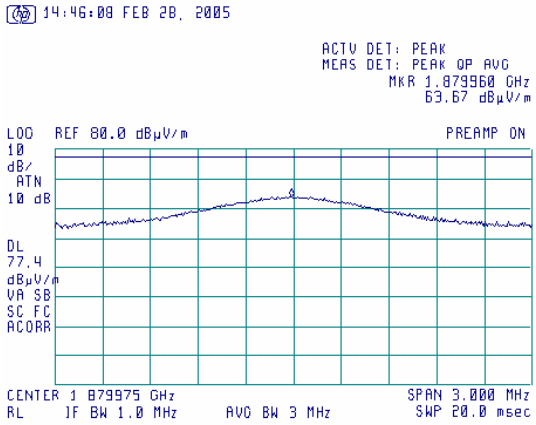
Plot 7.4.23 Radiated emission measurements at the 4th harmonic

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



Plot 7.4.24 Radiated emission measurements at the 4th harmonic

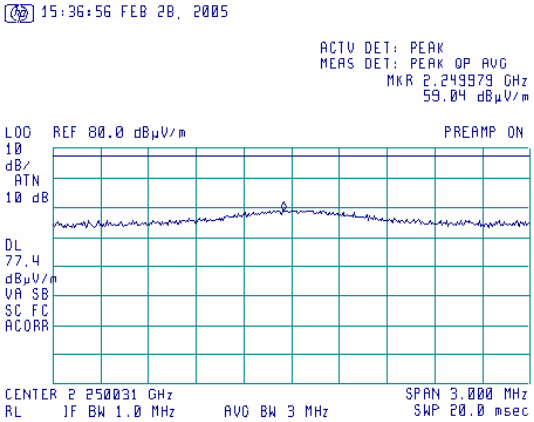
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

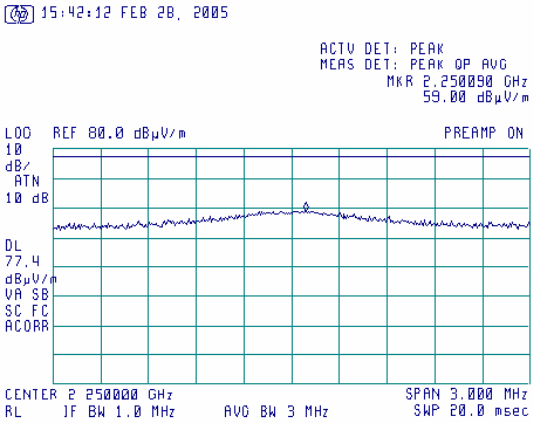
Plot 7.4.25 Radiated emission measurements at the 5th harmonic

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



Plot 7.4.26 Radiated emission measurements at the 5th harmonic

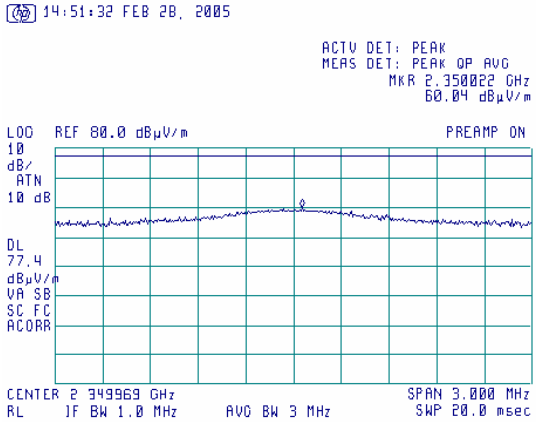
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

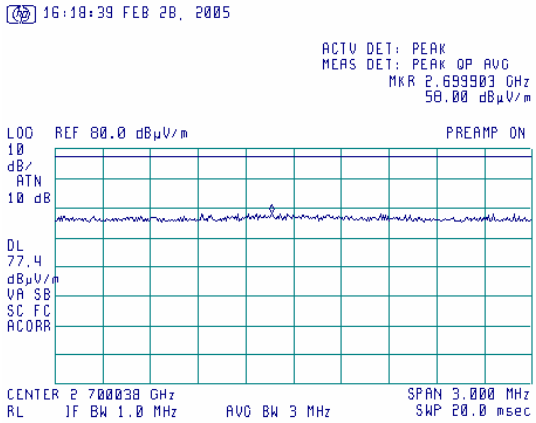
Plot 7.4.27 Radiated emission measurements at the 5th harmonic

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



Plot 7.4.28 Radiated emission measurements at the 6th harmonic

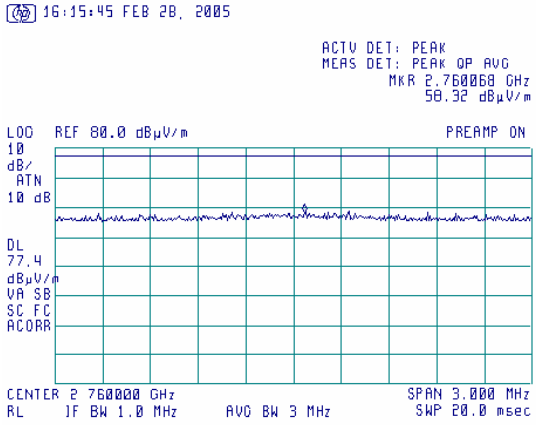
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

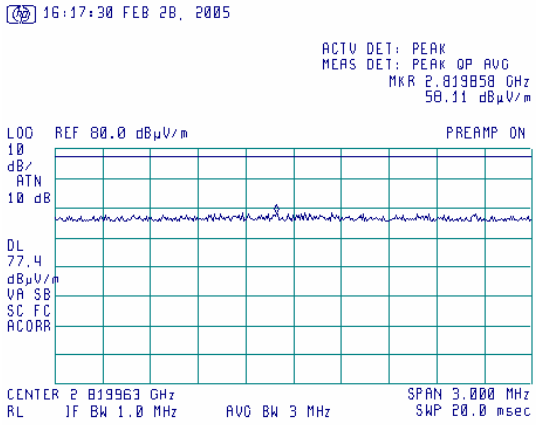
Plot 7.4.29 Radiated emission measurements at the 6th harmonic

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



Plot 7.4.30 Radiated emission measurements at the 6th harmonic

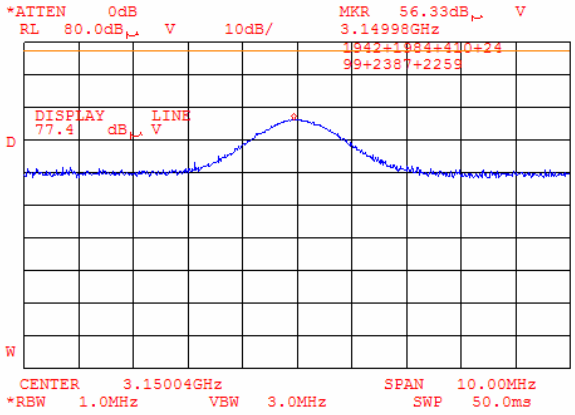
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

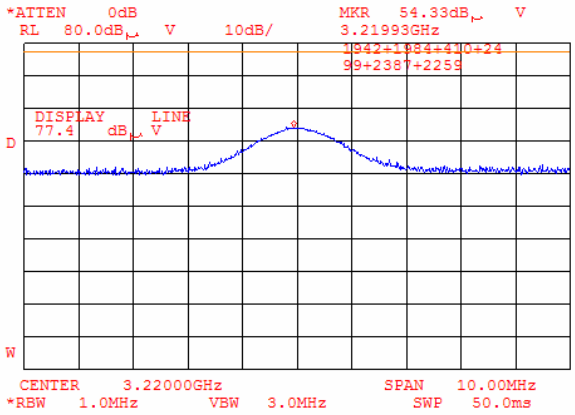
Plot 7.4.31 Radiated emission measurements at the 7th harmonic

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



Plot 7.4.32 Radiated emission measurements at the 7th harmonic

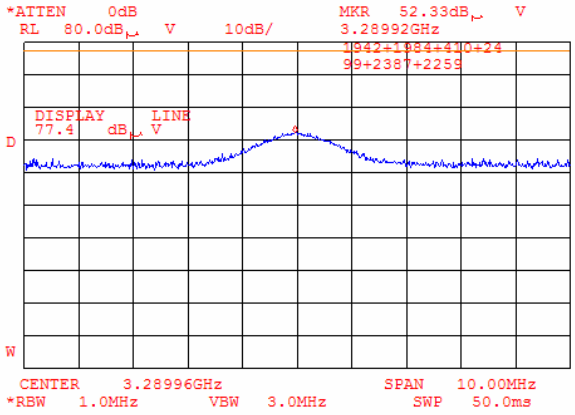
TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical
TEST DISTANCE: 3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

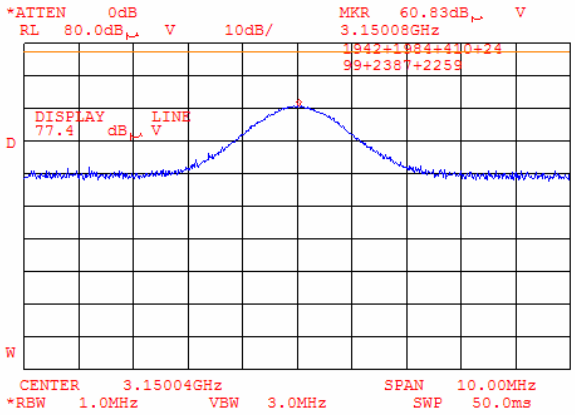
Plot 7.4.33 Radiated emission measurements at the 7th harmonic

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



Plot 7.4.34 Radiated emission measurements at the 7th harmonic

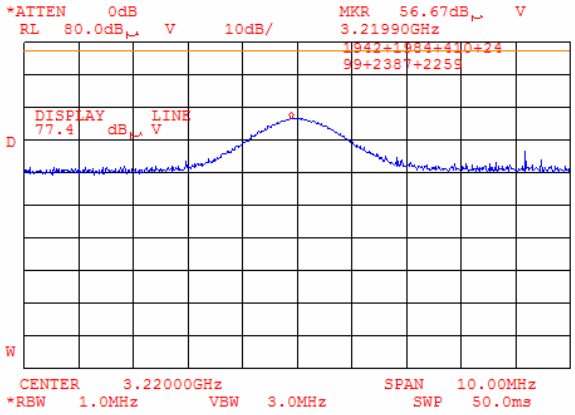
TEST SITE:	OATS
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

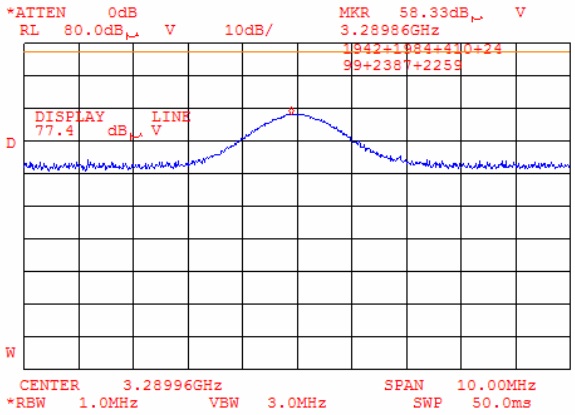
Plot 7.4.35 Radiated emission measurements at the 7th harmonic

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



Plot 7.4.36 Radiated emission measurements at the 7th harmonic

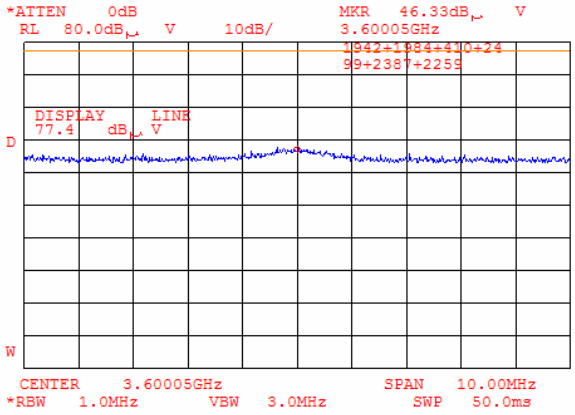
TEST SITE: OATS
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

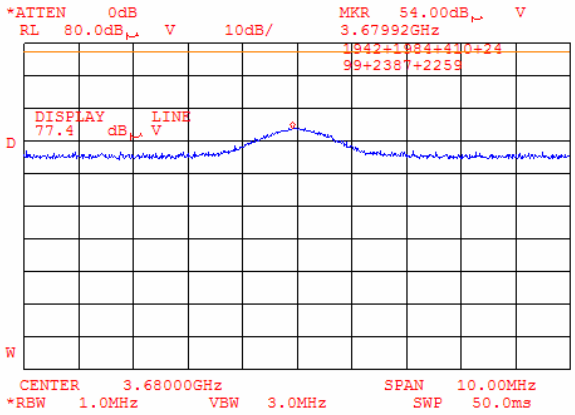
Plot 7.4.37 Radiated emission measurements at the 8th harmonic

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



Plot 7.4.38 Radiated emission measurements at the 8th harmonic

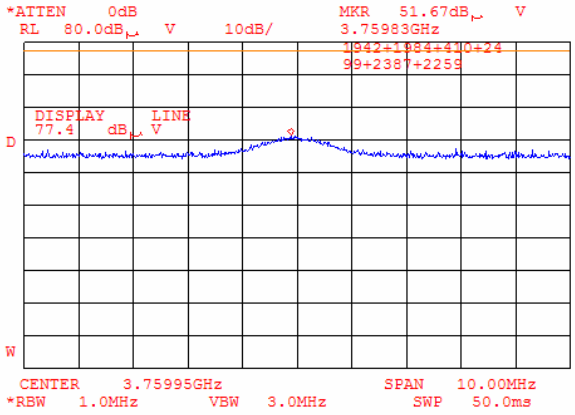
TEST SITE:	OATS
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

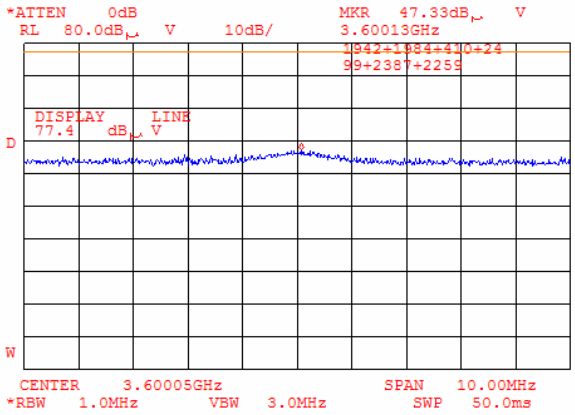
Plot 7.4.39 Radiated emission measurements at the 8th harmonic

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



Plot 7.4.40 Radiated emission measurements at the 8th harmonic

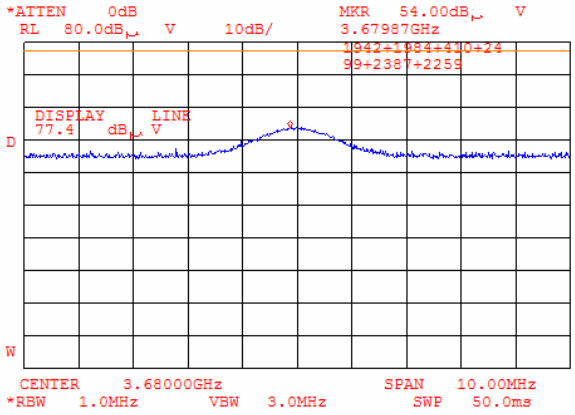
TEST SITE: OATS
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

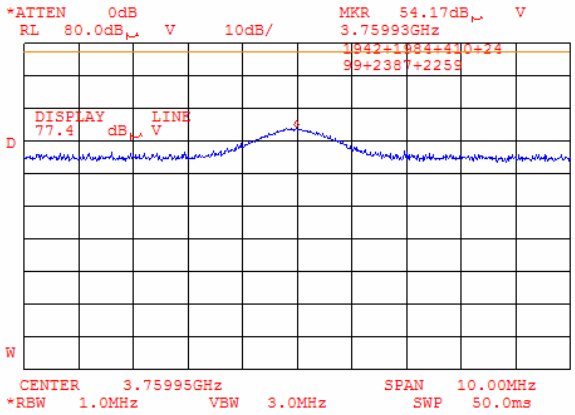
Plot 7.4.41 Radiated emission measurements at the 8th harmonic

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



Plot 7.4.42 Radiated emission measurements at the 8th harmonic

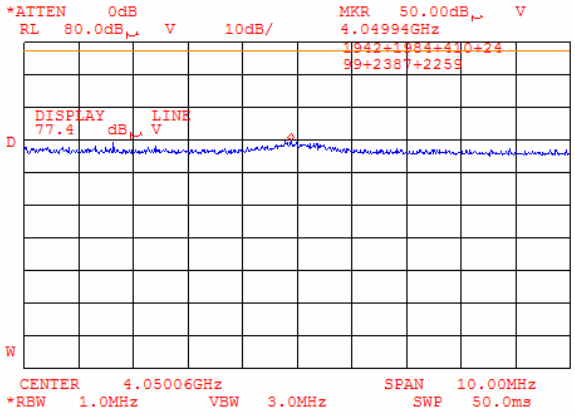
TEST SITE:	OATS
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

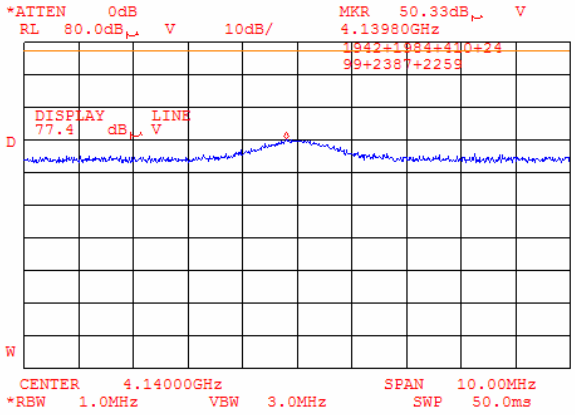
Plot 7.4.43 Radiated emission measurements at the 9th harmonic

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



Plot 7.4.44 Radiated emission measurements at the 9th harmonic

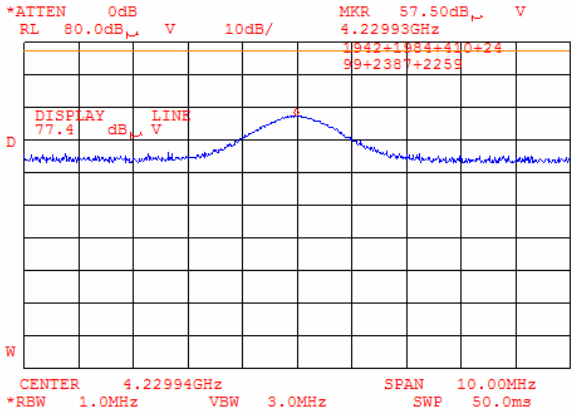
TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical
TEST DISTANCE: 3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

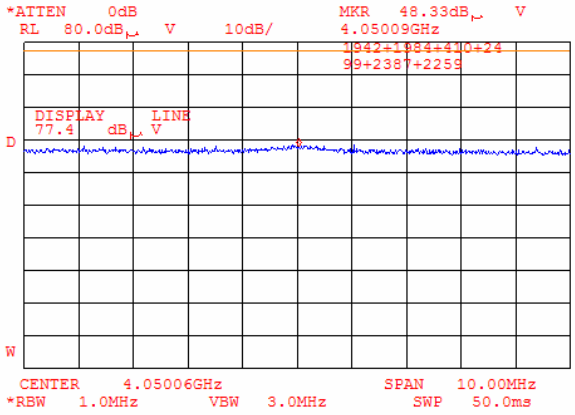
Plot 7.4.45 Radiated emission measurements at the 9th harmonic

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



Plot 7.4.46 Radiated emission measurements at the 9th harmonic

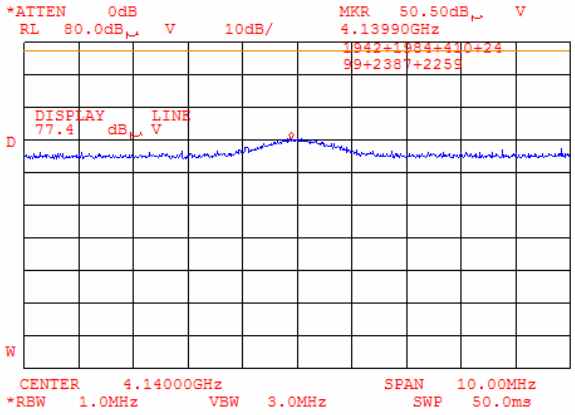
TEST SITE:	OATS
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

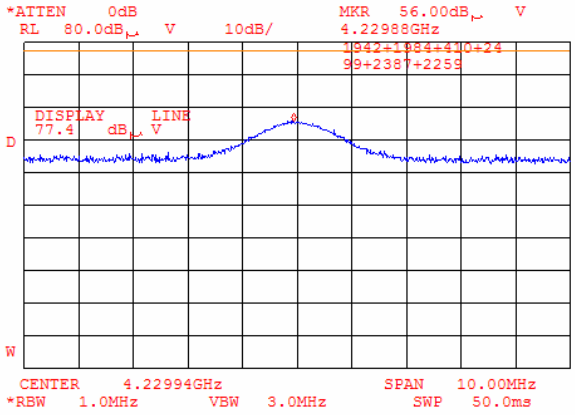
Plot 7.4.47 Radiated emission measurements at the 9th harmonic

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



Plot 7.4.48 Radiated emission measurements at the 9th harmonic

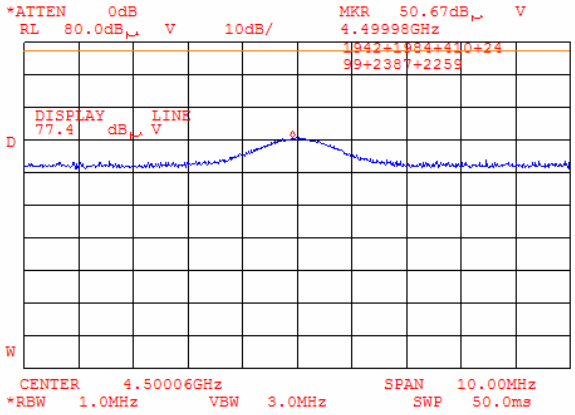
TEST SITE:	OATS
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

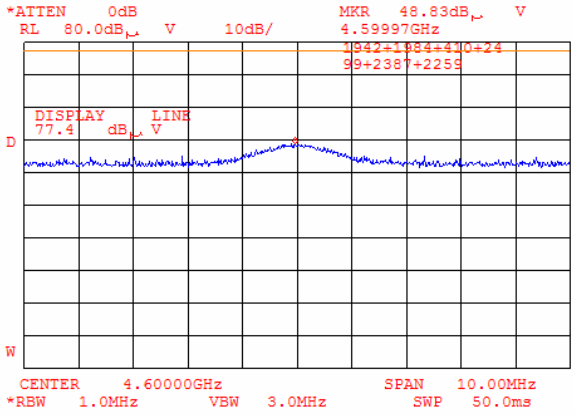
Plot 7.4.49 Radiated emission measurements at the 10th harmonic

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



Plot 7.4.50 Radiated emission measurements at the 10th harmonic

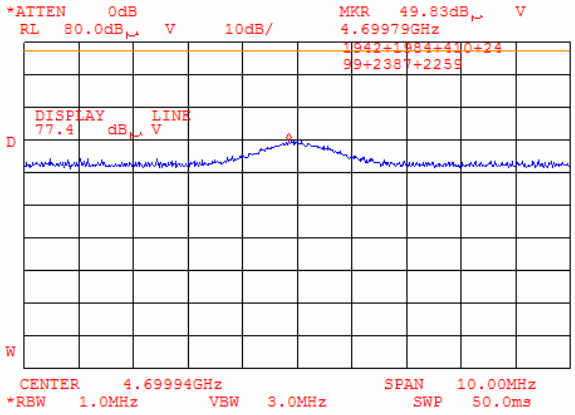
TEST SITE:	OATS
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

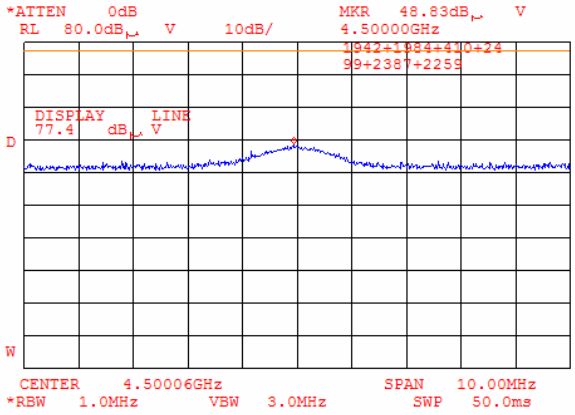
Plot 7.4.51 Radiated emission measurements at the 10th harmonic

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



Plot 7.4.52 Radiated emission measurements at the 10th harmonic

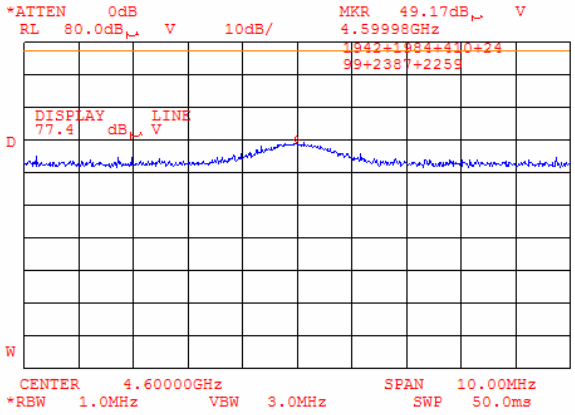
TEST SITE:	OATS
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.210(m); TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/26/2005 3:54:11 PM		
Temperature: 26 ºC	Air Pressure: 1013 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

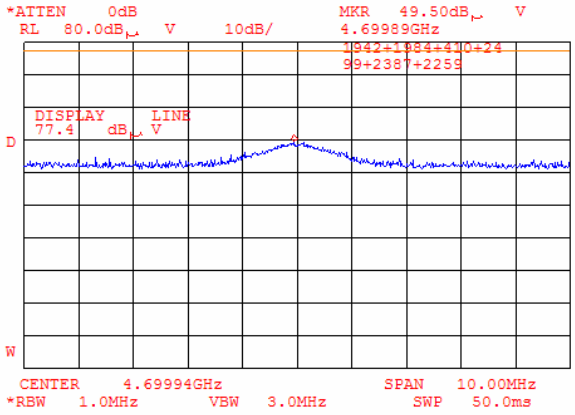
Plot 7.4.53 Radiated emission measurements at the 10th harmonic

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



Plot 7.4.54 Radiated emission measurements at the 10th harmonic

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



Test specification:	Section 90.213, Frequency stability		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/28/2005 5:47:34 PM		
Temperature: 23 ºC	Air Pressure: 1021 hPa	Relative Humidity: 40 %	Power Supply: 3.6 Vdc
Remarks:			

7.5 Frequency stability test

7.5.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.5.1. The test results are provided in Table 7.5.2.

Table 7.5.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450	2.5	1125
460		1150
470		1174

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 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.

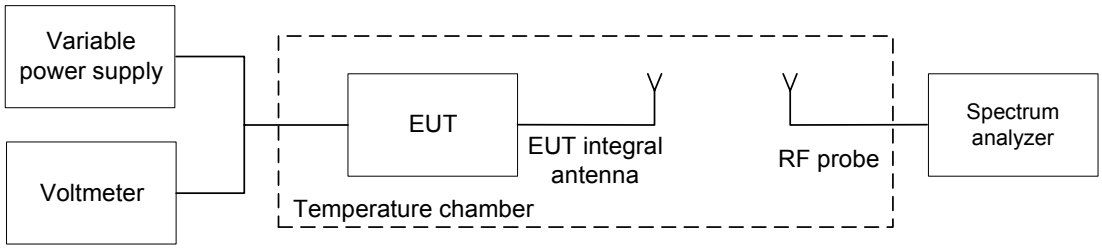
7.5.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

7.5.2.4 The above procedure was repeated at 0˚C and at the lowest test temperature.

7.5.2.5 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.

7.5.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.5.2.

Figure 7.5.1 Frequency stability test setup



Test specification:	**Section 90.213, Frequency stability**		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	4/28/2005 5:47:34 PM		
Temperature: 23 ºC	**Air Pressure:** 1021 hPa	**Relative Humidity:** 40 %	**Power Supply:** 3.6 Vdc
Remarks:			

Table 7.5.2 Frequency stability test results

OPERATING FREQUENCY: 450 MHz - 470 MHz
NOMINAL POWER VOLTAGE: 3.6 VDC
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 300 Hz
VIDEO BANDWIDTH: 300 Hz
MODULATION: Unmodulated

T, ºC	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1st min	2nd min	3rd min	4th min	5th min	10th min	Positive	Negative			
Low frequency													
-30	nominal	450.005975	450.006211	450.006290	450.006325	450.006553	450.006373	450.006335	858	0		-267	Pass
-20	nominal	450.006150	NA	NA	NA	NA	NA	450.006157	462	0		-663	Pass
-10	nominal	450.006252	NA	NA	NA	NA	NA	450.006339	644	0		-481	Pass
0	nominal	450.006312	450.006270	450.006248	450.006231	450.006221	450.006207	450.006181	617	0		-508	Pass
10	nominal	450.005627	NA	NA	NA	NA	NA	450.005743	0	-68		-1057	Pass
20	+15%	450.005732	NA	NA	NA	NA	NA	450.005594	37	0	1125	-1088	Pass
20	nominal	450.005786	NA	NA	NA	NA	NA	450.005695*	0	0		0	Pass
20	-15%	450.005689	NA	NA	NA	NA	NA	450.005668	0	-27		-1098	Pass
30	nominal	450.005805	450.005691	450.005615	450.005570	450.005658	450.005637	450.005719	110	-125		-1000	Pass
40	nominal	450.005825	NA	NA	NA	NA	NA	450.005859	164	0		-961	Pass
50	nominal	450.006170	NA	NA	NA	NA	NA	450.006170	475	0		-650	Pass
Mid frequency													
-30	nominal	460.000035	459.999995	460.000158	460.000256	460.000319	460.000092	460.000169	872	0		-278	Pass
-20	nominal	460.000083	NA	NA	NA	NA	NA	460.000068	636	0		-514	Pass
-10	nominal	460.000241	NA	NA	NA	NA	NA	460.000226	794	0		-356	Pass
0	nominal	460.000206	460.000164	460.000131	460.000116	460.000099	460.000089	460.000079	759	0		-391	Pass
10	nominal	459.999721	NA	NA	NA	NA	NA	459.999718	274	0		-876	Pass
20	+15%	459.999474	NA	NA	NA	NA	NA	459.999461	27	0	1150	-1123	Pass
20	nominal	459.999603	NA	NA	NA	NA	NA	459.999447*	0	0		0	Pass
20	-15%	459.999716	NA	NA	NA	NA	NA	459.999639	269	0		-881	Pass
30	nominal	459.999582	459.999523	459.999452	459.999514	459.999485	459.999460	459.999516	135	0		-1015	Pass
40	nominal	459.999807	NA	NA	NA	NA	NA	459.999759	360	0		-790	Pass
50	nominal	459.999856	NA	NA	NA	NA	NA	460.000183	736	0		-414	Pass
High frequency													
-30	nominal	469.993920	469.994257	469.994048	469.994129	469.994196	469.994232	469.994058	844	0		-330	Pass
-20	nominal	469.994016	NA	NA	NA	NA	NA	469.993940	603	0		-571	Pass
-10	nominal	469.994089	NA	NA	NA	NA	NA	469.994095	682	0		-492	Pass
0	nominal	469.994149	469.994098	469.994050	469.994017	469.993991	469.993962	469.993935	736	0		-438	Pass
10	nominal	469.993663	NA	NA	NA	NA	NA	469.993520	250	0		-924	Pass
20	+15%	469.993507	NA	NA	NA	NA	NA	469.993323	94	-90	1174	-1080	Pass
20	nominal	469.993506	NA	NA	NA	NA	NA	469.993413*	0	0		0	Pass
20	-15%	469.993572	NA	NA	NA	NA	NA	469.993453	159	0		-1015	Pass
30	nominal	469.993671	469.993404	469.993493	469.993330	469.993365	469.993316	469.993301	258	-112		-916	Pass
40	nominal	469.993598	NA	NA	NA	NA	NA	469.993600	187	0		-987	Pass
50	nominal	469.993523	NA	NA	NA	NA	NA	469.993677	264	0		-910	Pass

* - Reference frequency

Reference numbers of test equipment used

HL 0493	HL 0758	HL 1527	HL 1653	HL2404			

Full description is given in Appendix A.

Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	5/4/2005 5:49:10 PM		
Temperature: 22ºC	Air Pressure: 1017 hPa	Relative Humidity: 46%	Power Supply: 3.6 Vdc
Remarks:			

7.6 Transient frequency behavior test

7.6.1 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 7.6.1. The test results are provided in the associated plots.

Table 7.6.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
150.0 – 174.0 MHz band			
25.0	± 25.0	5.0	t_1
	± 12.5	20.0	t_2
	± 25.0	5.0	t_3
12.5	± 12.5	5.0	t_1
	± 6.25	20.0	t_2
	± 12.5	5.0	t_3
6.25	± 6.25	5.0	t_1
	± 3.125	20.0	t_2
	± 6.25	5.0	t_3
421.0 – 512.0 MHz band			
25.0	± 25.0	10.0	t_1
	± 12.5	25.0	t_2
	± 25.0	10.0	t_3
12.5	± 12.5	10.0	t_1
	± 6.25	25.0	t_2
	± 12.5	10.0	t_3
6.25	± 6.25	10.0	t_1
	± 3.125	25.0	t_2
	± 6.25	10.0	t_3

* - t_{on} is the instant when a 1 kHz test signal is completely suppressed;
t_1 is the time period immediately following t_{on};
t_2 is the time period immediately following t_1;
t_3 is the time period from the instant when the transmitter is turned off until t_{off};
t_{off} is the instant when the 1 kHz test signal starts to rise.

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. 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.

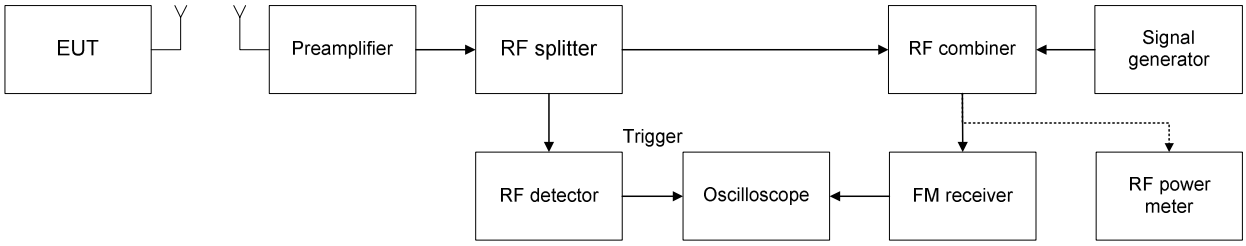
7.6.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 25 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

7.6.2.3 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.

7.6.2.4 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.

Test specification:	**Section 90.214, Transient frequency behaviour**		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	5/4/2005 5:49:10 PM		
Temperature: 22ºC	**Air Pressure:** 1017 hPa	**Relative Humidity:** 46%	**Power Supply:** 3.6 Vdc
Remarks:			

Figure 7.6.1 Transient frequency test setup



Test specification:	**Section 90.214, Transient frequency behaviour**		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	5/4/2005 5:49:10 PM		
Temperature: 22ºC	**Air Pressure:** 1017 hPa	**Relative Humidity:** 46%	**Power Supply:** 3.6 Vdc
Remarks:			

Table 7.6.2 Transient frequency behavior test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
Channel bandwidth 12.5 kHz						
450.00625	*t_1	10.0	>25*	± 25.0	See Note*	PASS
	T_2	25.0	0	± 12.5	-12.5	
	*t_3	10.0	7.8125	± 25.0	-17.1875*	
460	*t_1	10.0	>25*	± 25.0	See Note*	PASS
	T_2	25.0	0	± 12.5	-12.5	
	*t_3	10.0	0	± 25.0	-25	
469.99375	*t_1	10.0	>25*	± 25.0	See Note*	PASS
	T_2	25.0	0	± 12.5	-12.5	
	*t_3	10.0	2.5	± 25.0	-22.5	

*NOTE: If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

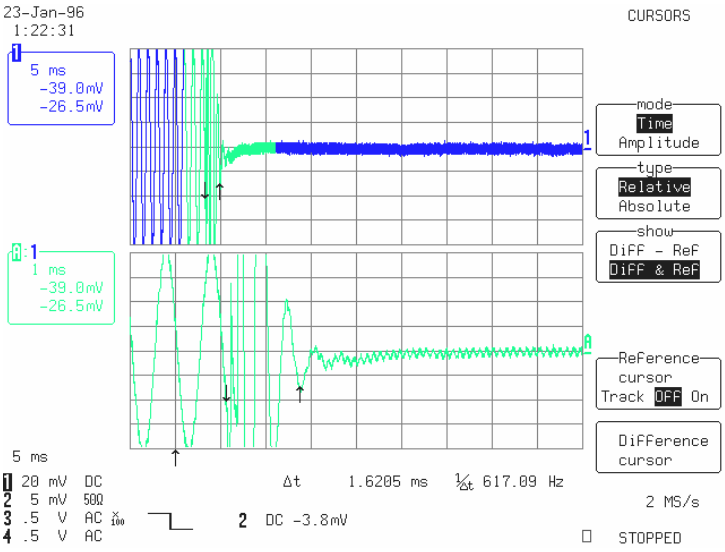
Reference numbers of test equipment used

HL 0539	HL 0778	HL 1553	HL 2014	HL 2653			

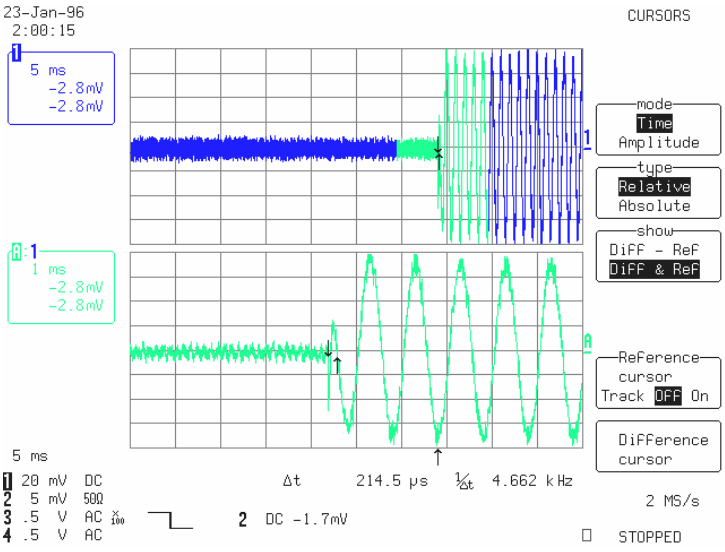
Full description is given in Appendix A.

Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	5/4/2005 5:49:10 PM		
Temperature: 22ºC	Air Pressure: 1017 hPa	Relative Humidity: 46%	Power Supply: 3.6 Vdc
Remarks:			

Plot 7.6.1 Transient frequency during power ON test results at low carrier frequency

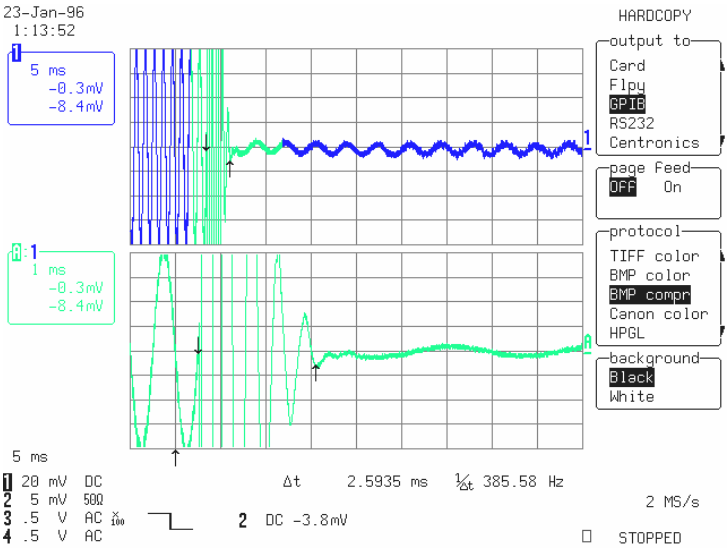


Plot 7.6.2 Transient frequency during power OFF test results at low carrier frequency

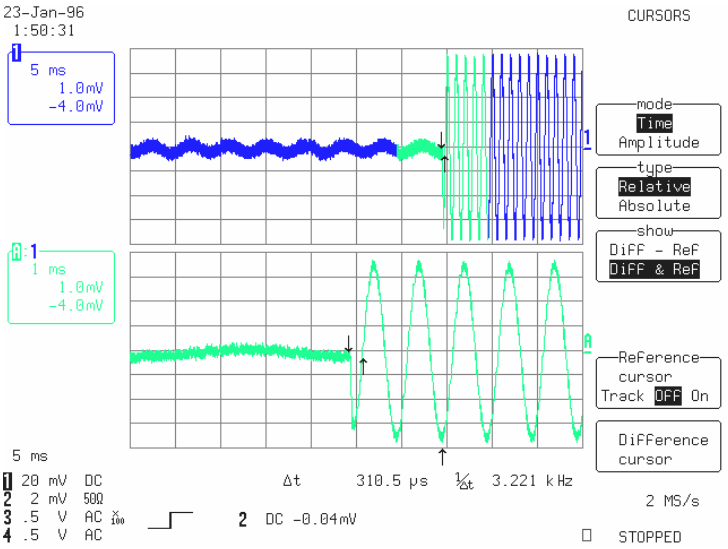


Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	5/4/2005 5:49:10 PM		
Temperature: 22ºC	Air Pressure: 1017 hPa	Relative Humidity: 46%	Power Supply: 3.6 Vdc
Remarks:			

Plot 7.6.3 Transient frequency during power ON test results at mid carrier frequency

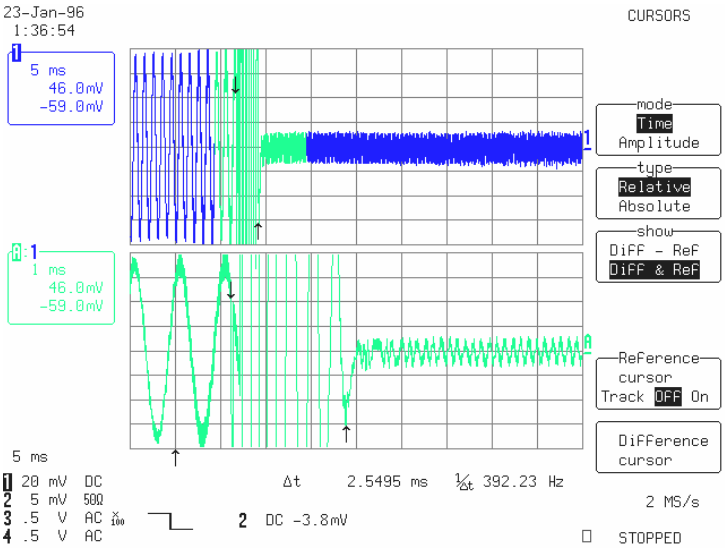


Plot 7.6.4 Transient frequency during power OFF test results at mid carrier frequency

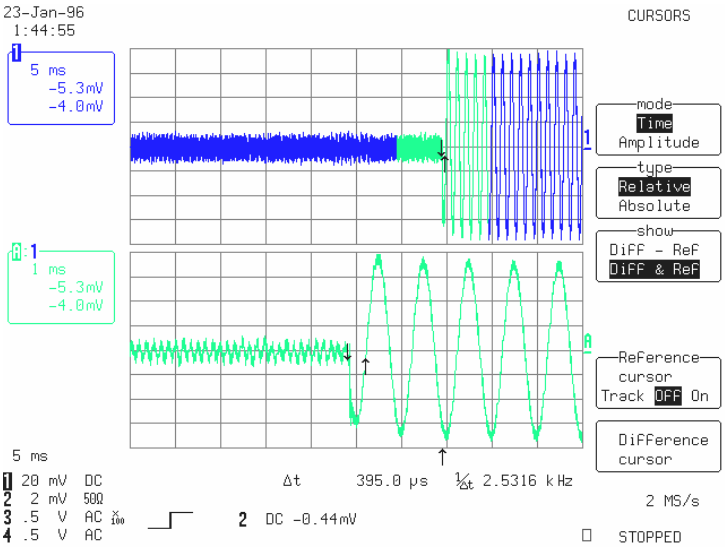


Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	5/4/2005 5:49:10 PM		
Temperature: 22ºC	Air Pressure: 1017 hPa	Relative Humidity: 46%	Power Supply: 3.6 Vdc
Remarks:			

Plot 7.6.5 Transient frequency during power ON test results at high carrier frequency



Plot 7.6.6 Transient frequency during power OFF test results at high carrier frequency



Test specification:	Section 2.1091, RF radiation exposure evaluation		
Test procedure:	47 CFR, Section 1.1307(b)1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 11:18:30 AM		
Temperature: 25 ºC	Air Pressure: 1015 hPa	Relative Humidity: 41 %	Power Supply: 3.6 Vdc
Remarks:			

7.7 RF exposure

7.7.1 General

This test was performed to determine the minimum safe distance between the transmitter antenna and human to avoid public exposure in excess of limits for general population (uncontrolled exposure). Specification test limits are given in Table 7.7.1.

Table 7.7.1 RF exposure limits

Frequency range, MHz	Power density*		Electric field strength**, V/m
	mW/cm^2	W/m^2	
150.0 – 170.0	0.2	2.0	27.5
450.0 – 470.0	0.3 – 0.31	3.0 – 3.1	33.6 – 34.2
700.0	0.47	4.7	42.1
902.0 – 928.0	0.60 – 0.62	6.0 – 6.2	47.6 – 48.3
2400.0 – 2483.5	1.00	10.0	61.4
5725.0 – 5850.0	1.00	10.0	61.4

* - Power density limit within 300 - 1500 MHz was calculated according to the following equation: S = F / 1500, where S is power density in mW/cm^2 and F is frequency in MHz
** - Electric field strength limit was calculated from power density as follows: E = sqrt (S×120×π), where E is electric field strength in V/m and S is power density in W/m^2

7.7.2 Test procedure for E-field strength measurements

7.7.2.1 The EUT, connected to the antenna providing the maximum directional gain, was set up as shown in Figure 7.7.1.

7.7.2.2 The E-field probe was pointed to the EUT antenna zero azimuth at a 3 m distance, the maximum field strength reading was recorded in Table 7.7.2.

7.7.2.3 The E-field probe was slowly moved toward the EUT until E-field equivalent to the maximum permitted power density was measured.

7.7.2.4 The obtained antenna to probe distance was recorded in Table 7.7.2 as a minimum separation distance.

7.7.2.5 The test was repeated at the rest of test distances according to Table 7.7.2.

Table 7.7.2 Maximum permissible exposure (MPE) measurement

Test distance, m	Field strength, V/m	Equivalent power density, mW/cm^2	Limit, mW/cm^2	Margin, mW/cm^2	Verdict
3.0	0.00	0.0000	0.3	-0.3000	Pass
2.5	0.00	0.0000	0.3	-0.3000	Pass
2.0	0.00	0.0000	0.3	-0.3000	Pass
1.5	0.02	0.0000	0.3	-0.3000	Pass
1.0	1.40	0.0005	0.3	-0.2995	Pass
0.5	4.12	0.0045	0.3	-0.2955	Pass
0.3	8.54	0.0193	0.3	-0.2807	Pass
0.2	11.20	0.0333	0.3	-0.2667	Pass
0.1	15.50	0.0637	0.3	-0.2363	Pass

* - Equivalent power density was calculated from electric field strength as follows: $S = 0.1 \times E^2/(120 \times \pi)$, where E is electric field strength in V/m and S is power density in mW/cm^2

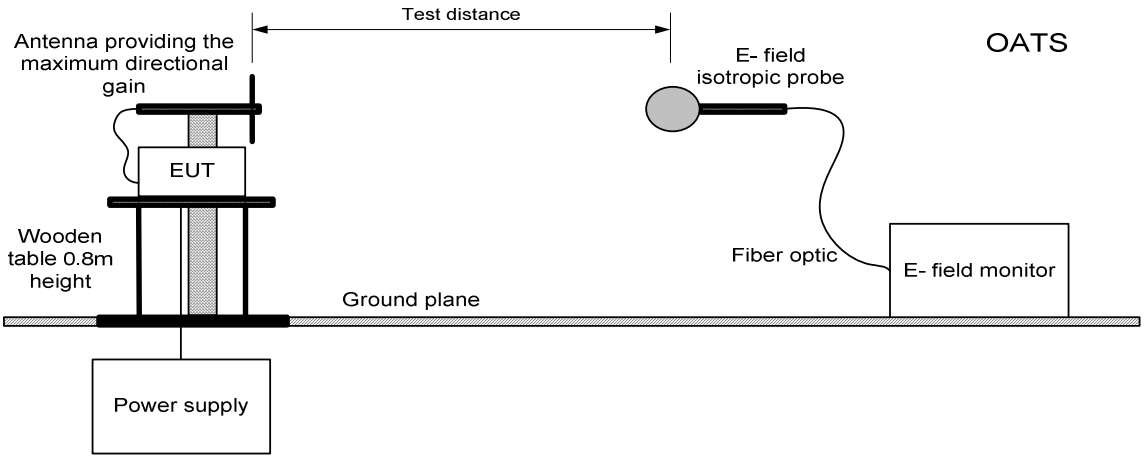
Reference numbers of test equipment used

HL 0174	HL 2078						

Full description is given in Appendix A.

Test specification:	Section 2.1091, RF radiation exposure evaluation		
Test procedure:	47 CFR, Section 1.1307(b)1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	4/25/2005 11:18:30 AM		
Temperature: 25 ºC	Air Pressure: 1015 hPa	Relative Humidity: 41 %	Power Supply: 3.6 Vdc
Remarks:			

Figure 7.7.1 Maximum permissible exposure (MPE) measurement set up



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:	4/26/2005 4:03:08 PM		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 38 %	Power Supply: 3.6 Vdc
Remarks:			

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: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
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 360^0, 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.

7.8.3 Test procedure for measurements at OATS

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

7.8.3.2 Preliminary measurements were performed in the anechoic chamber at 3 m test distance. The specified frequency range was investigated with biconical and log periodic antennas connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

7.8.3.3 The EUT was set up as shown in Figure 7.8.2, energized and the performance check was conducted.

7.8.3.4 Final measurements were performed at the open area test site at 10 m test distance. The EUT wires and cables were arranged to produce maximum emission as it was found during preliminary measurements. The frequencies yield the worst test results (the lowest margins) during preliminary testing were investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m and its polarization was changed from vertical to horizontal. At frequencies where high ambient noise was encountered, the final measurements were taken in the anechoic chamber at 3 m distance.

7.8.3.5 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:	4/26/2005 4:03:08 PM		
Temperature: 24 ºC	Air Pressure: 1015 hPa	Relative Humidity: 38 %	Power Supply: 3.6 Vdc
Remarks:			

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

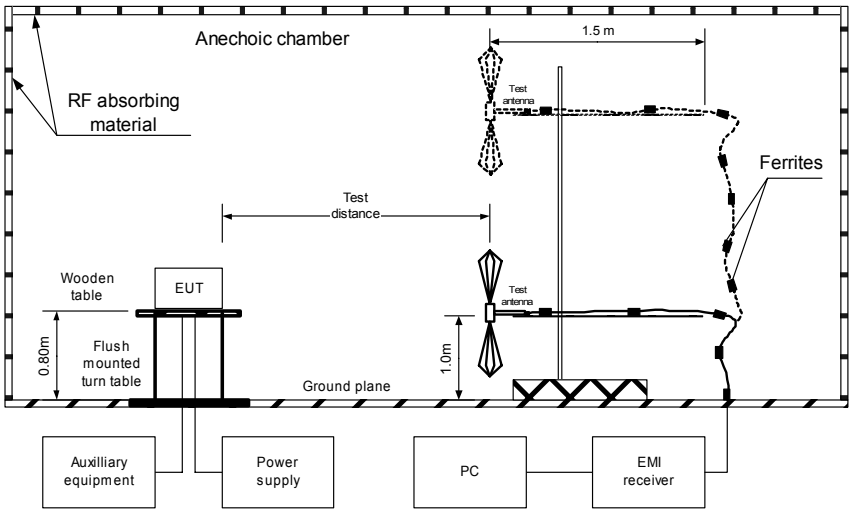
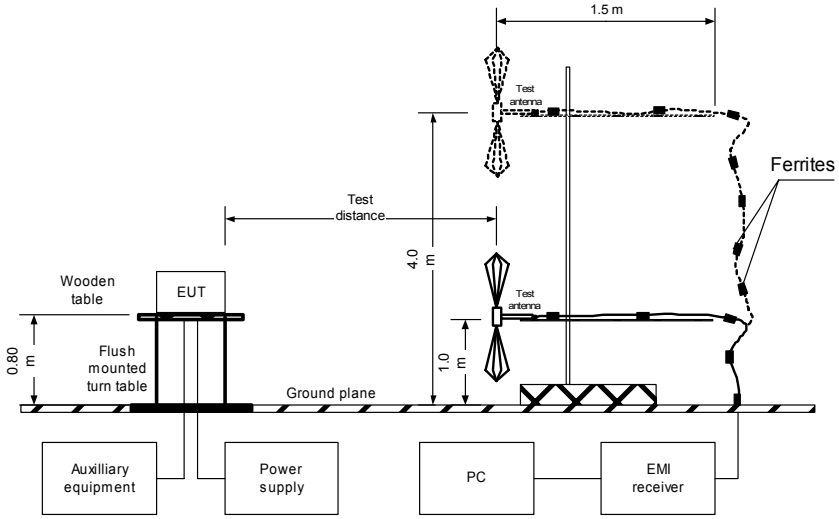


Figure 7.8.2 Setup for radiated emission measurements at OATS, table-top equipment



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:	4/26/2005 4:03:08 PM		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 38 %	**Power Supply:** 3.6 Vdc
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*				
30 – 1000	No emissions were found							Pass

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 2000 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak emission, dB(µV/m)	Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
1000 – 2000	No emissions were found							Pass

*- Margin = Measured emission - specification limit.
**- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

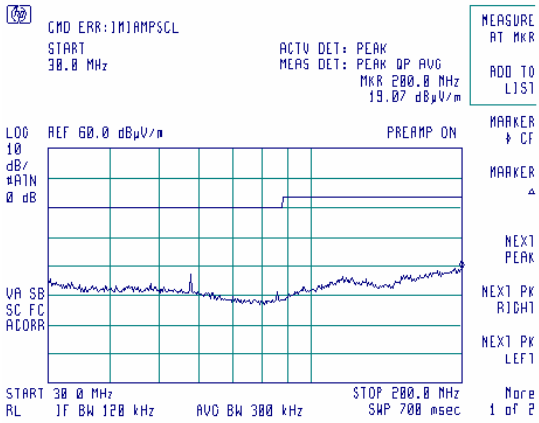
HL 0521	HL 0589	HL 0604	HL 1947	HL 1984	HL 2009		

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:	4/26/2005 4:03:08 PM		
Temperature: 24 °C	Air Pressure: 1015 hPa	Relative Humidity: 38 %	Power Supply: 3.6 Vdc
Remarks:			

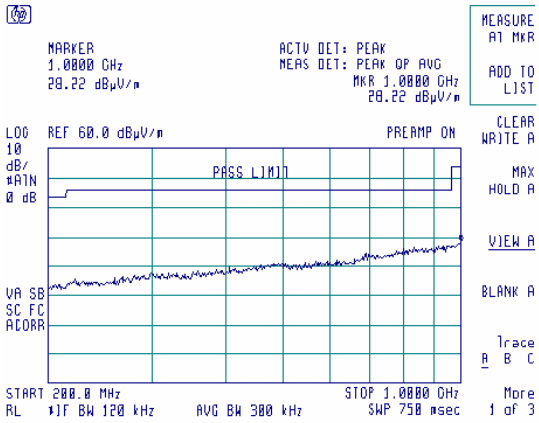
Plot 7.8.1 Radiated emission measurements in 30- 200 MHz range, vertical and horizontal antenna polarization

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



Plot 7.8.2 Radiated emission measurements in 200- 1000 MHz range, vertical and horizontal antenna polarization

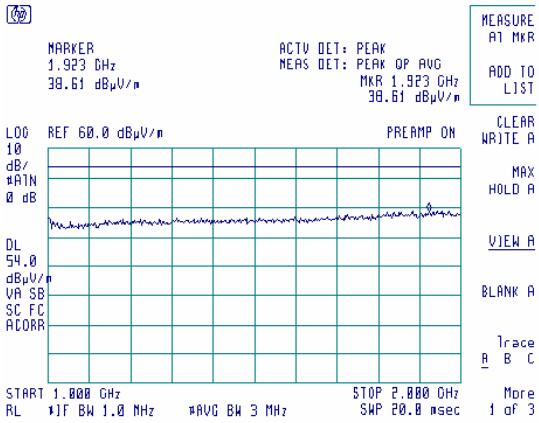
TEST SITE: Anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Stand-by



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:	4/26/2005 4:03:08 PM		
Temperature: 24 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 38 %	**Power Supply:** 3.6 Vdc
Remarks:			

Plot 7.8.3 Radiated emission measurements above 1000 MHz, vertical and horizontal antenna polarization

TEST SITE: 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.
0029	Antenna, Dipole, Tunable 200 -500 MHz	Electro-Metrics	TDS-25/30-1	297	29-Jan-05	29-Jan-06
0034	Antenna, Log Periodic, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	1988	12-Jan-05	12-Jan-06
0174	Monitor, Field, 10kHz-1GHz, 1-300 V/m, w/fiberoptic	Amplifier Research	FM1000	60525	13-Feb-05	13-Feb-06
0415	Cable, Coax, RF, RG-214	HL	CC-3	056	13-Feb-05	13-Feb-06
0446	Antenna, Loop active, 10kHz-30MHz	EMCO	6502	2857	13-Feb-05	13-Feb-06
0465	Anechoic Chamber 9(L) x 6.5(W) x 5.5(H) m	HL	AC - 1	023	10-Oct-04	10-Oct-05
0493	Oven temperature -45…175 deg C	Thermotron	S-1.2 Mini-Max	14016	10-Oct-04	10-Oct-05
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	10-Oct-04	10-Oct-05
0539	Generator Signal, 9 kHz - 1.2 GHz	Marconi Instruments	2023	112121 / 041	03-Dec-04	03-Dec-05
0589	Cable Coaxial, GORE A2P01POL118, 2.3 m	HL	GORE-3	176	02-Dec-04	02-Dec-05
0592	Position Controller	HL	L2-SR3000 (HL CRL-3)	100	18-May-05	18-May-06
0593	Antenna Mast, 1-4 m Pneumatic	Madgesh	AM-F1	101	03-Feb-05	03-Feb-06
0594	Turn Table FOR ANECHOIC CHAMBER flush mount d=1.2 m Pneumatic	HL	TT-WDC1	102	27-Jan-05	27-Jan-06
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE 26 - 2000 MHz	EMCO	3141	9611-1011	27-Jan-05	27-Jan-06
0661	Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm	Hewlett Packard	83640B	3614A002 66	27-Jan-05	27-Jan-06
0758	Power supply, dual, 36 V, 1 A	Horizon Electronics	DHR 36-1	5361231	14-Sep-04	14-Sep-05
1365	Cable Coaxial, S-FLC 12-50, 5 m	HL	C214-5	1365	02-Dec-04	02-Dec-05
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies (HP)	8564EC	3946A002 19	30-Aug-04	30-Aug-05
1430	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL1432	Agilent Technologies (HP)	8542E	3807A002 62,3705A0 0217	01-Sep-04	01-Sep-05
1527	Cable RF, 1.3 m	Telequis	MIL-C-17F-RG 058 CU	1527	23-Sep-04	23-Sep-05
1553	Cable RF, 3.5 m	Alpha Wire	RG-214	1553	02-Dec-04	02-Dec-05

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
1653	Analyzer EMC 9 kHz - 1.5 GHz	Agilent Technologies (HP)	E7401A	US39440281	06-Feb-05	06-Feb-06
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	22-Mar-05	22-Mar-06
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	02-Dec-04	02-Dec-05
2014	Attenuator, Manual Step, 0-99/1 dB, 0-4 GHz, 2 W	Weinschel	AC9004-99-11	16924	08-Dec-04	08-Dec-05
2078	Isotropic Field Probe 80 MHz - 40 GHz	Amplifier Research	FP2080	302541	08-Dec-04	08-Dec-05
2259	Amplifier Low Noise 2-20 GHz	Sophia Wireless	LNA0220-C	0223	05-Nov-04	05-Nov-05
2400	Cable 40GHz, 1.5 m, green	Rhophase Microwave Limited	KPS-1503A-1500-KPS	X2946	23-Sep-04	23-Sep-05
2404	PC Notebook Presario 2100, Cel. 1.8, RAM 256MB, HD 20GB	Compaq	2105EA	CN30828506	16-Aug-04	16-Aug-05
2653	Oscilloscope, Digital storage 175MHz, 100Ms/s, 10Kpts/ch,4ch,	LeCroy Corporation	9304	1448	24-Nov-04	24-Nov-05

9 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

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

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11 APPENDIX D Specification references

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

12 APPENDIX 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(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
dB(μA)	decibel referred to one microampere
dBΩ	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
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	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
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(μV) to convert it into field intensity in dB(μA/m).
Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field intensity in dB(μV/m).

Log periodic antenna factor

Electro-Metrics, model LPA-25/30, serial number 1988

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
200	12.6	625	20.4
225	12.2	650	20.9
250	13.4	675	22.0
275	14.3	700	22.2
300	15.2	725	22.7
325	15.7	750	22.5
350	15.9	775	22.7
375	16.4	800	22.8
400	17.0	825	23.2
425	17.4	850	23.5
450	17.9	875	23.9
475	18.6	900	24.0
500	19.1	925	24.0
525	19.3	950	24.2
550	19.6	975	24.7
575	19.8	1000	25.1
600	20.0		

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

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

Cable loss
Cable Coaxial, RG-58/RG-214, s/n 056, HL 0415
+ Cable Coaxial, RG-214, 11.5m, s/n 148, HL 0812

No.	Frequency, MHz	Cable loss, dB	Measured uncertainty, dB
1	20	0.73	±0.12
2	30	0.91	
3	50	1.2	
4	80	1.56	
5	100	1.76	
6	200	2.59	
7	300	3.26	
8	400	3.93	
9	500	4.42	
10	600	4.92	
11	700	5.36	
12	800	5.88	
13	900	6.41	
14	1000	6.71	
15	1500	8.63	
16	2000	10.39	

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

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	30	0.33	≤ 6.5	±0.12
2	50	0.40		
3	100	0.57		
4	300	0.97		
5	500	1.25		
6	800	1.59		
7	1000	1.81		
8	1200	1.97		
9	1400	2.15		
10	1600	2.28		
11	1800	2.43		
12	2000	2.61		
13	2200	2.75		
14	2400	2.89		
15	2600	2.97		
16	2800	3.21	≤ 6.5	±0.12
17	3000	3.32		
18	3300	3.47		
19	3600	3.62		
20	3900	3.84		
21	4200	3.92		±0.17
22	4500	4.07		
23	4800	4.36		
24	5100	4.62		
25	5400	4.78		
26	5700	5.16		
27	6000	5.67		
28	6500	5.99		

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

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

Cable loss
RF cable 3.5 m, Alpha Wire, model RG-214, S/N 149, HL 1553

No.	Frequency, MHz	Cable loss, dB	Measurement uncertainty, dB
1	1	0.01	±0.05
2	10	0.07	
3	30	0.12	
4	50	0.22	
5	100	0.26	
6	200	0.40	
7	300	0.52	
8	400	0.60	
9	500	0.70	
10	600	0.77	
11	700	0.84	
12	800	1.00	
13	900	1.00	
14	1000	1.05	
15	2000	1.70	

Cable loss
Cable 18 GHz, 4 m, green, model: SPS-1803A-4000-NPS, S/N T4657, HL 1941

Frequency, GHz	Cable loss, dB
0.03	0.39
0.05	0.49
0.1	0.68
0.2	0.95
0.3	1.30
0.5	1.58
0.7	1.84
0.9	2.08
1.1	2.28
1.3	2.56
1.5	2.91
1.7	2.95
1.9	3.17
2.1	3.22
2.3	3.25
2.5	3.39
2.7	3.51
2.9	3.67
3.1	3.81
3.3	3.92
3.5	4.05
3.7	4.14
3.9	4.30
4.1	4.44
4.3	4.55
4.5	4.68
4.7	4.75
4.9	4.84
5.1	4.86
5.3	4.89
5.5	5.00
5.7	5.05
5.9	5.19
6.1	5.28
7.7	5.58

Frequency, GHz	Cable loss, dB
7.9	5.63
8.1	5.67
8.3	5.70
8.5	5.74
8.7	5.78
8.9	5.84
9.1	5.89
9.3	5.94
9.5	6.02
9.7	6.10
9.9	6.12
10.1	6.09
10.3	6.03
10.5	6.01
10.7	6.05
10.9	6.08
11.1	6.10
11.3	6.18
11.5	6.23
11.7	6.20
11.9	6.16
12.1	6.18
12.4	6.33
13.0	6.51
13.5	6.51
14.0	6.75
14.5	6.82
15.0	6.93
15.5	7.16
16.0	7.10
16.5	7.18
17.0	7.67
17.5	7.71
18.0	7.61

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

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

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

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

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

Cable loss
Cable coaxial, 40GHz, 1.5 m, green, Rhophase Microwave Limited, model: KPS-1503A-1500-KPS, HL 2400

Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB
0.03	0.06	6.5	1.46	15.50	2.34
0.05	0.08	6.7	1.49	16.00	2.34
0.1	0.15	6.9	1.50	16.50	2.40
0.2	0.23	7.1	1.51	17.00	2.46
0.3	0.29	7.3	1.55	17.50	2.54
0.5	0.37	7.5	1.56	18.00	2.61
0.7	0.46	7.7	1.58	18.50	2.59
0.9	0.53	7.9	1.60	19.00	2.59
1.1	0.58	8.1	1.61	19.50	2.67
1.3	0.65	8.3	1.68	20.00	2.62
1.5	0.66	8.5	1.68	20.50	2.73
1.7	0.72	8.7	1.75	21.00	2.71
1.9	0.76	8.9	1.74	21.50	2.78
2.1	0.79	9.1	1.81	22.00	2.83
2.3	0.85	9.3	1.79	22.50	2.81
2.5	0.90	9.5	1.86	23.50	2.91
2.7	0.91	9.7	1.85	24.00	2.97
2.9	0.97	9.9	1.87	24.50	2.98
3.1	0.97	10.1	1.88	25.00	2.97
3.3	1.03	10.30	1.82	25.50	3.03
3.5	1.06	10.50	1.92	26.00	3.04
3.7	1.10	10.70	1.86	26.50	3.11
3.9	1.13	10.90	1.96	27.00	2.97
4.1	1.16	11.10	1.90	28.00	3.15
4.3	1.18	11.30	1.99	29.00	3.07
4.5	1.21	11.50	1.95	30.00	3.13
4.7	1.23	11.70	2.00	31.00	3.13
4.9	1.26	11.90	2.01	32.00	3.18
5.1	1.28	12.10	1.99	33.00	3.31
5.3	1.31	12.40	2.06	34.00	3.32
5.5	1.32	13.00	2.11	35.00	3.37
5.7	1.36	13.50	2.17	36.00	3.36
5.9	1.37	14.00	2.36	37.00	3.46
6.1	1.38	14.50	2.32	39.00	3.49
6.3	1.44	15.00	2.30	40.00	3.52