HERMON LABORATORIES

ACCREDITED
839.01
Electrical

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

TEST REPORT

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

FOR:

Miltel Communications Ltd.

Remote Data Collector
150 - 170 MHz

Model: Repeater 2A

FCC ID:MLLGL2RPT150

Table of contents

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:	Remote data collector
Product type:	Transceiver
Model(s):	Repeater 2A
Serial number:	24
Receipt date	9/18/2005

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:	16691
Location:	Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel
Test started:	9/18/2005
Test completed:	11/02/2005
Test specification(s):	47CFR part 90, §§90.217(b), part 15 , subpart B
Test suite:	FCC_90_BS_with_RF_connector_below_120mW (7/15/2004 12:12:42 AM, modified)

5 Tests summary

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

Testing was completed against all relevant requirements of the test standard. 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	November 2, 2005	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	November 10, 2005	
Approved by:	Mr. M. Nikishin, EMC and Radio group leader	November 13, 2005	

6 EUT description

6.1 General information

The EUT is a data link transciever operating in 150 -170 MHz range that is used for data acquisition in Miltel's telemetric data collection system and powered from AC mains through 12 VDC /100-240 VAC adapter.

6.2 Ports and lines

Port type	Port description	Connected		Connector type	Qty.	Cable type	Cable length
		From	To				
Power / signal	12 VDC / Communication	EUT	AC/DC adapter / PC	4 pin non-detachable	1	Shielded	4.5 m
RF	Antenna	EUT J1	Open circuit	SMA	1	NA	NA
RF	Antenna	EUT J2, J3, J4	50 Ohm termination	SMA	3	NA	NA
Power	120 VAC	AC/DC adapter	AC mains	2 pin	1	Unshielded	1.5 m
Power	120 VAC	PC	AC mains	IEC 60320	1	Unshielded	1.5 m

6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Laptop	Compaq	2165EA	CN30828506
PC	Siemens Nixdorf	M5/166ATX	Qk028799
Monitor	ACER	7134E	9178502006
Keyboard	Fujitsu	FKB8729	OZ614979
Mouse	Logitech	M-S488	LZH03200640
Printer	Epson	LX-810	44B1127035

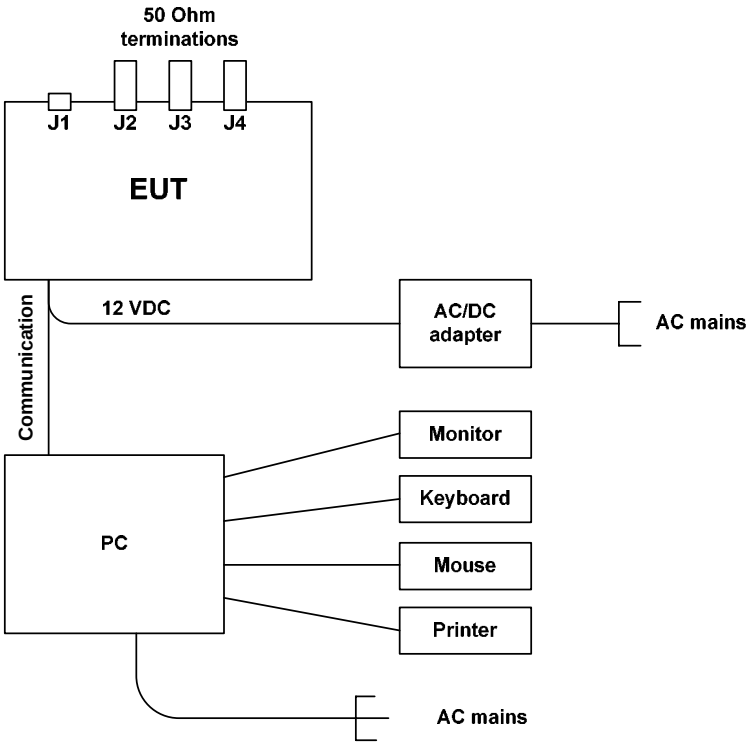
6.4 Operating frequencies

Source	Frequency, MHz	
Digital portion	4	20
Receiver	150 – 170	NA
Transmitter	150 – 170	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	150 - 170 MHz
Operating frequency range	150.2 – 169.8 MHz
RF channel spacing	12.5 kHz

Maximum rated output power (EIRP)	At transmitter 50 Ω RF output connector	18 dBm
	Equivalent isotropically radiated power (for equipment with no RF connector)	

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	SMA standard connector	integral		with temporary RF connector
			X	without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Omni	MARS	M2163	2 dBi
Monopole	Miltel Communications	WE-25-SMA-600	0 dBi

Transmitter 99% power bandwidth	10.8 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)	Alternating symbol					
Transmitter duty cycle supplied for test	100%	**Tx ON time**	msec	**Period**	msec	

Transmitter power source						
	Battery	**Nominal rated voltage**		Battery type		
	DC	**Nominal rated voltage**				
X	AC mains	**Nominal rated voltage**	120 VAC	Frequency	60 Hz	

Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:17:16 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

7 Transmitter tests according to 47CFR part 90 requirements

7.1 Peak output power test

7.1.1 General

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

Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Maximum peak output power	
	mW	dBm
150.0 – 170.0	120	20.8

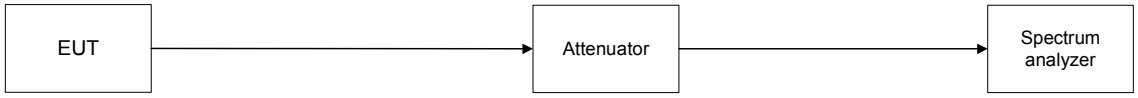
7.1.2 Test procedure

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

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

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

Figure 7.1.1 Peak output power test setup



Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:17:16 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE:	150 – 170 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	2000 kHz
VIDEO BANDWIDTH:	3000 kHz
MODULATION:	Alternating symbol
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
EUT OUTPUT:	J1 (J2, J3 and J4 are antenna inputs)

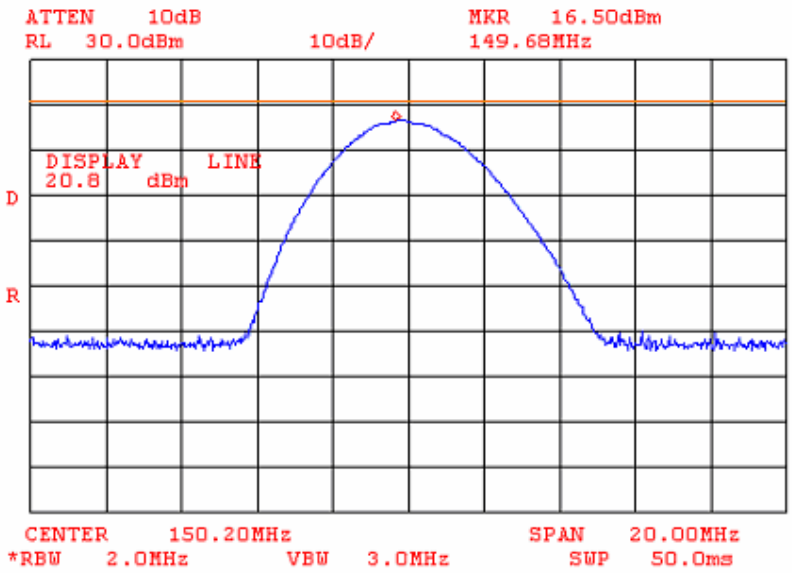
Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
150.2	16.50	Included	Included	16.50	20.8	-4.30	Pass
160.0	15.67	Included	Included	15.67	20.8	-5.13	Pass
169.8	18.00	Included	Included	18.00	20.8	-2.80	Pass

Reference numbers of test equipment used

HL 1424	HL 2399	HL 2524					

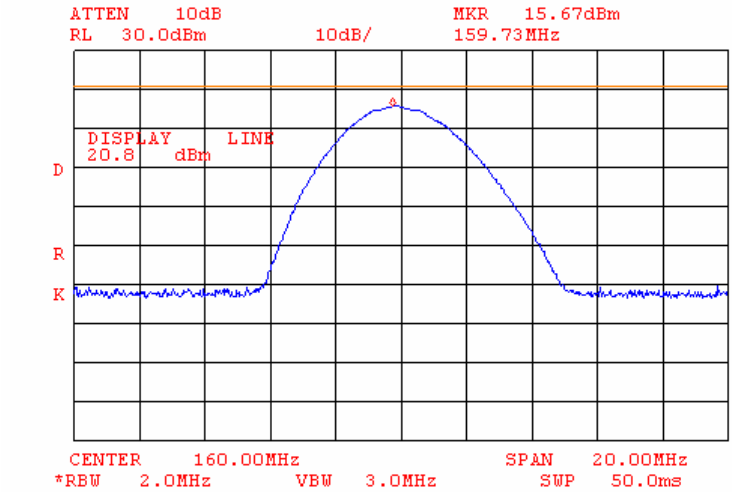
Full description is given in Appendix A.

Plot 7.1.1 Peak output power test results at low frequency

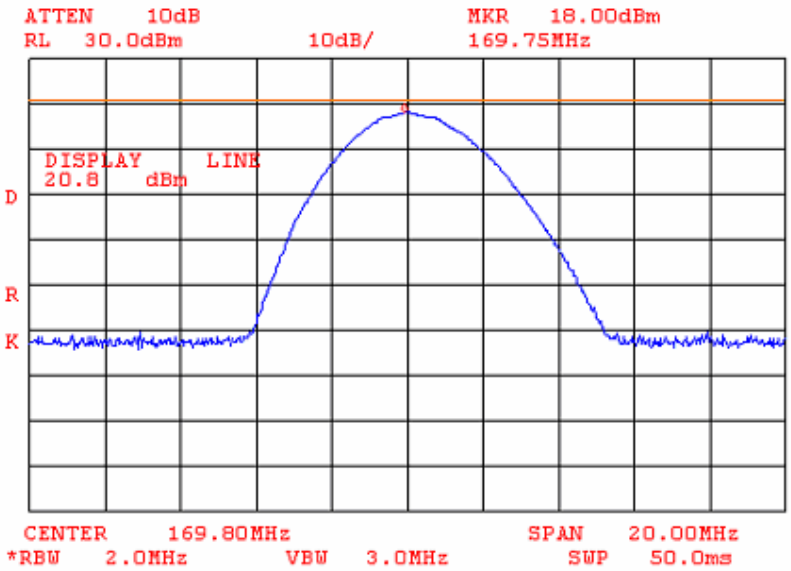


Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:17:16 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

Plot 7.1.2 Peak output power test results at mid frequency



Plot 7.1.3 Peak output power test results at high frequency



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:35:30 PM		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
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
150 – 170	26	20

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

7.2.2 Test procedure

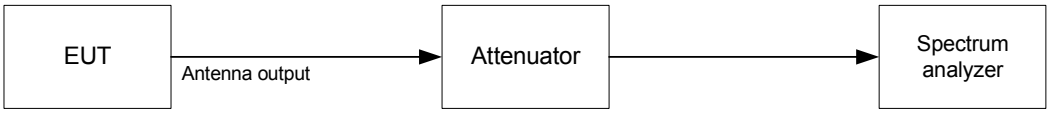
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

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:	9/25/2005 3:35:30 PM		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	1 kHz
VIDEO BANDWIDTH:	3 kHz
MODULATION ENVELOPE REFERENCE POINTS:	26 dBc
MODULATION:	FSK
MODULATING SIGNAL:	Alternative signal
BIT RATE:	600 bps
ANTENNA OUTPUT:	Port J1 (J2, J3 and J4 are antenna inputs)

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
150.2	10.75	11.25	-0.50	Pass
160.0	10.50	11.25	-0.75	Pass
169.8	10.83	11.25	-0.42	Pass

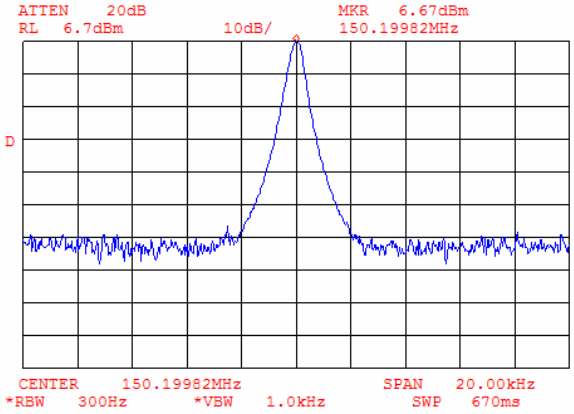
Reference numbers of test equipment used

HL 1424	HL 2399	HL 2524					

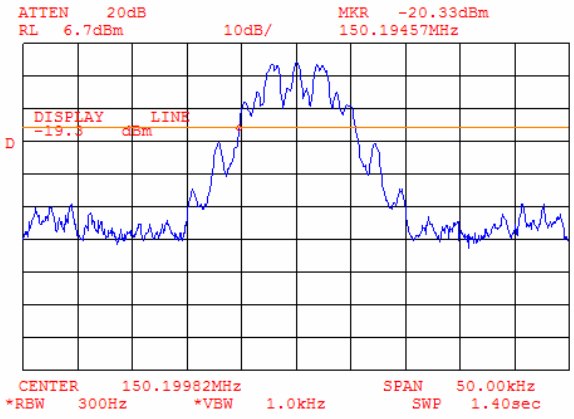
Full description is given in Appendix A.

Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:35:30 PM		
Temperature: 24 °C	Air Pressure: 1014 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.1 Occupied bandwidth test result at low frequency, unmodulated reference

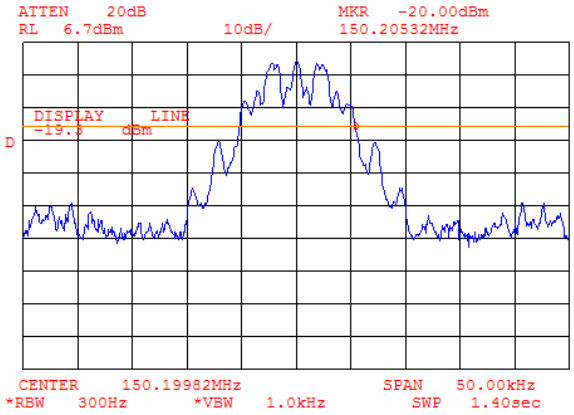


Plot 7.2.2 Occupied bandwidth test result at low frequency, lower cross point



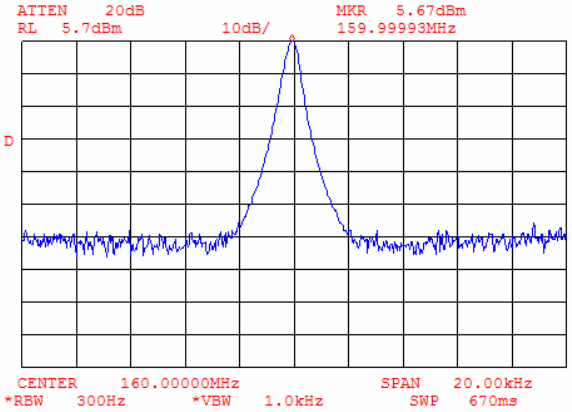
Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:35:30 PM		
Temperature: 24 °C	Air Pressure: 1014 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.3 Occupied bandwidth test result at low frequency, upper cross point

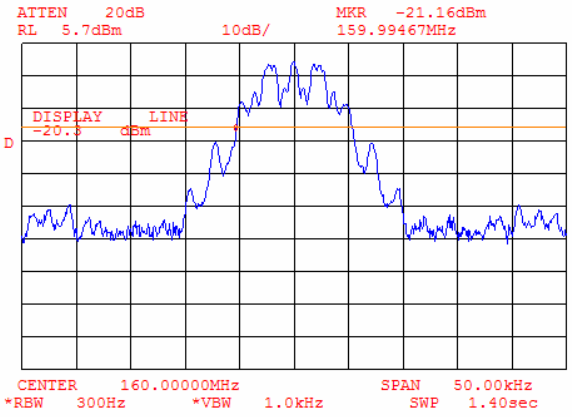


Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:35:30 PM		
Temperature: 24 °C	Air Pressure: 1014 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.4 Occupied bandwidth test result at mid frequency, unmodulated reference

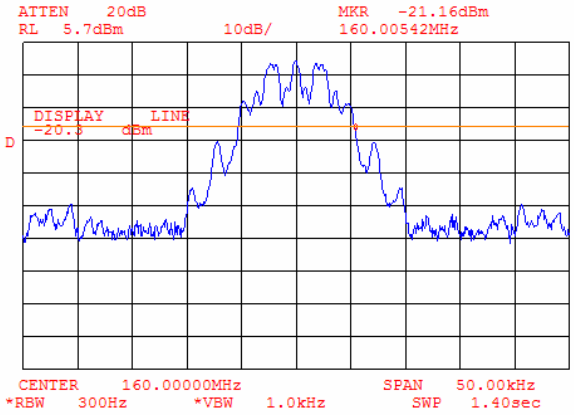


Plot 7.2.5 Occupied bandwidth test result at mid frequency, lower cross point



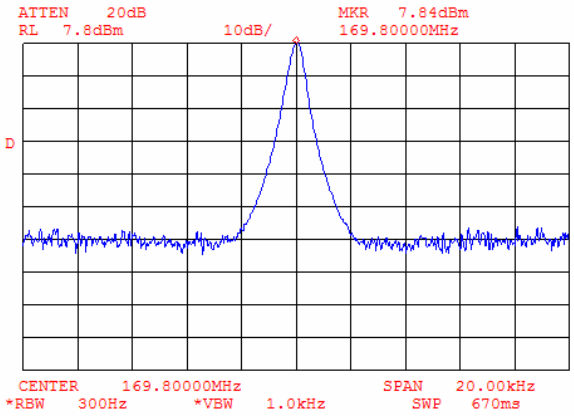
Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:35:30 PM		
Temperature: 24 °C	Air Pressure: 1014 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.6 Occupied bandwidth test result at mid frequency, upper cross point

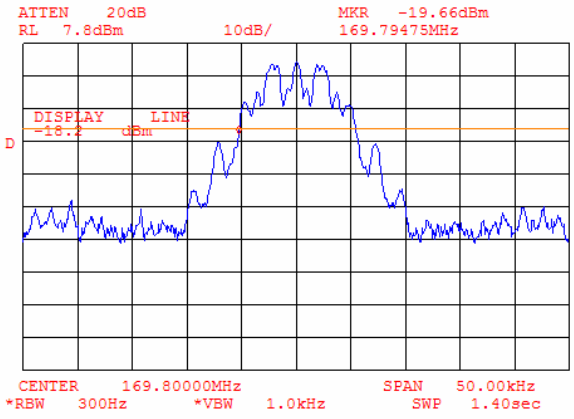


Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:35:30 PM		
Temperature: 24 °C	Air Pressure: 1014 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.7 Occupied bandwidth test result at high frequency, unmodulated reference

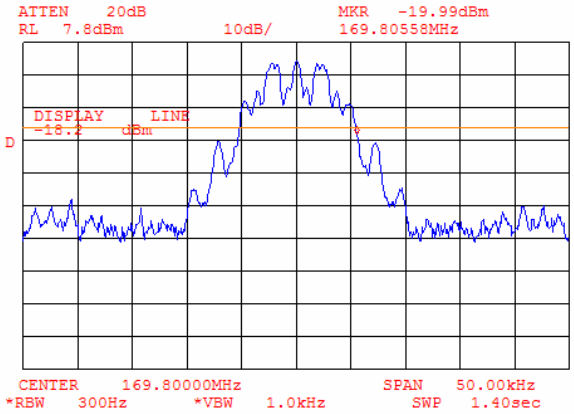


Plot 7.2.8 Occupied bandwidth test result at high frequency, lower cross point



Test specification:	**Section 90.209, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	9/25/2005 3:35:30 PM		
Temperature: 24 °C	**Air Pressure:** 1014 hPa	**Relative Humidity:** 48 %	**Power Supply:** 120 VAC
Remarks:			

Plot 7.2.9 Occupied bandwidth test result at high frequency, upper cross point



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:	9/26/2005 10:31:19 AM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

7.3 Frequency stability test

7.3.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.3.1. The test results are provided in Table 7.3.2.

Table 7.3.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
150 – 170	NA	NA

7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The EUT power was turned off. Temperature within test chamber was set to +30˚C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

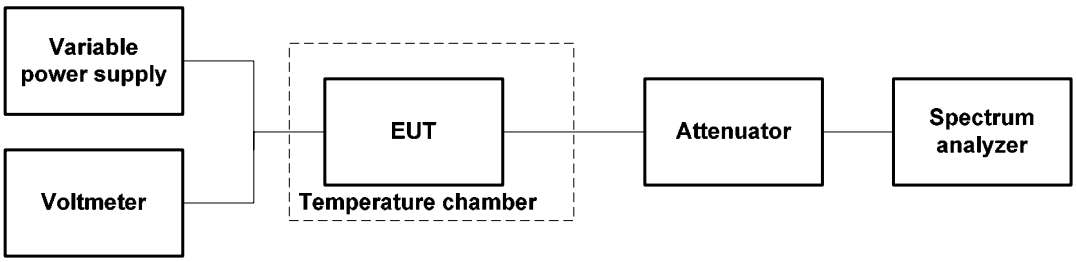
7.3.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

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

7.3.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.

7.3.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.3.2.

Figure 7.3.1 Frequency stability test setup



Test specification:	**Section 90.213, Frequency stability**		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	9/26/2005 10:31:19 AM		
Temperature: 24 ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 45 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY: 150.2 – 169.8 MHz
NOMINAL POWER VOLTAGE: 12 VDC
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 1 kHz
VIDEO BANDWIDTH: 1 kHz
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	150.199346	150.199302	150.199296	150.199300	150.199296	150.199298	150.199302	0	-1152		NA	NA
-20	nominal	150.200204	NA	NA	NA	NA	NA	150.200144	0	-304		NA	NA
-10	nominal	150.200286	NA	NA	NA	NA	NA	150.200280	0	-168		NA	NA
0	nominal	150.200040	150.200050	150.200050	150.200052	150.200052	150.200052	150.200048	0	-408		NA	NA
10	nominal	150.199862	NA	NA	NA	NA	NA	150.199900	0	-586		NA	NA
20	+15%	150.200274	NA	NA	NA	NA	NA	150.200266	0	-182	NA	NA	NA
20	nominal	150.200450	NA	NA	NA	NA	NA	150.200448*	0	0		NA	NA
20	-15%	150.200052	NA	NA	NA	NA	NA	150.200020	0	-428		NA	NA
30	nominal	150.199702	150.199726	150.199728	150.199728	150.199726	150.199722	150.199702	0	-746		NA	NA
40	nominal	150.198942	NA	NA	NA	NA	NA	150.198922	0	-1526		NA	NA
50	nominal	150.198338	NA	NA	NA	NA	NA	150.198338	0	-2110		NA	NA
160.0 MHz													
-30	nominal	159.999486	159.999442	159.999434	159.999424	159.999422	159.999414	159.999394	0	-1102		NA	NA
-20	nominal	160.000306	NA	NA	NA	NA	NA	160.000266	0	-230		NA	NA
-10	nominal	160.000434	NA	NA	NA	NA	NA	160.000428	0	-68		NA	NA
0	nominal	160.000192	160.000198	160.000204	160.000206	160.000204	160.000202	160.000198	0	-304		NA	NA
10	nominal	160.000020	NA	NA	NA	NA	NA	159.999988	0	-508		NA	NA
20	+15%	160.000368	NA	NA	NA	NA	NA	160.000322	0	-174	NA	NA	NA
20	nominal	160.000546	NA	NA	NA	NA	NA	160.000496*	0	0		NA	NA
20	-15%	160.000204	NA	NA	NA	NA	NA	160.000174	0	-322		NA	NA
30	nominal	159.999764	159.999772	159.999776	159.999776	159.999774	159.999768	159.999752	0	-744		NA	NA
40	nominal	159.998968	NA	NA	NA	NA	NA	159.998986	0	-1528		NA	NA
50	nominal	159.998342	NA	NA	NA	NA	NA	159.998334	0	-2162		NA	NA
169.8 MHz													
-30	nominal	169.799698	169.799650	169.799634	169.799620	169.799612	169.799604	169.799556	0	-980		NA	NA
-20	nominal	169.800422	NA	NA	NA	NA	NA	169.800352	0	-184		NA	NA
-10	nominal	169.800624	NA	NA	NA	NA	NA	169.800616	88	0		NA	NA
0	nominal	169.800292	169.800326	169.800332	169.800338	169.800342	169.800348	169.800352	0	-244		NA	NA
10	nominal	169.800104	NA	NA	NA	NA	NA	169.800084	0	-452		NA	NA
20	+15%	169.800420	NA	NA	NA	NA	NA	169.800390	0	-146	NA	NA	NA
20	nominal	169.800598	NA	NA	NA	NA	NA	169.800536*	0	0		NA	NA
20	-15%	169.800372	NA	NA	NA	NA	NA	169.800330	0	-206		NA	NA
30	nominal	169.799822	169.799834	169.799834	169.799832	169.799830	169.799828	169.799812	0	-724		NA	NA
40	nominal	169.799040	NA	NA	NA	NA	NA	169.799054	0	-1496		NA	NA
50	nominal	169.798344	NA	NA	NA	NA	NA	169.798350	0	-2192		NA	NA

* - Reference frequency

Reference numbers of test equipment used

HL 0493	HL 0758	HL 0808	HL 0892	HL 1508			

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:	10/19/2005 6:10:31 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

7.4 Transient frequency behaviour test

7.4.1 General

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

Table 7.4.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
150.0 – 174.0 MHz band			
12.5	± 12.5	5.0	t_1
	± 6.25	20.0	t_2
	± 12.5	5.0	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.

7.4.2 Test procedure

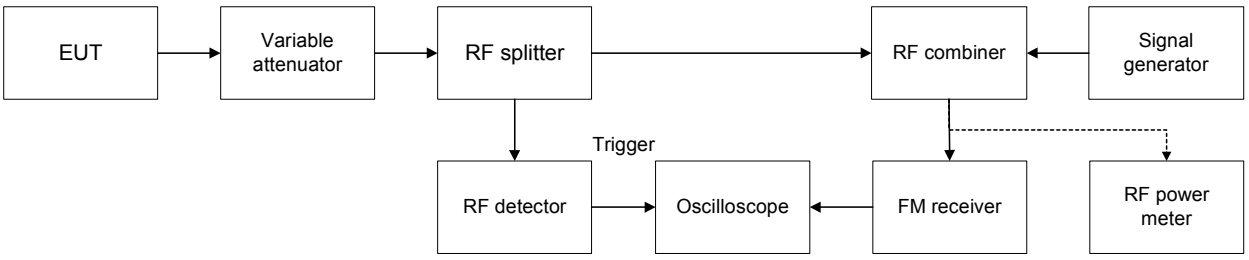
7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

7.4.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 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.

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

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

Figure 7.4.1 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:	10/19/2005 6:10:31 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

Table 7.4.2 Transient frequency behaviour test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
150.2	t_1	5.0	<12.5	± 12.5	NA	Pass
	t_2	20.0	0	± 6.25	6.25	
	t_3	5.0	-10.625	± 12.5	-1.875	
160.0	t_1	5.0	<12.5	± 12.5	NA	Pass
	t_2	20.0	0	± 6.25	6.25	
	t_3	5.0	10.937	± 12.5	-1.563	
169.8	t_1	5.0	<12.5	± 12.5	NA	Pass
	t_2	20.0	0	± 6.25	6.25	
	t_3	5.0	-11.25	± 12.5	-1.25	

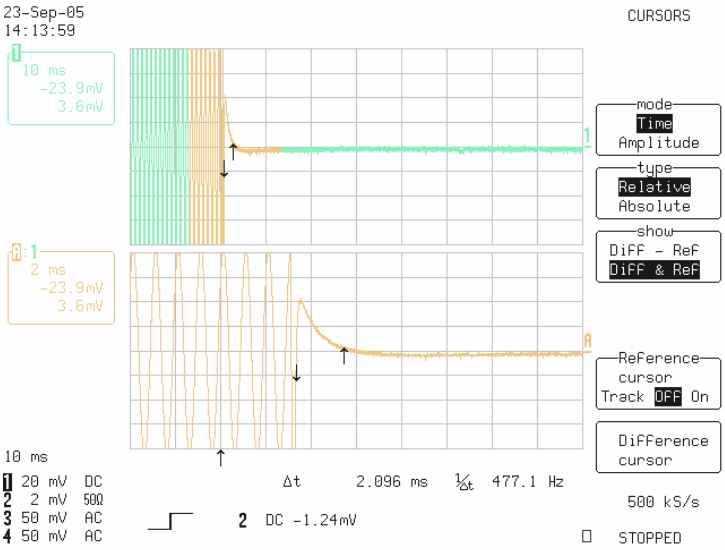
Reference numbers of test equipment used

HL 0661	HL 0670	HL 0788	HL 1653	HL 1907	HL 1956	HL 2014	HL 2254
HL 2400	HL 2634						

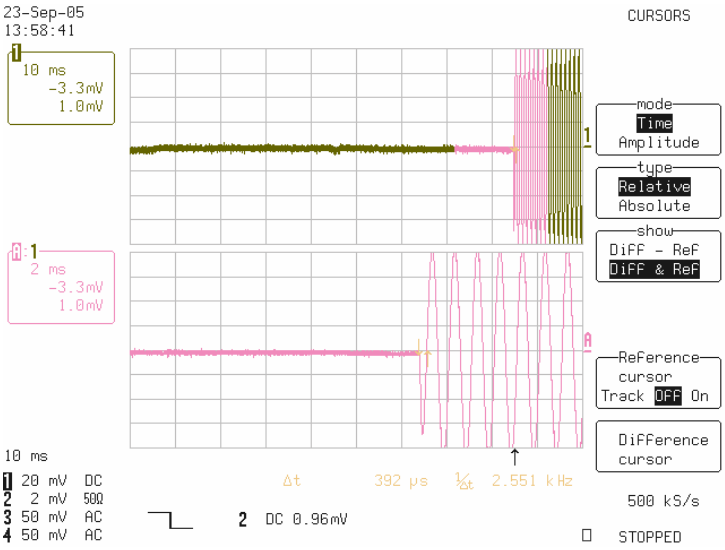
Full description is given in Appendix A.

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:	10/19/2005 6:10:31 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

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

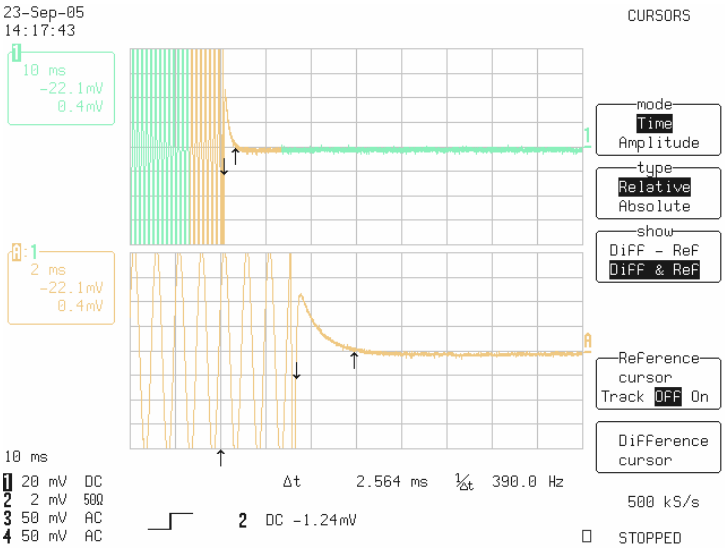


Plot 7.4.2 Transient frequency during power OFF test results at low carrier frequency

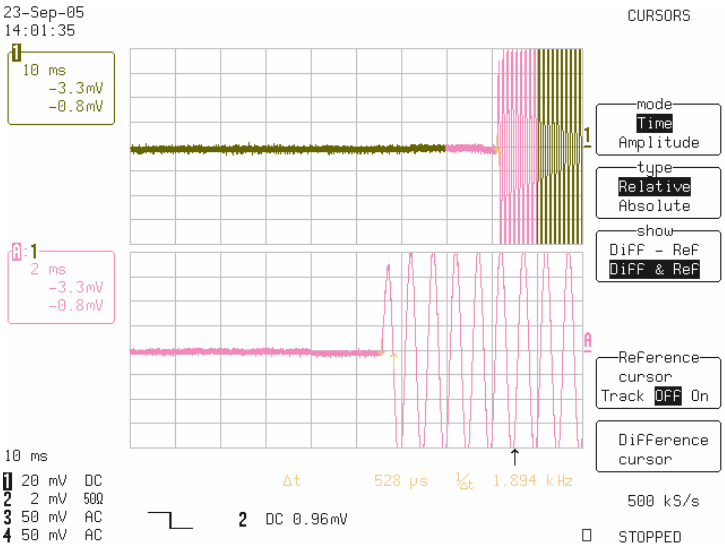


Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:10:31 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

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

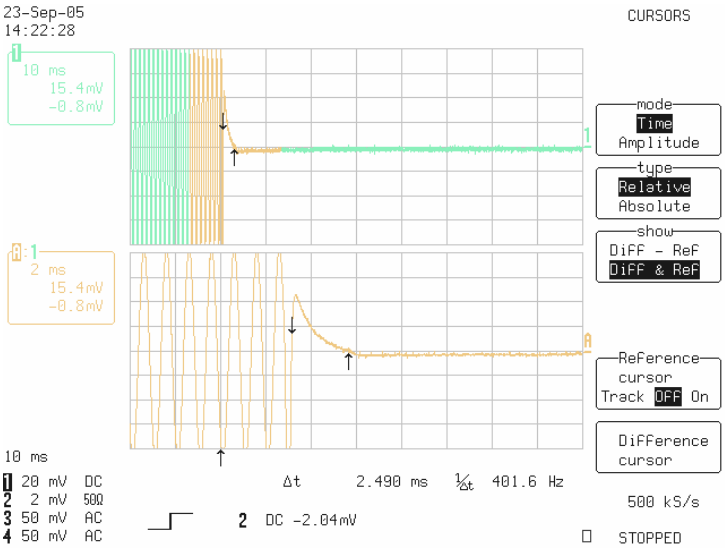


Plot 7.4.4 Transient frequency during power OFF test results at mid carrier frequency

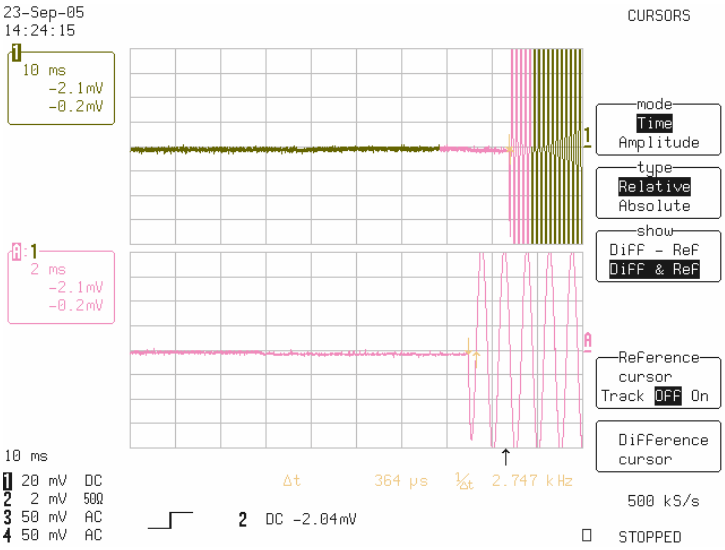


Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:10:31 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

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



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



Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/26/2005 10:39:44 AM		
Temperature: 24 ºC	Air Pressure: 1010 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

7.5 Band edge emission

7.5.1 General

This test was performed to verify the EUT band edge emission, including all associated side bands and frequency drift under extreme test conditions, was attenuated at least 30 dB below the unmodulated carrier level. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Band edge emission limits

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

7.5.2 Test procedure

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

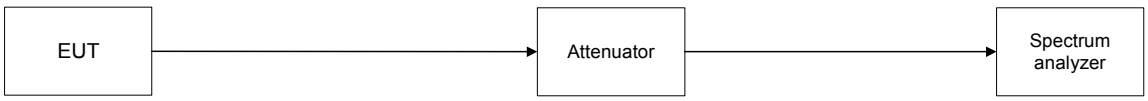
7.5.2.2 The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure the peak measurements. The spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

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

7.5.2.4 The total bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained bandwidth was verified to be within the allowed frequency range.

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

Figure 7.5.1 Band edge emission measurement set up



Test specification:	**Section 90.217, Band edge emission**		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	9/26/2005 10:39:44 AM		
Temperature: 24 ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 45 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.5.2 Band edge emission test results

OPERATING FREQUENCY RANGE:	150.2 – 169.8 MHz
DETECTOR USED:	Peak hold
SWEEP RATE:	2 kHz/s
RESOLUTION BANDWIDTH:	1 kHz
VIDEO BANDWIDTH:	3 kHz
MODULATION:	FSK
MODULATING SIGNAL:	Alternative signal
BIT RATE:	600 bps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
ATTENUATION BELOW CARRIER:	30 dBc

Band edge	Measured frequency, MHz*	Frequency drift, kHz		Band edge frequency, MHz**	Band edge limit, MHz	Margin, kHz***	Verdict
		Negative	Positive				
Low carrier frequency							
Low	150.1926	2.110	NA	150.19049	150.1875	2.99	Pass
High	150.20693	NA	0.002	150.206932	150.2125	-5.57	Pass
Mid carrier frequency							
Low	159.9927	2.162	NA	159.990538	159.9875	3.04	Pass
High	160.00703	NA	0.050	160.00708	160.0125	-5.42	Pass
High carrier frequency							
Low	169.7928	2.192	NA	169.790608	169.7875	3.11	Pass
High	169.80713	NA	0.088	169.807218	169.8125	-5.28	Pass

* - Measured frequency beyond which the emission level is attenuated at least 30 dB below the unmodulated carrier
** - Band edge frequency = Measured frequency ± Frequency drift under extreme conditions
*** - Margin = Band edge limit – Band edge frequency

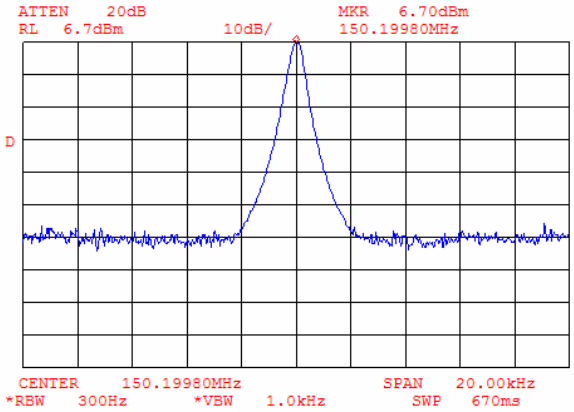
Reference numbers of test equipment used

HL 1424	HL 2399	HL 2524					

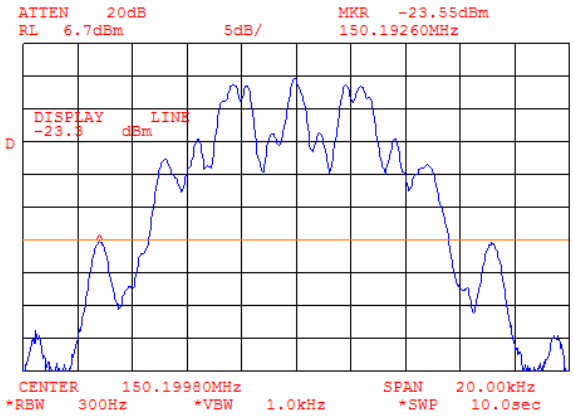
Full description is given in Appendix A.

Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/26/2005 10:39:44 AM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

Plot 7.5.1 Band edge emission test results at low carrier frequency, reference unmodulated

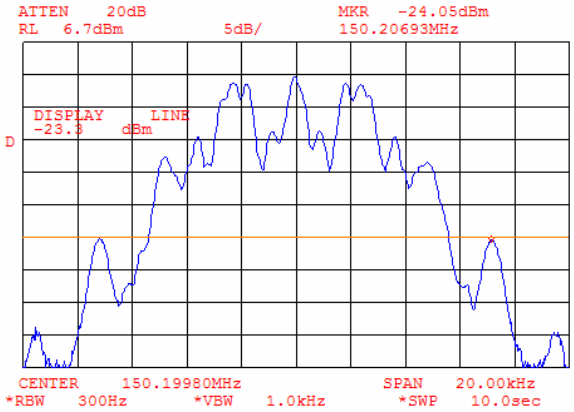


Plot 7.5.2 Lower band edge emission test results at low carrier frequency



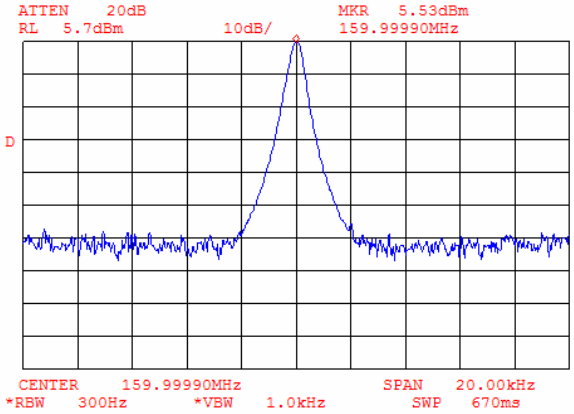
Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/26/2005 10:39:44 AM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

Plot 7.5.3 Upper band edge emission test results at low carrier frequency

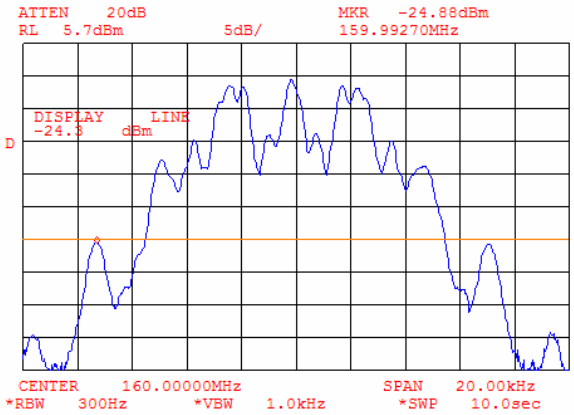


Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/26/2005 10:39:44 AM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

Plot 7.5.4 Band edge emission test results at mid carrier frequency, reference unmodulated

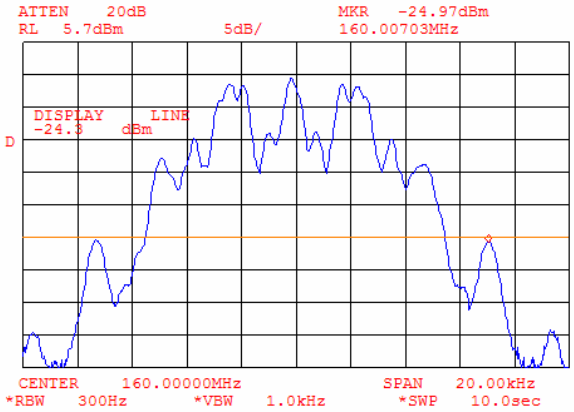


Plot 7.5.5 Lower band edge emission test results at mid carrier frequency



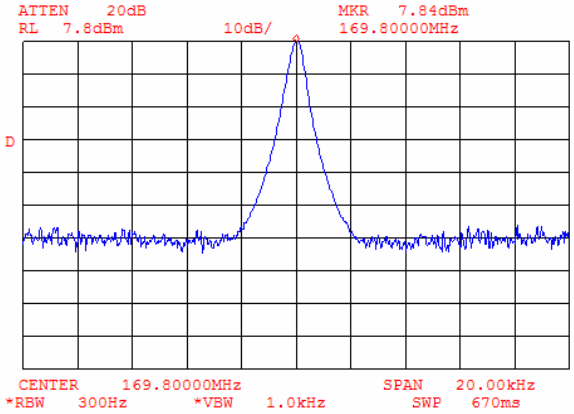
Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/26/2005 10:39:44 AM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

Plot 7.5.6 Upper band edge emission test results at mid carrier frequency

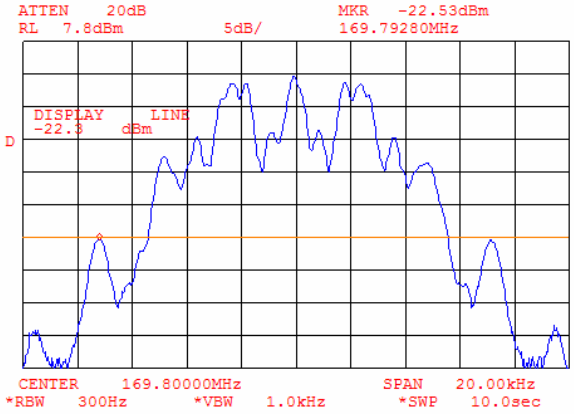


Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/26/2005 10:39:44 AM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

Plot 7.5.7 Band edge emission test results at high carrier frequency, reference unmodulated

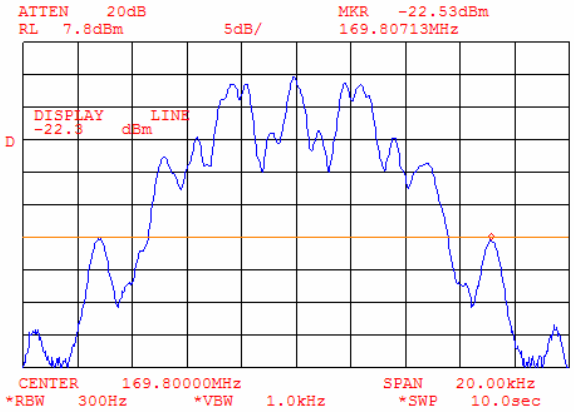


Plot 7.5.8 Lower band edge emission test results at high carrier frequency



Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/26/2005 10:39:44 AM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

Plot 7.5.9 Upper band edge emission test results at high carrier frequency



Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 ºC	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

7.6 Spurious emissions at RF antenna connector test

7.6.1 General

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

Table 7.6.1 Spurious emission limits

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

* - spurious emission limits do not apply to the in band emission within:
± 25 kHz from the carrier for equipment designed to operate with 12.5 kHz channel bandwidth
± 12.5 kHz from the carrier for equipment designed to operate with 6.25 kHz channel bandwidth

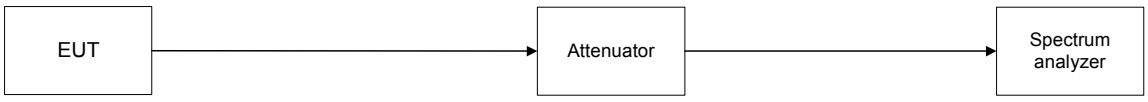
7.6.2 Test procedure

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

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

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

Figure 7.6.1 Spurious emission test setup



Test specification:	**Section 90.217, Conducted spurious emissions**		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 ºC	**Air Pressure:** 1012 hPa	**Relative Humidity:** 48 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.6.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 150.2 – 169.8 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 2000 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATION: FSK
MODULATING SIGNAL: Alternative
BIT RATE: 600 bps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
TRANSMITTER OUTPUT POWER: 16.50 dBm at low frequency
15.67 dBm at mid frequency
18.00 dBm at high frequency

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Low carrier frequency									
300.4050	-46.17	Included	Included	100	-46.17	62.67	30	32.67	Pass
450.6008	-55.17	Included	Included	100	-55.17	71.67	30	41.67	Pass
Mid carrier frequency									
320.0133	-52.33	Included	Included	100	-52.33	67.90	30	37.90	Pass
480.0067	-55.67	Included	Included	100	-55.67	71.34	30	41.34	Pass
High carrier frequency									
339.6108	-51.17	Included	Included	100	-51.17	69.17	30	39.17	Pass
509.4008	-54.00	Included	Included	100	-54.00	72.00	30	42.00	Pass

*****- Margin = Spurious emission – specification limit.

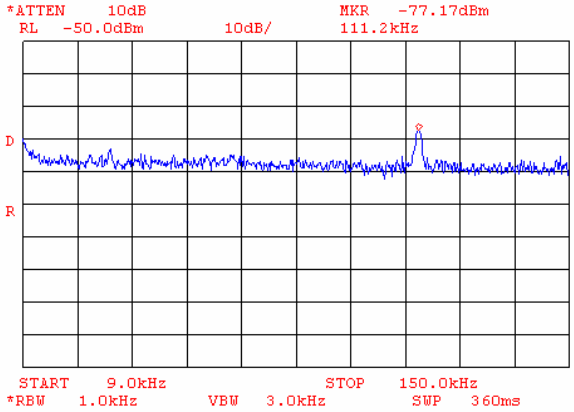
Reference numbers of test equipment used

HL 1424	HL 2399	HL 2524					

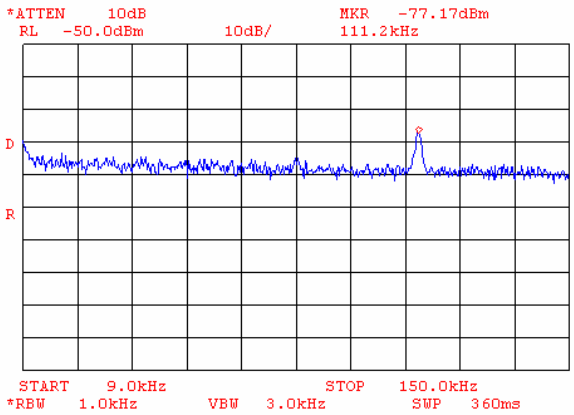
Full description is given in Appendix A.

Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

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

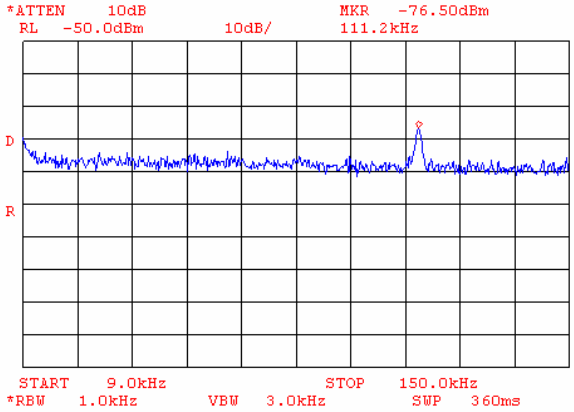


Plot 7.6.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency

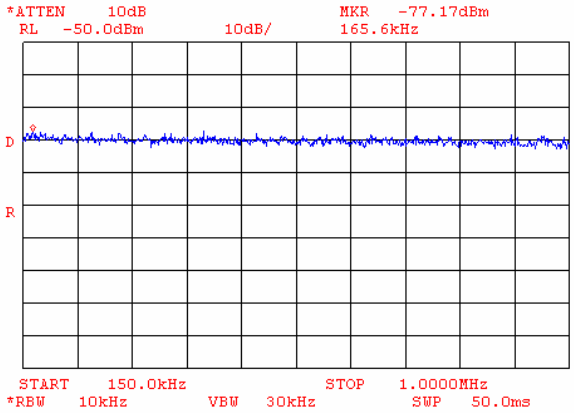


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

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

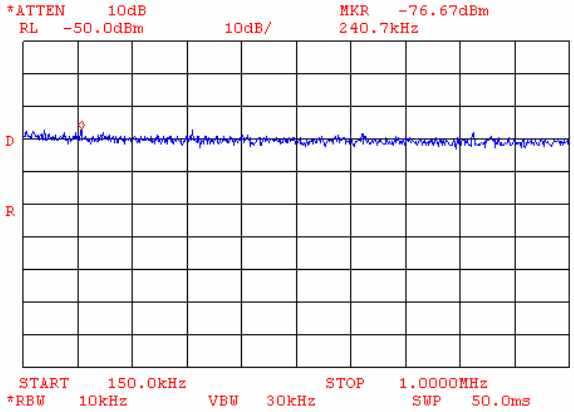


Plot 7.6.4 Spurious emission measurements in 0.15 - 1.0 MHz range at low carrier frequency

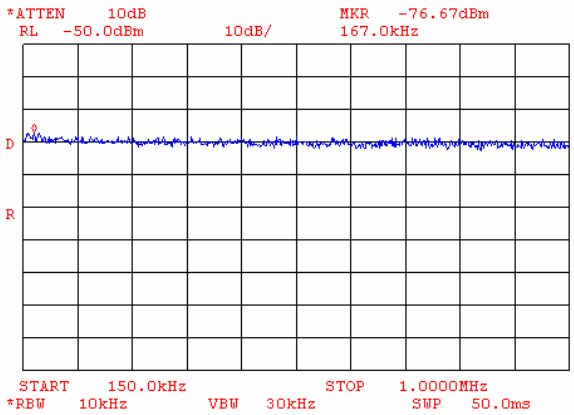


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.5 Spurious emission measurements in 0.15 - 1.0 MHz range at mid carrier frequency

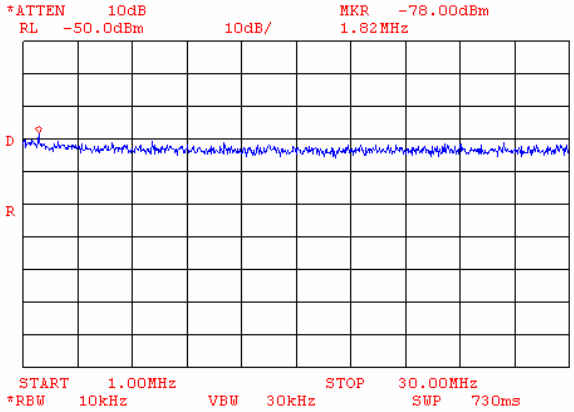


Plot 7.6.6 Spurious emission measurements in 0.15 – 1.0 MHz range at high carrier frequency

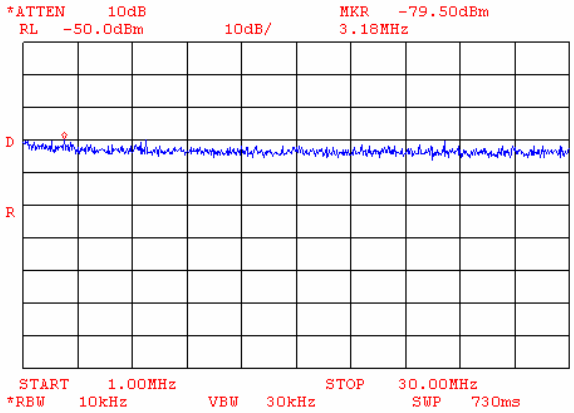


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.7 Spurious emission measurements in 1.0 - 30 MHz range at low carrier frequency

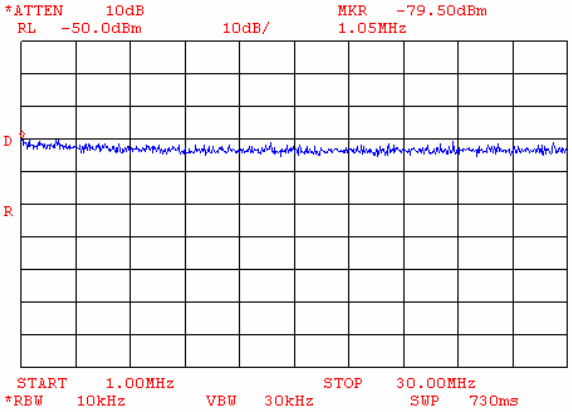


Plot 7.6.8 Spurious emission measurements in 1.0 - 30 MHz range at mid carrier frequency

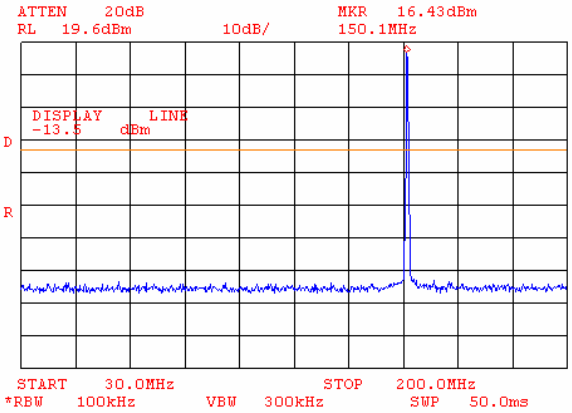


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.9 Spurious emission measurements in 1.0 - 30 MHz range at high carrier frequency

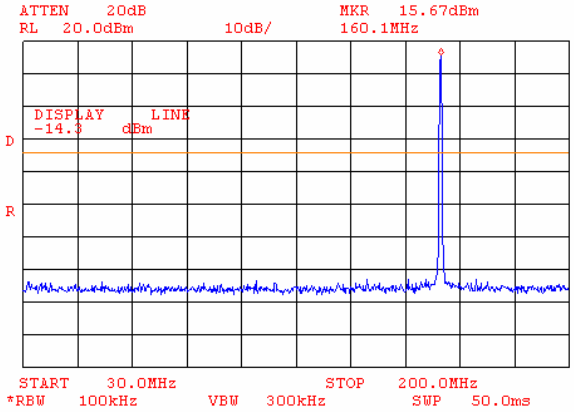


Plot 7.6.10 Spurious emission measurements in 30 - 200 MHz range at low carrier frequency

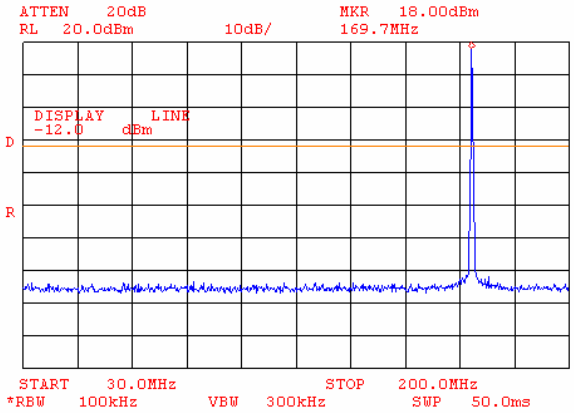


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.11 Spurious emission measurements in 30 - 200 MHz range at mid carrier frequency

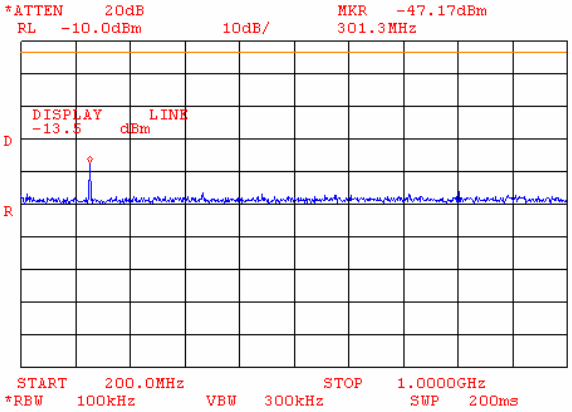


Plot 7.6.12 Spurious emission measurements in 30 - 200 MHz range at high carrier frequency

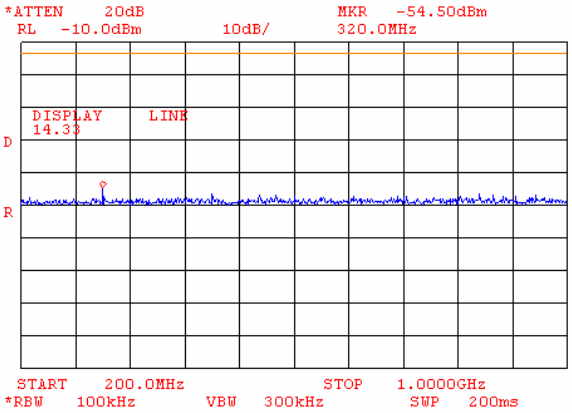


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.13 Spurious emission measurements in 200 - 1000 MHz range at low carrier frequency

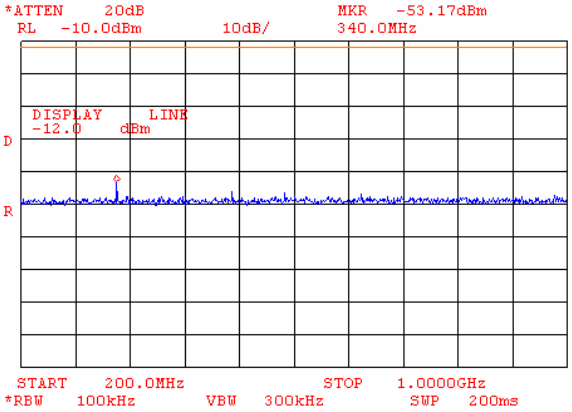


Plot 7.6.14 Spurious emission measurements in 200 - 1000 MHz range at mid carrier frequency

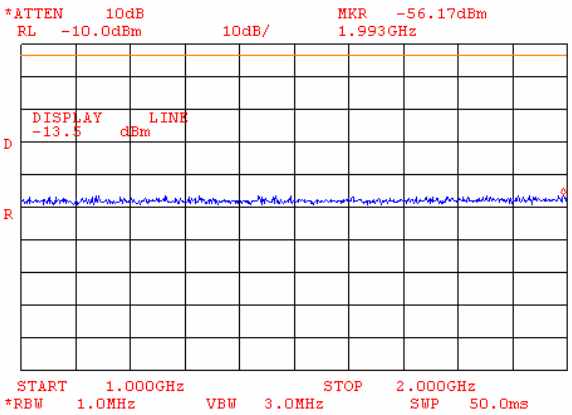


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.15 Spurious emission measurements in 200 - 1000 MHz range at high carrier frequency

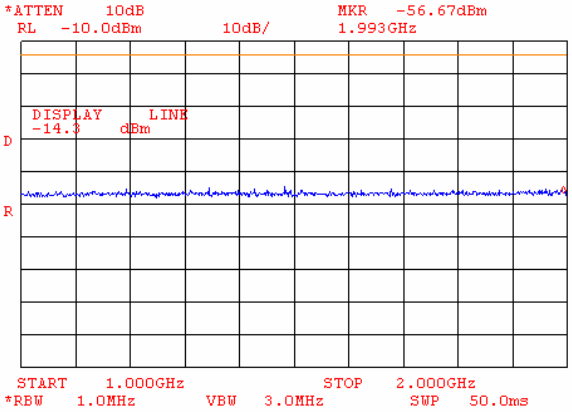


Plot 7.6.16 Spurious emission measurements in 1000 - 2000 MHz range at low carrier frequency

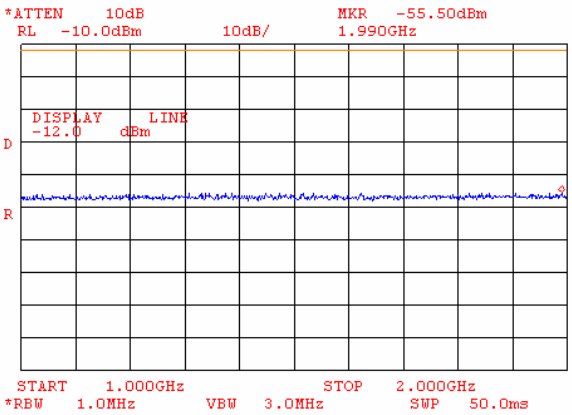


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.17 Spurious emission measurements in 1000 - 2000 MHz at mid carrier frequency

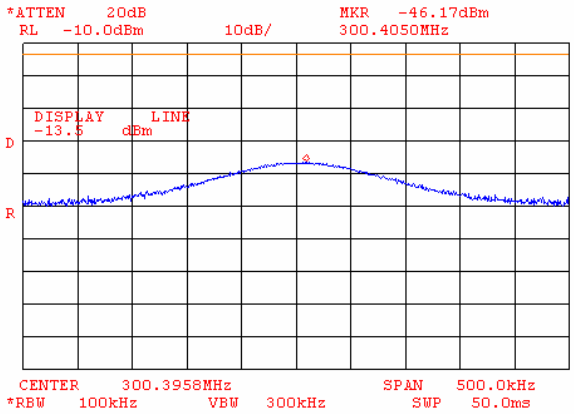


Plot 7.6.18 Spurious emission measurements in 1000 - 2000 MHz at high carrier frequency

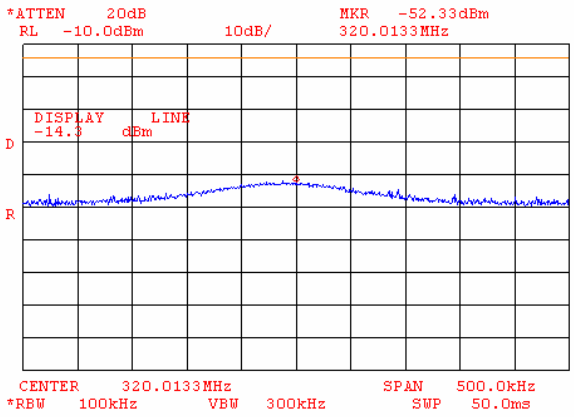


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.19 Conducted spurious emission measurements at the 2nd harmonic of low carrier frequency

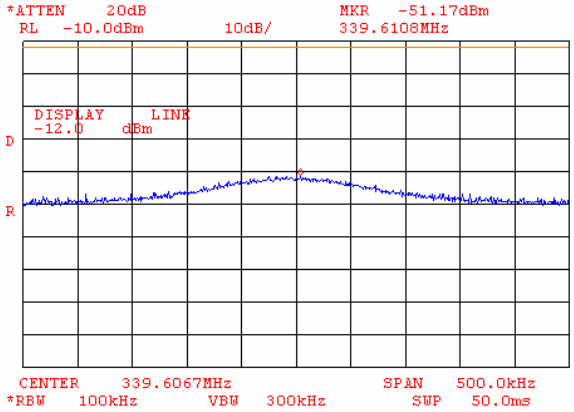


Plot 7.6.20 Conducted spurious emission measurements at the 2nd harmonic of mid carrier frequency

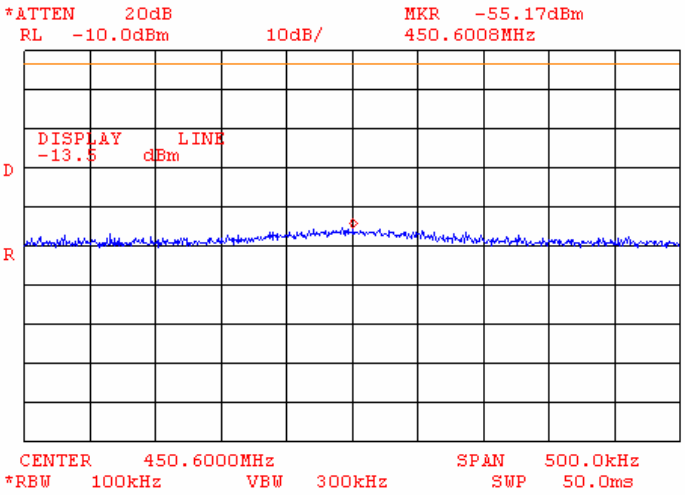


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.21 Conducted spurious emission measurements at the 2nd harmonic of high carrier frequency

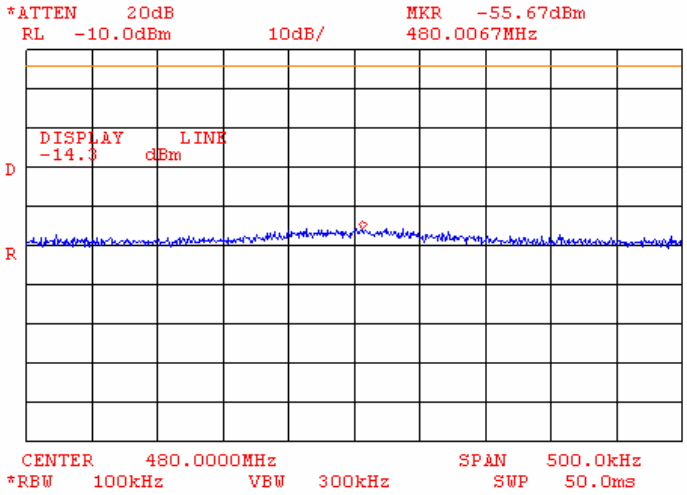


Plot 7.6.22 Conducted spurious emission measurements at the 3rd harmonic of low carrier frequency

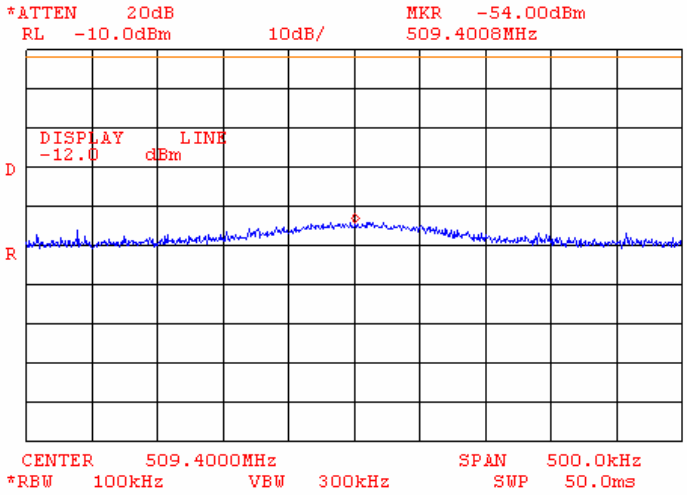


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.23 Conducted spurious emission measurements at the 3rd harmonic of mid carrier frequency

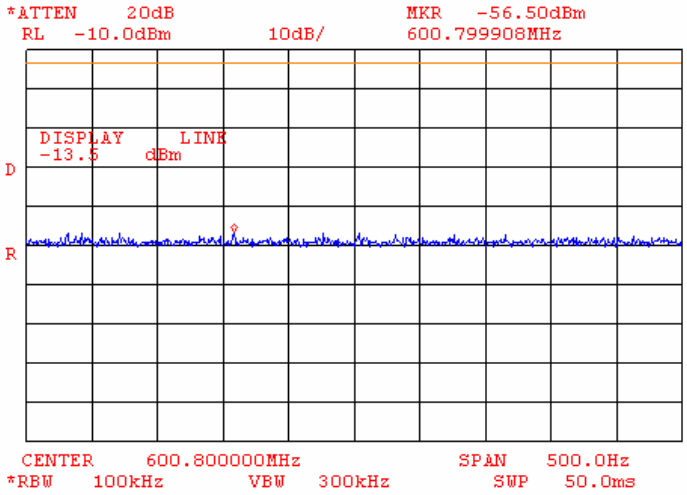


Plot 7.6.24 Conducted spurious emission measurements at the 3rd harmonic of high carrier frequency

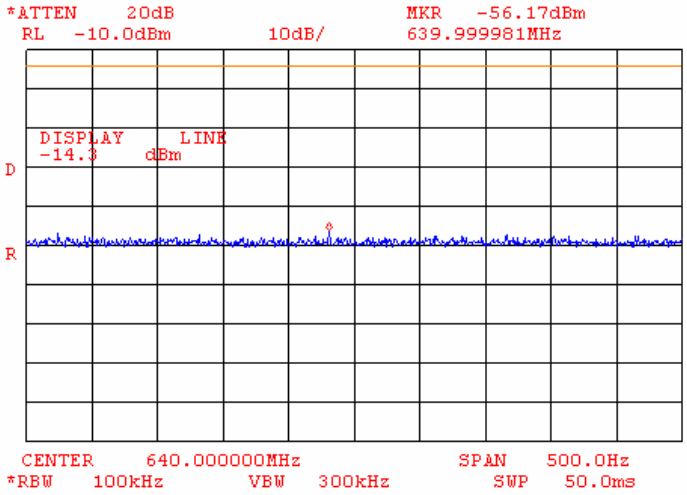


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.25 Conducted spurious emission measurements at the 4th harmonic of low carrier frequency

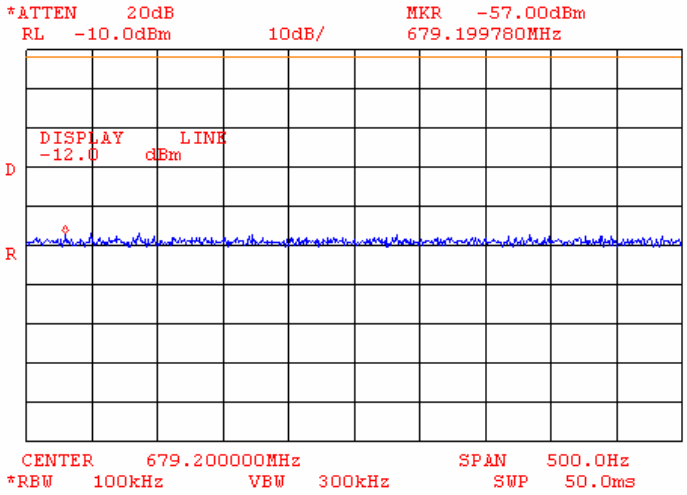


Plot 7.6.26 Conducted spurious emission measurements at the 4th harmonic of mid carrier frequency

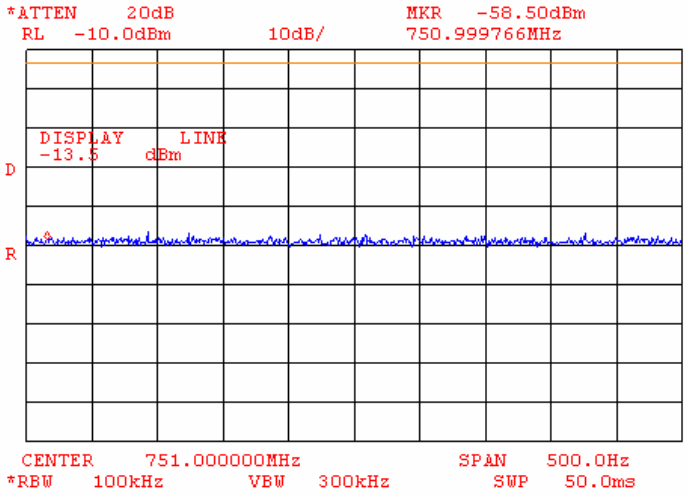


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.27 Conducted spurious emission measurements at the 4th harmonic of high carrier frequency

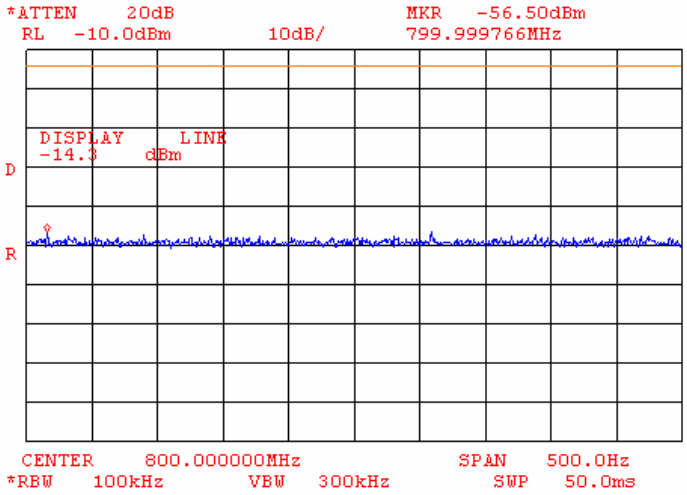


Plot 7.6.28 Conducted spurious emission measurements at the 5th harmonic of low carrier frequency

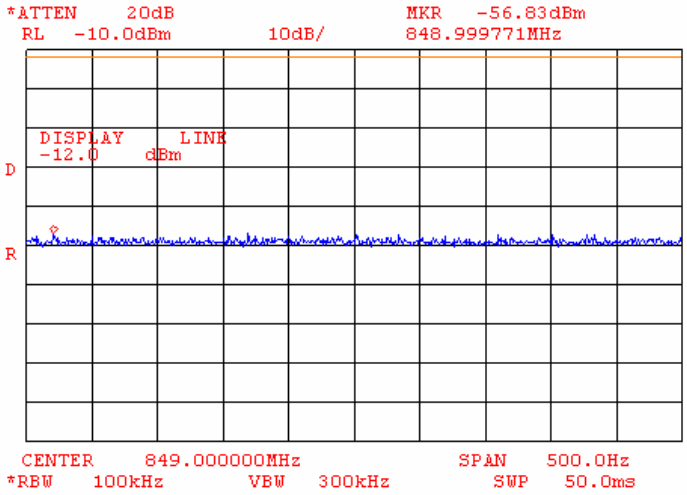


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.29 Conducted spurious emission measurements at the 5th harmonic of mid carrier frequency

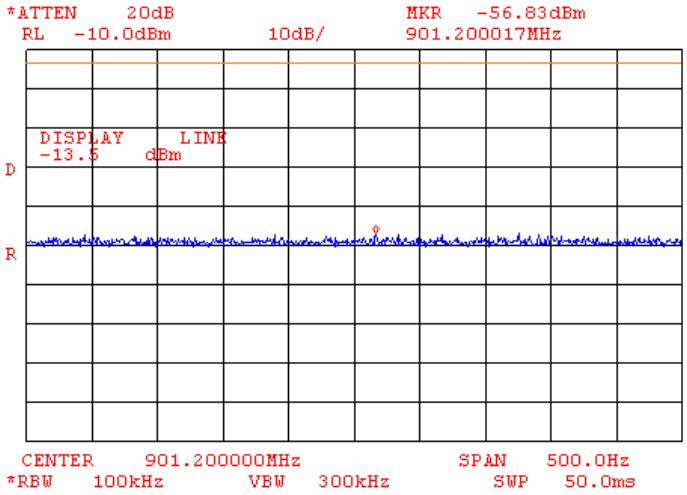


Plot 7.6.30 Conducted spurious emission measurements at the 5th harmonic of high carrier frequency

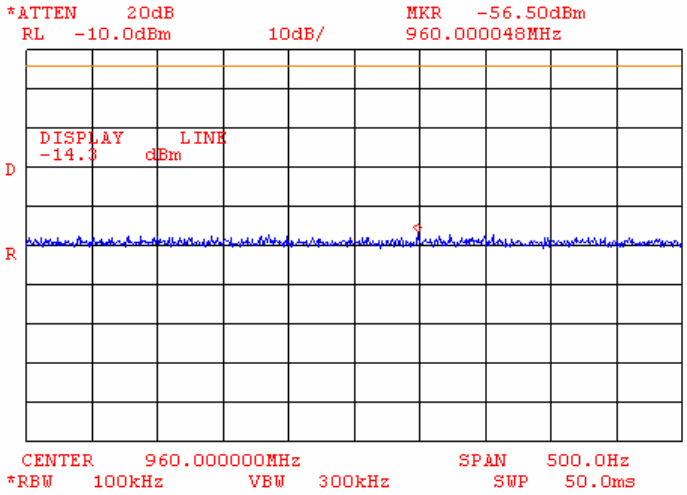


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.31 Conducted spurious emission measurements at the 6th harmonic of low carrier frequency

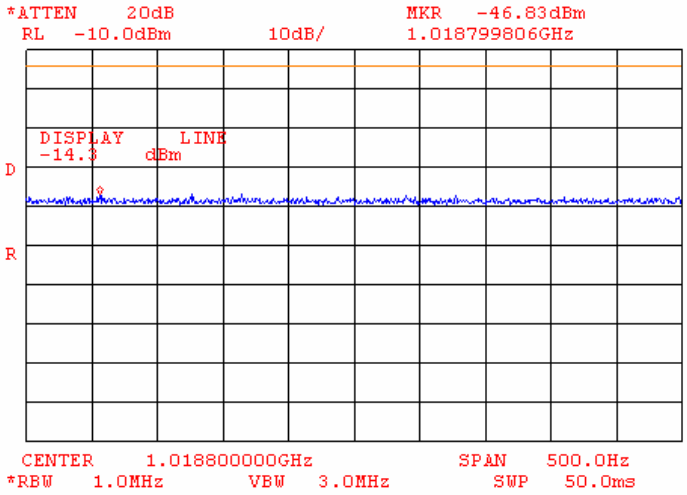


Plot 7.6.32 Conducted spurious emission measurements at the 6th harmonic of mid carrier frequency



Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:38:47 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.33 Conducted spurious emission measurements at the 6th harmonic of high carrier frequency



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

7.7 Radiated spurious emission measurements

7.7.1 General

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

Table 7.7.1 Radiated spurious emission test limits

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

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

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

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

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

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

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and the performance check was conducted.

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

7.7.2.3 The worst test results (the lowest margins) were recorded in Table 7.7.2 and shown in the associated plots.

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

7.7.3.1 The EUT was set up as shown in Figure 7.7.2, energized and the performance check was conducted.

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

7.7.3.3 The worst test results (the lowest margins) were recorded in Table 7.7.2 and shown in the associated plots.

7.7.4 Test procedure for substitution ERP measurements of spurious

7.7.4.1 The test equipment was set up as shown in Figure 7.7.3 and energized.

7.7.4.2 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.

7.7.4.3 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.

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

7.7.4.5 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.

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

7.7.4.7 The worst test results (the lowest margins) were recorded in Table 7.7.3 and shown in the associated plots.

Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

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

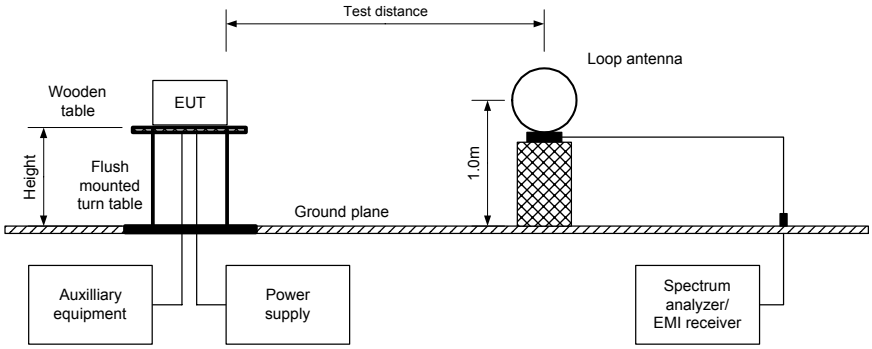
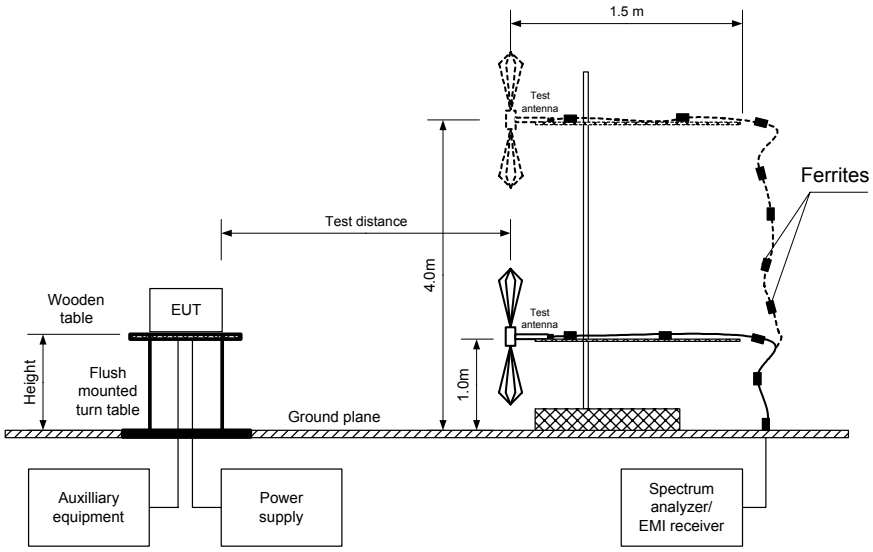
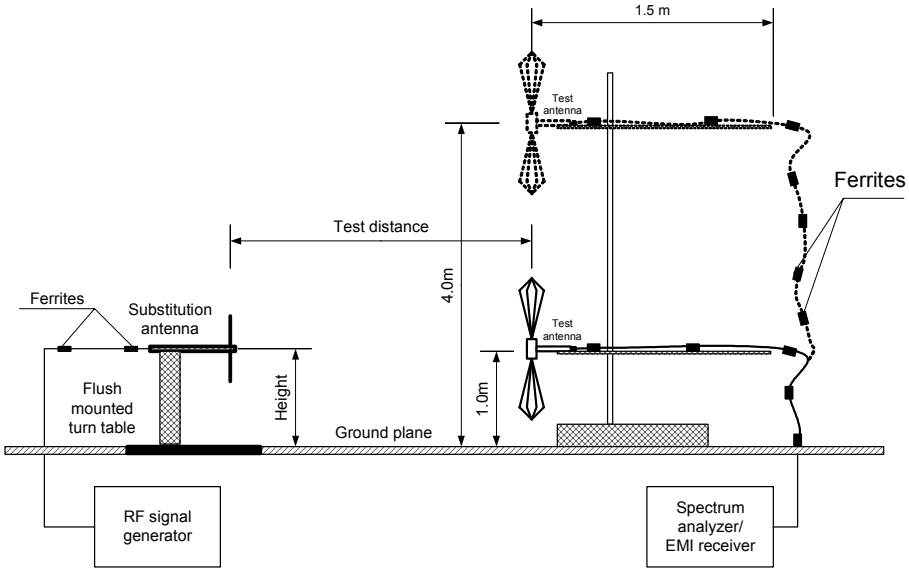


Figure 7.7.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

Figure 7.7.3 Setup for substitution ERP measurements of spurious



Test specification:	**Section 90.217, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	**Air Pressure:** 1022 hPa	**Relative Humidity:** 44 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.7.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 150 - 170 MHz
TEST DISTANCE: 3 m
TEST SITE: Semi anechoic chamber
EUT HEIGHT: 0.8 m
INVESTIGATED FREQUENCY RANGE: 0.009 – 2900 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: Unmodulated
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 150.2 MHz							
300.400	37.2	81.73	-44.53	120	Vertical	1.2	233
450.600	20.7	81.73	-61.03	120	Vertical	1.0	229
Mid carrier frequency 160.0000 MHz							
320.000	32.0	80.90	-48.90	120	Vertical	1.1	128
480.100	23.6	80.90	-57.30	120	Vertical	1.0	295
High carrier frequency 169.8 MHz							
339.600	26.3	83.23	-56.93	120	Vertical	1.1	198
509.500	18.2	83.23	-65.03	120	Vertical	1.2	226

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

Test specification:	**Section 90.217, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	**Air Pressure:** 1022 hPa	**Relative Humidity:** 44 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.7.3 Substitution ERP of spurious test results

ASSIGNED FREQUENCY RANGE: 150 -170 MHz
TRANSMITTER CARRIER ERP: 16.50 dBm at low frequency
15.67 dBm at mid frequency
18.00 dBm at high frequency
TEST SITE: Semi anechoic chamber
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	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Low carrier frequency											
300.400	37.20	120	Vertical	-55.93	-0.45	1.34	-57.72	74.22	30.00	44.22	Pass
450.600	20.70	120	Vertical	-78.02	-1.00	1.65	-80.67	97.17	30.00	67.17	Pass
Mid carrier frequency											
339.600	26.30	120	Vertical	-66.83	-0.37	1.42	-62.90	78.57	30.00	48.57	Pass
509.500	18.20	120	Vertical	-74.69	-1.55	1.77	-78.24	93.91	30.00	63.91	Pass
High carrier frequency											
339.600	26.30	120	Vertical	-66.83	-0.37	1.42	-68.62	86.62	30.00	56.62	Pass
509.500	18.20	120	Vertical	-74.69	-1.55	1.77	-78.01	96.01	30.00	66.01	Pass

*****- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

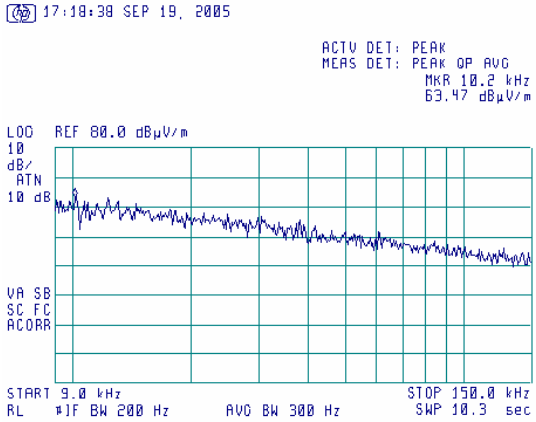
HL 0029	HL 0446	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604
HL 0661	HL 1947	HL 1984	HL 2009	HL 2400			

Full description is given in Appendix A.

Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

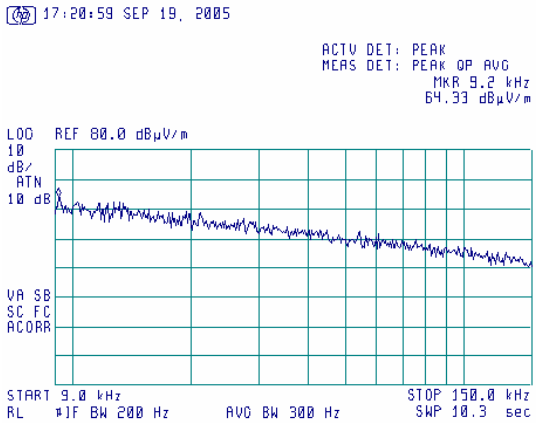
Plot 7.7.1 Radiated emission measurements in 9 - 150 kHz range

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



Plot 7.7.2 Radiated emission measurements in 9 - 150 kHz range

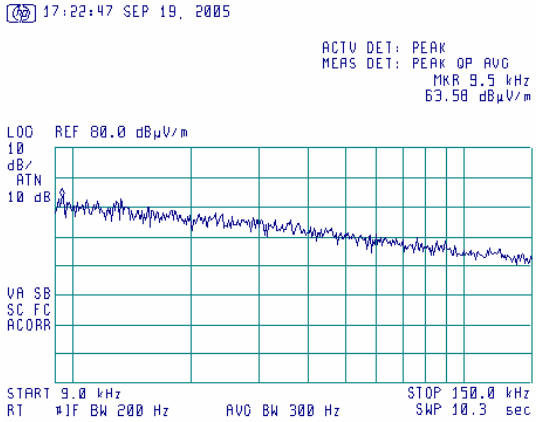
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

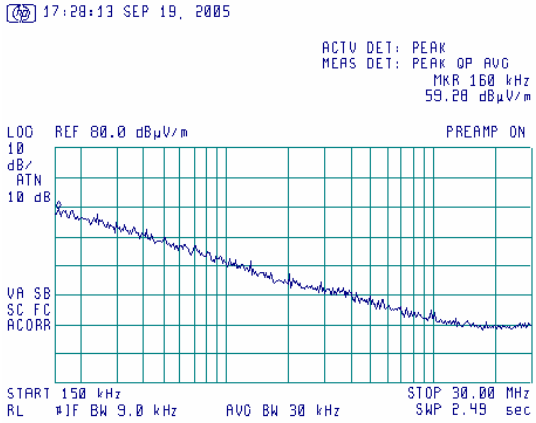
Plot 7.7.3 Radiated emission measurements in 9 - 150 kHz range

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



Plot 7.7.4 Radiated emission measurements in 0.15 - 30 MHz range

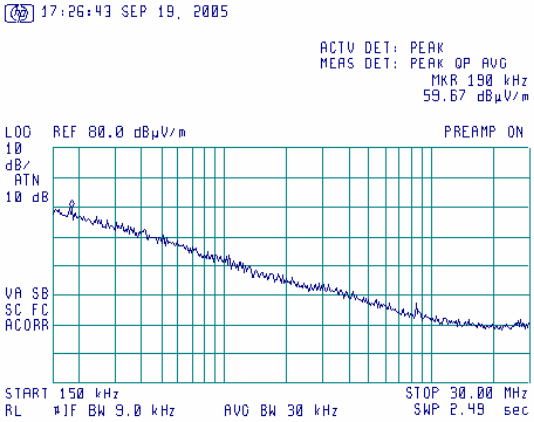
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

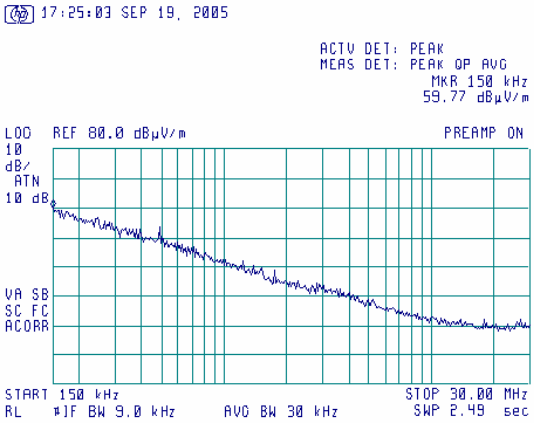
Plot 7.7.5 Radiated emission measurements in 0.15 - 30 MHz range

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



Plot 7.7.6 Radiated emission measurements in 0.15 - 30 MHz range

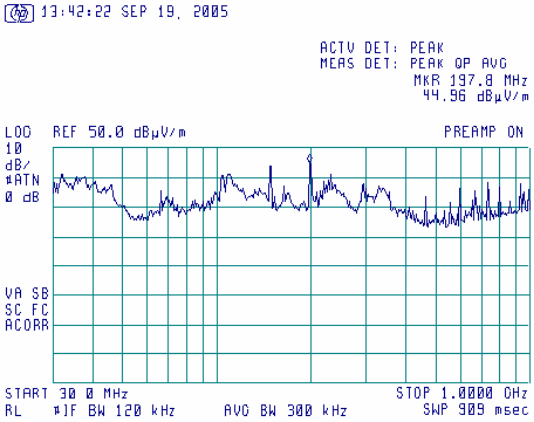
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

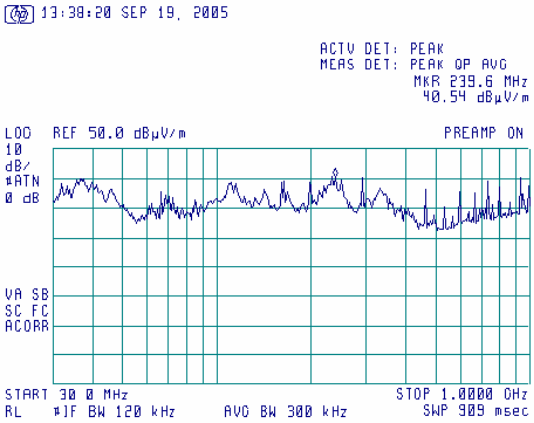
Plot 7.7.7 Radiated emission measurements in 30 - 1000 MHz range

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



Plot 7.7.8 Radiated emission measurements in 30 - 1000 MHz range

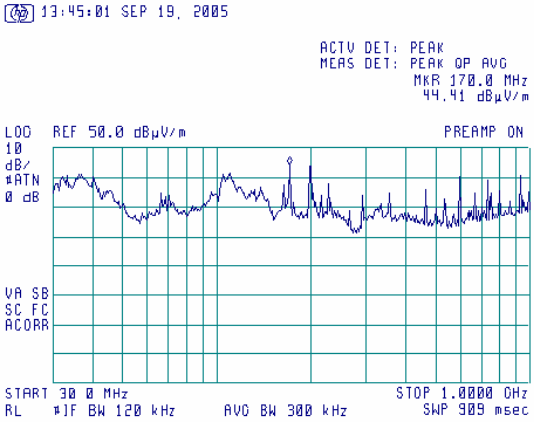
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

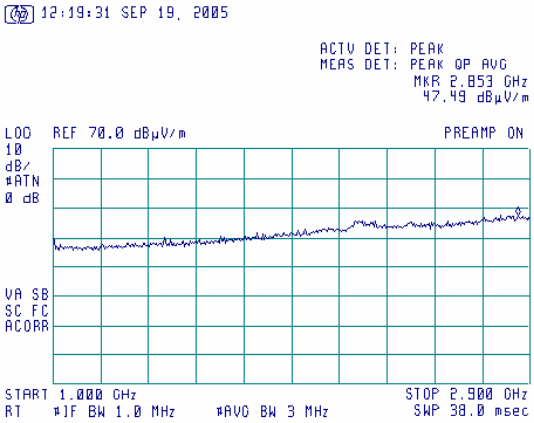
Plot 7.7.9 Radiated emission measurements in 30 - 1000 MHz range

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



Plot 7.7.10 Radiated emission measurements in 1000 – 2900 MHz range

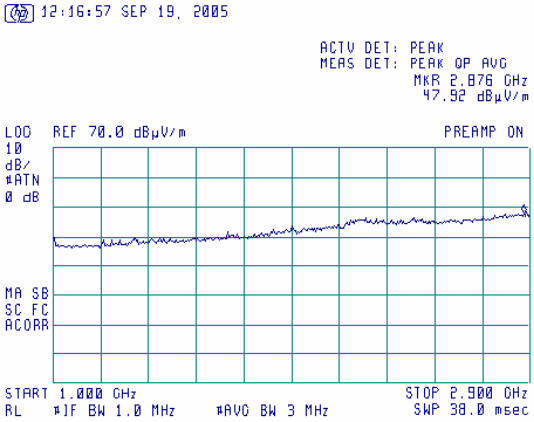
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

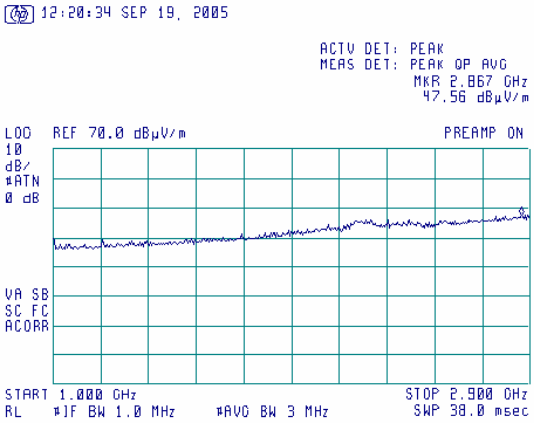
Plot 7.7.11 Radiated emission measurements in 1000 – 2900 MHz range

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



Plot 7.7.12 Radiated emission measurements in 1000 – 2900 MHz range

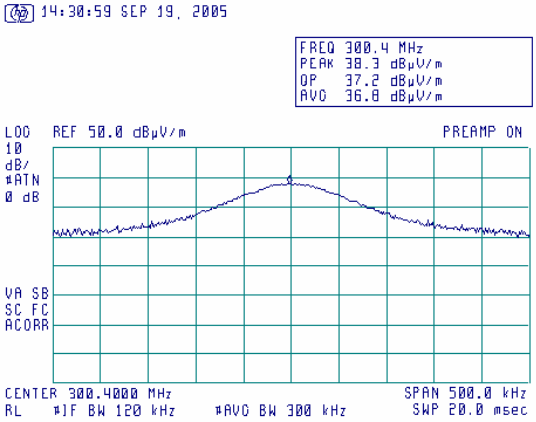
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

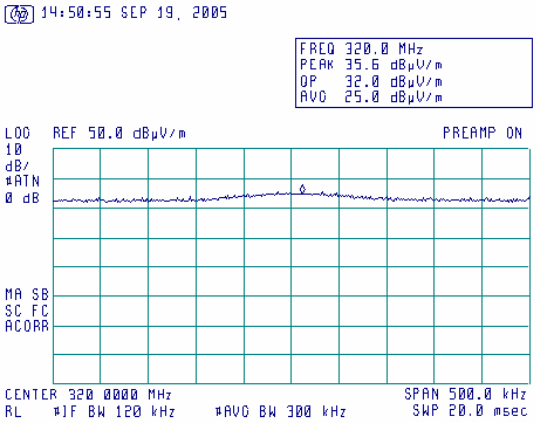
Plot 7.7.13 Radiated emission measurements at the 2nd harmonic

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



Plot 7.7.14 Radiated emission measurements at the 2nd harmonic

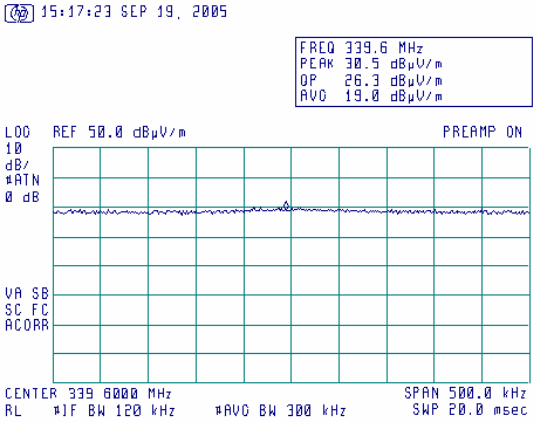
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

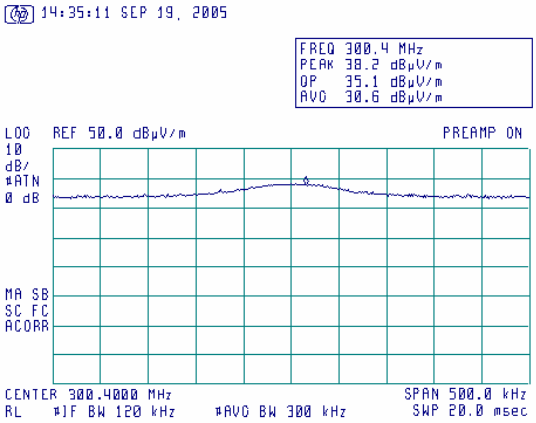
Plot 7.7.15 Radiated emission measurements at the 2nd harmonic

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



Plot 7.7.16 Radiated emission measurements at the 2nd harmonic

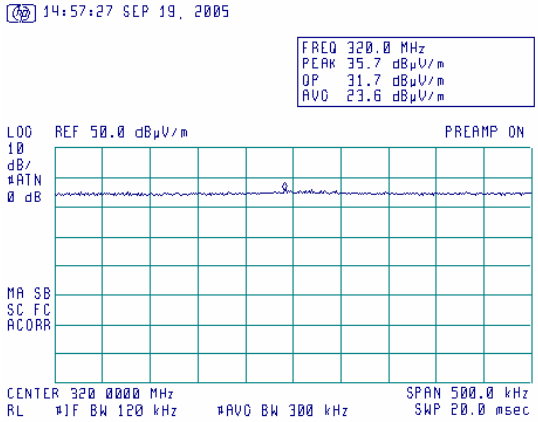
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

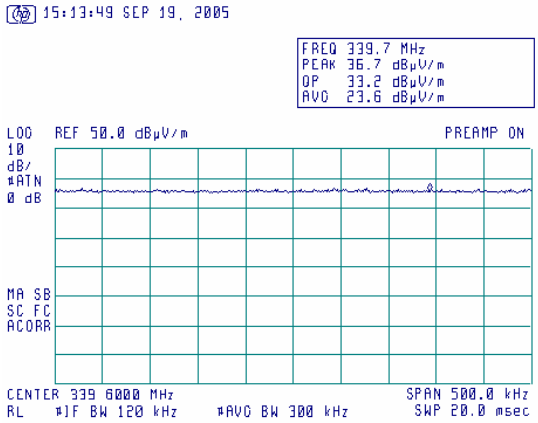
Plot 7.7.17 Radiated emission measurements at the 2nd harmonic

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



Plot 7.7.18 Radiated emission measurements at the 2nd harmonic

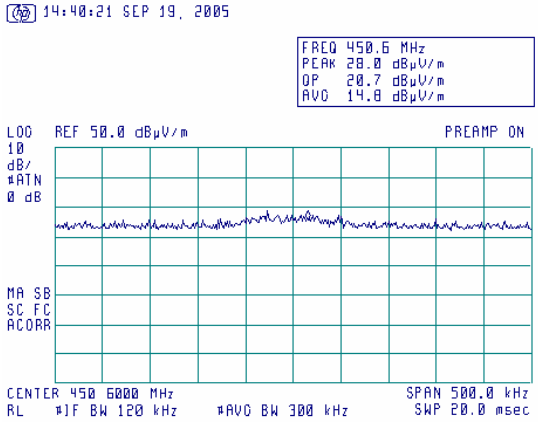
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

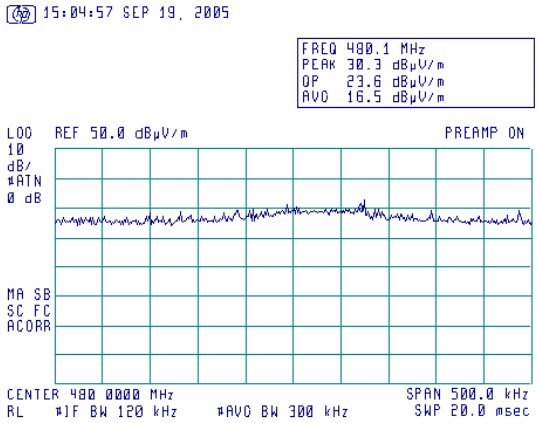
Plot 7.7.19 Radiated emission measurements at the 3rd harmonic

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



Plot 7.7.20 Radiated emission measurements at the 3rd harmonic

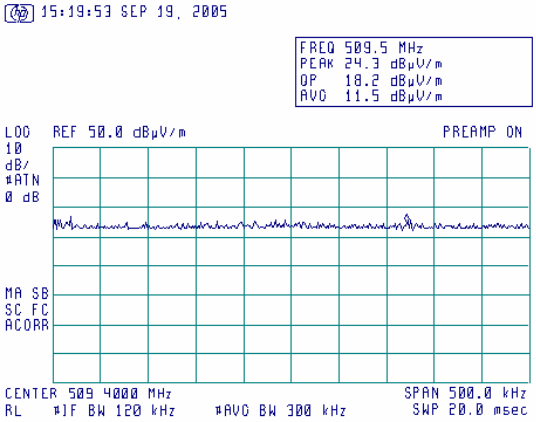
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

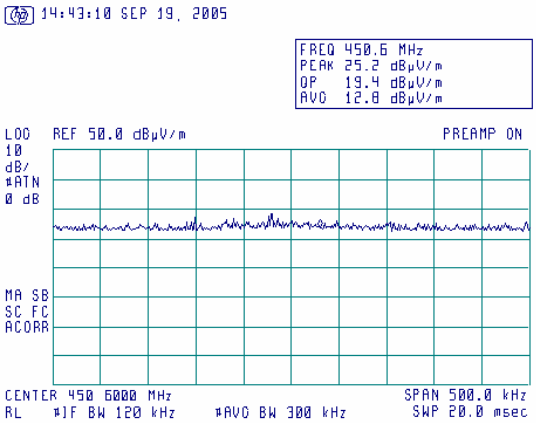
Plot 7.7.21 Radiated emission measurements at the 3rd harmonic

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



Plot 7.7.22 Radiated emission measurements at the 3rd harmonic

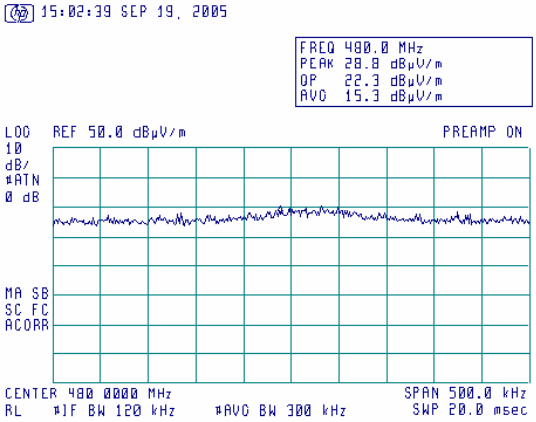
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

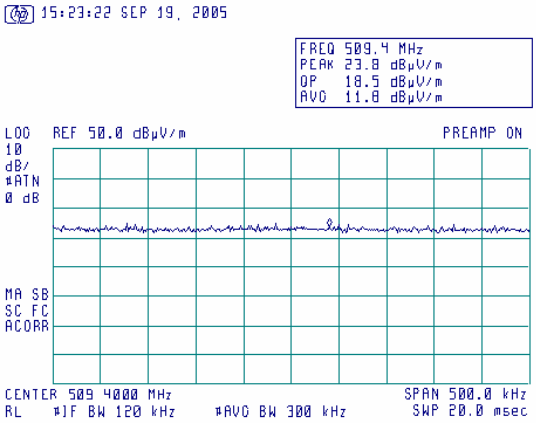
Plot 7.7.23 Radiated emission measurements at the 3rd harmonic

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



Plot 7.7.24 Radiated emission measurements at the 3rd harmonic

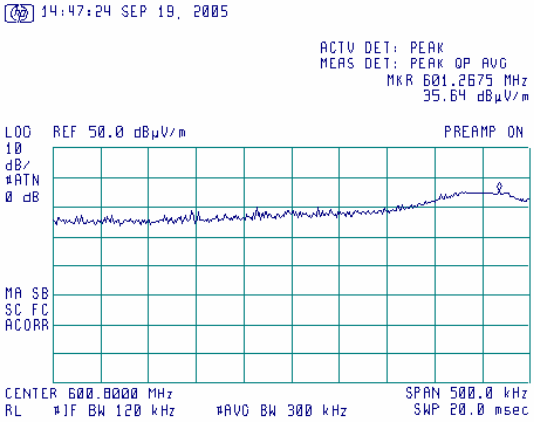
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

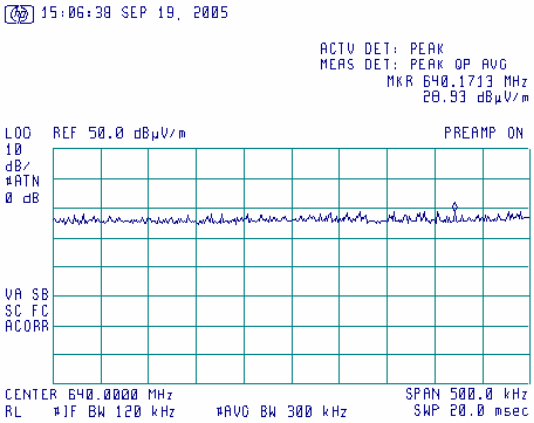
Plot 7.7.25 Radiated emission measurements at the 4th harmonic

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



Plot 7.7.26 Radiated emission measurements at the 4th harmonic

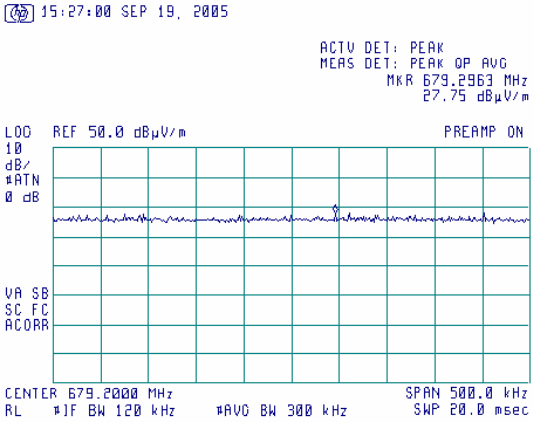
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

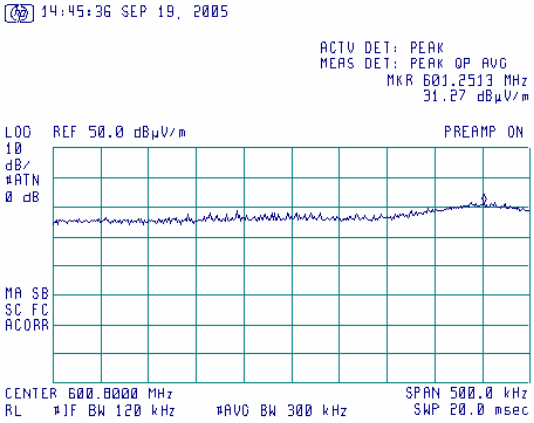
Plot 7.7.27 Radiated emission measurements at the 4th harmonic

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



Plot 7.7.28 Radiated emission measurements at the 4th harmonic

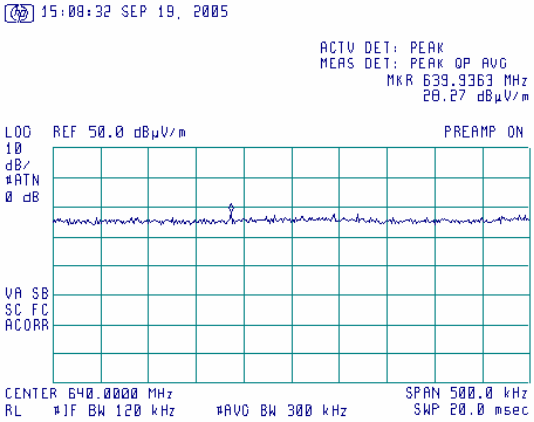
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

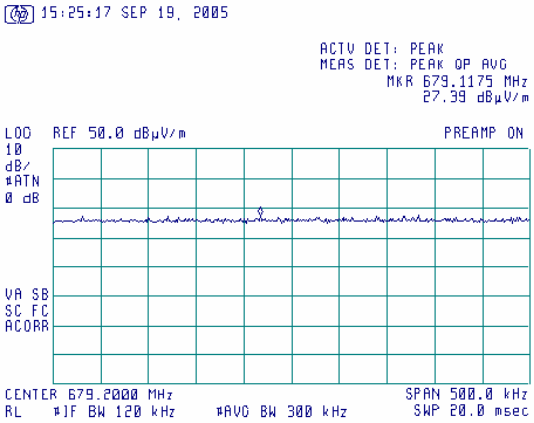
Plot 7.7.29 Radiated emission measurements at the 4th harmonic

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



Plot 7.7.30 Radiated emission measurements at the 4th harmonic

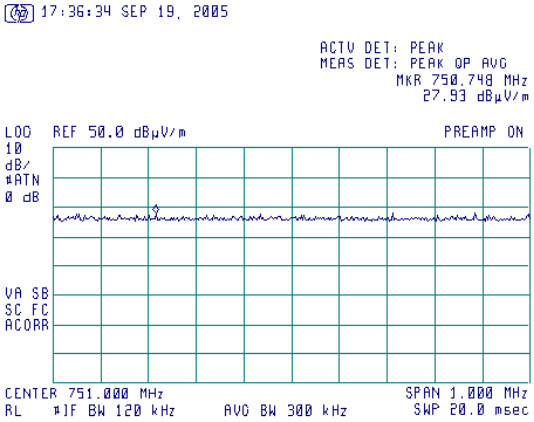
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

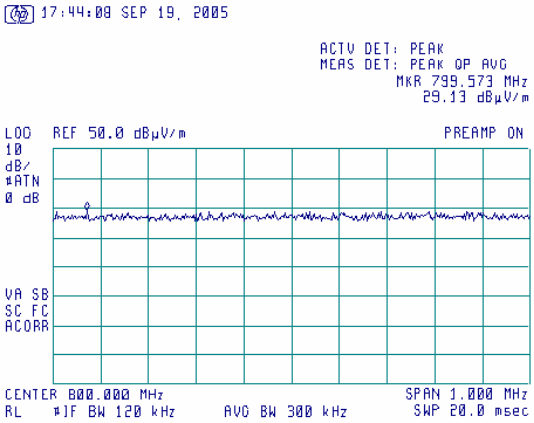
Plot 7.7.31 Radiated emission measurements at the 5th harmonic

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



Plot 7.7.32 Radiated emission measurements at the 5th harmonic

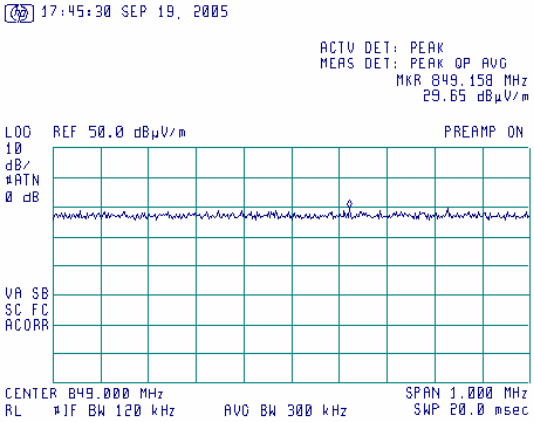
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

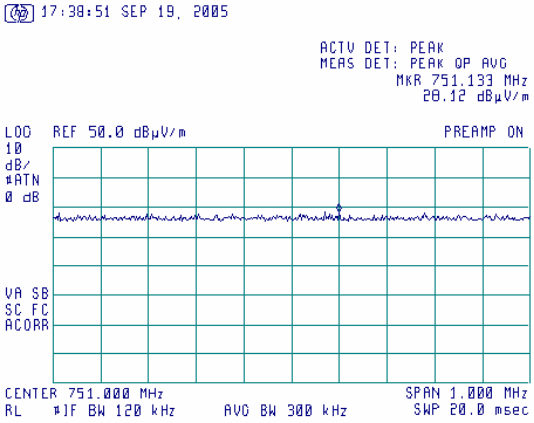
Plot 7.7.33 Radiated emission measurements at the 5th harmonic

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



Plot 7.7.34 Radiated emission measurements at the 5th harmonic

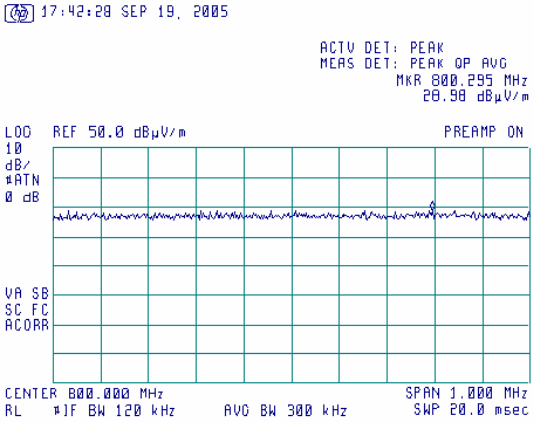
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

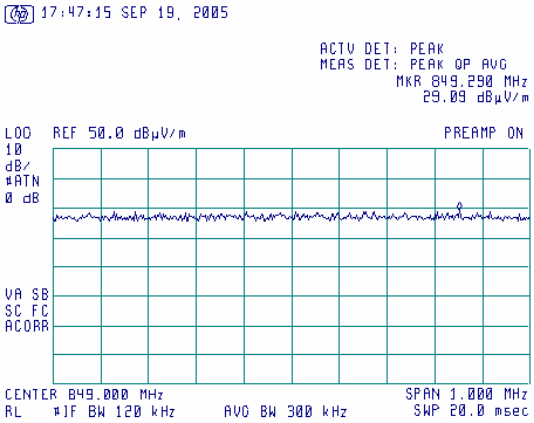
Plot 7.7.35 Radiated emission measurements at the 5th harmonic

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



Plot 7.7.36 Radiated emission measurements at the 5th harmonic

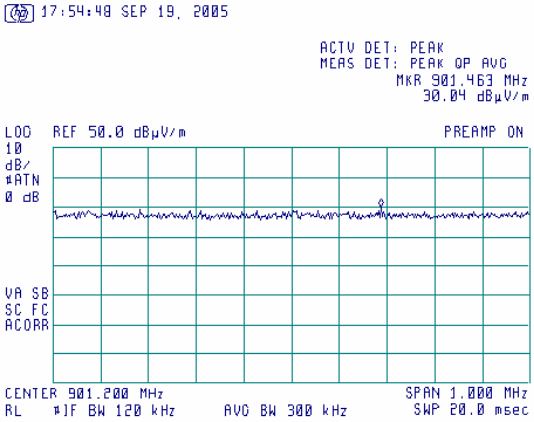
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

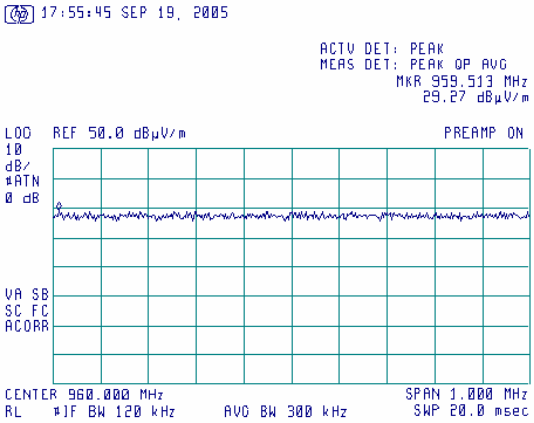
Plot 7.7.37 Radiated emission measurements at the 6th harmonic

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



Plot 7.7.38 Radiated emission measurements at the 6th harmonic

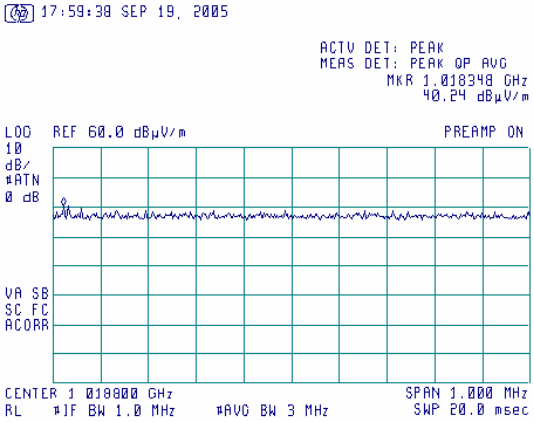
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

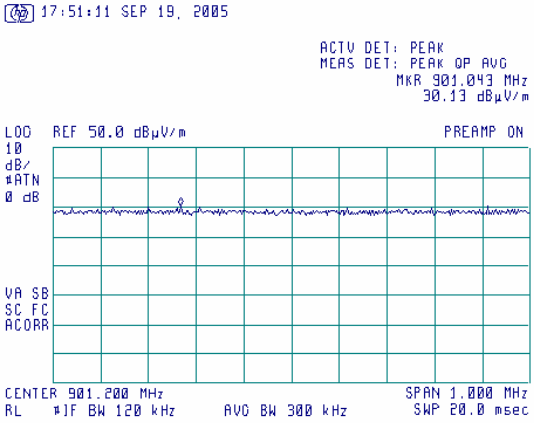
Plot 7.7.39 Radiated emission measurements at the 6th harmonic

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



Plot 7.7.40 Radiated emission measurements at the 6th harmonic

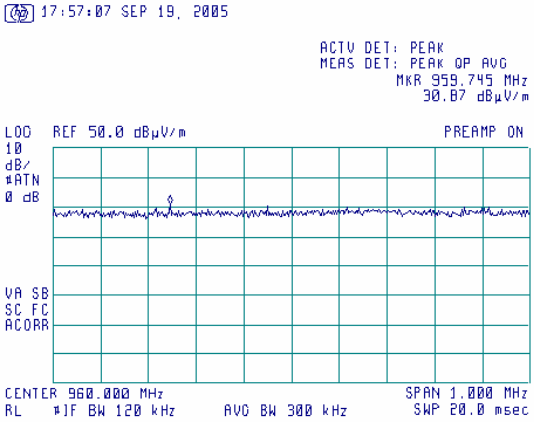
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2005 6:16:35 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

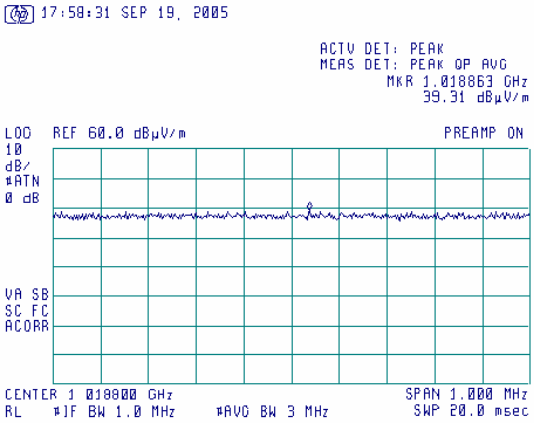
Plot 7.7.41 Radiated emission measurements at the 6th harmonic

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



Plot 7.7.42 Radiated emission measurements at the 6th harmonic

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



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/20/2005 12:26:03 PM		
Temperature: 24.5 ºC	Air Pressure: 1012 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

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

8.1 Conducted emissions

8.1.1 General

This test was performed to measure common mode conducted emissions at the mains power port.
Specification test limits are given in Table 8.1.1. The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.

Table 8.1.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(µV)		Class A limit, dB(µV)	
	QP	AVRG	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*	79	66
0.5 - 5.0	56	46	73	60
5.0 - 30	60	50	73	60

* The limit decreases linearly with the logarithm of frequency.

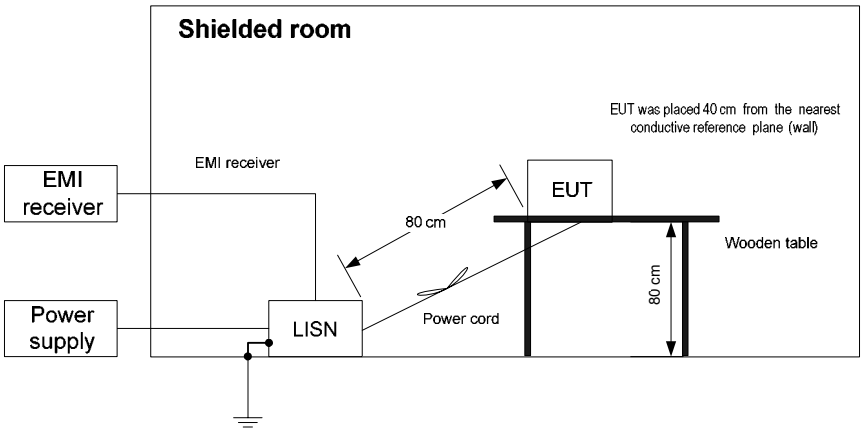
8.1.2 Test procedure

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

8.1.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 8.1.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

8.1.2.3 The position of the device cables was varied to determine maximum emission level.

Figure 8.1.1 Setup for conducted emission measurements, table-top equipment



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/20/2005 12:26:03 PM		
Temperature: 24.5 ºC	Air Pressure: 1012 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

Table 8.1.2 Conducted emission test results

LINE: AC mains
LIMIT: Class B
EUT OPERATING MODE: Receive
EUT SET UP: TABLE-TOP
TEST SITE: SHIELDED ROOM
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE: 150 kHz - 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(µV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*	Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*		
0.175802	50.82	45.99	64.74	-18.75	40.14	54.74	-14.60	L1	Pass
0.210062	47.78	43.38	63.27	-19.89	37.93	53.27	-15.34		
0.278100	41.20	40.41	60.94	-20.53	38.54	50.94	-12.40		
0.312729	42.92	42.32	59.91	-17.59	40.91	49.91	-9.00		
2.224441	38.50	37.25	56.00	-18.75	35.05	46.00	-10.95		
3.964747	39.11	37.13	56.00	-18.87	33.02	46.00	-12.98		
0.175799	51.03	46.34	64.74	-18.40	39.95	54.74	-14.79	L2	Pass
0.210062	47.42	43.01	63.27	-20.26	37.33	53.27	-15.94		
0.278103	39.88	38.97	60.94	-21.97	37.20	50.94	-13.74		
0.312733	42.03	41.36	59.91	-18.55	39.93	49.91	-9.98		
2.224440	37.57	36.06	56.00	-19.94	34.03	46.00	-11.97		
3.964747	36.90	34.21	56.00	-21.79	29.48	46.00	-16.52		

*****- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

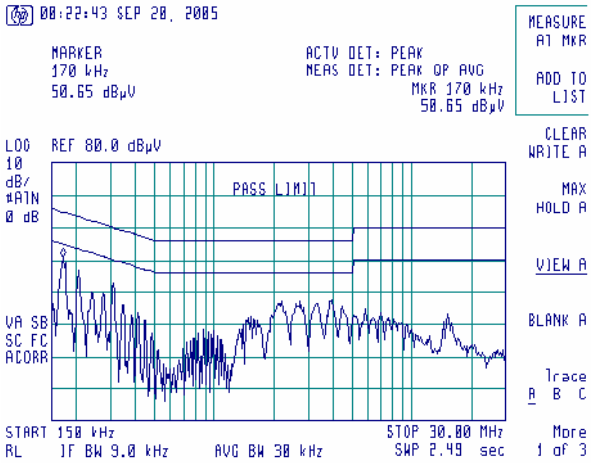
HL 0447	HL 0672	HL 0787	HL 1430	HL 1502	HL 2061		

Full description is given in Appendix A.

Test specification:	**Section 15.107, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	9/20/2005 12:26:03 PM		
Temperature: 24.5 ºC	**Air Pressure:** 1012 hPa	**Relative Humidity:** 38 %	**Power Supply:** 120 VAC
Remarks:			

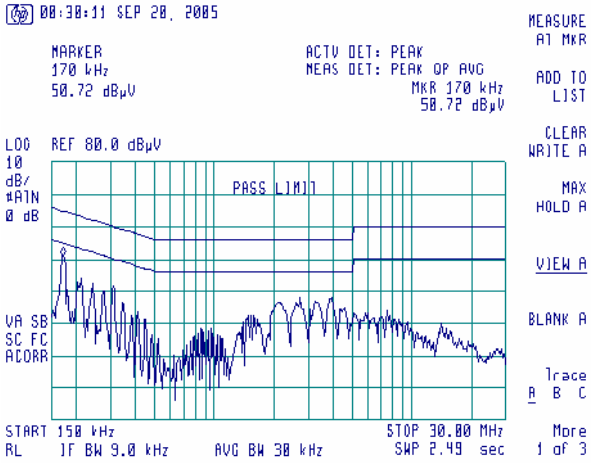
Plot 8.1.1 Conducted emission measurements

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Receive
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.2 Conducted emission measurements

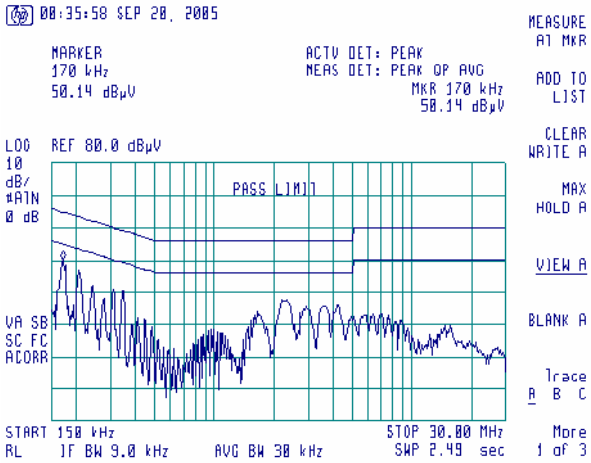
LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Receive
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/20/2005 12:26:03 PM		
Temperature: 24.5 ºC	Air Pressure: 1012 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

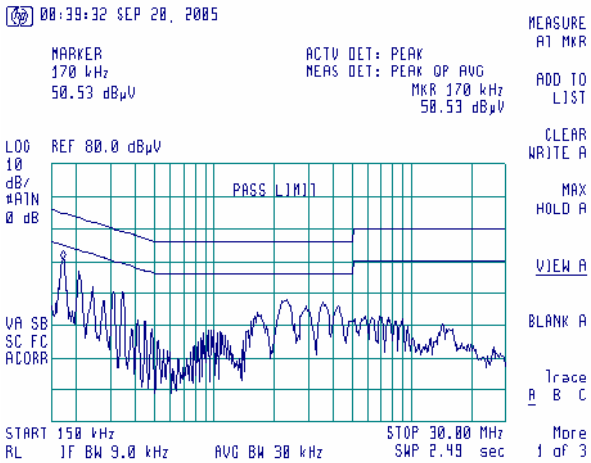
Plot 8.1.3 Conducted emission measurements

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Transmit 150.2 MHz
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.4 Conducted emission measurements

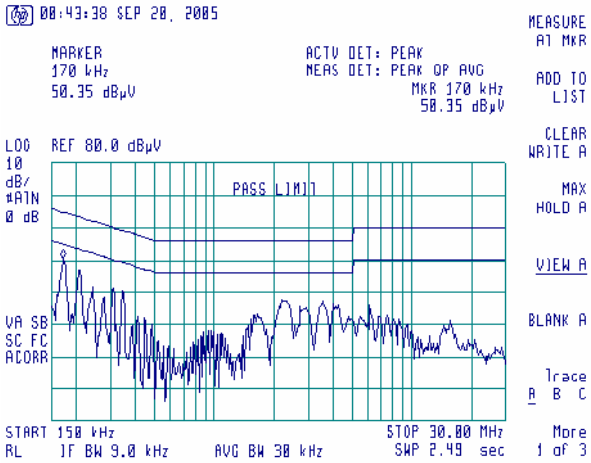
LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Transmit 150.2 MHz
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/20/2005 12:26:03 PM		
Temperature: 24.5 ºC	Air Pressure: 1012 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

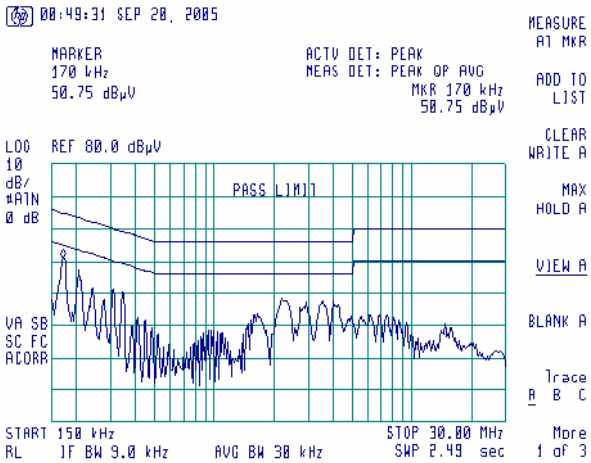
Plot 8.1.5 Conducted emission measurements

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Transmit 160.0 MHz
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.6 Conducted emission measurements

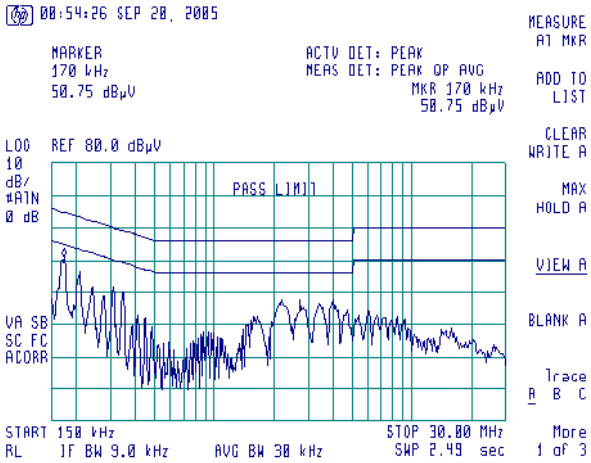
LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Transmit 160.0 MHz
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/20/2005 12:26:03 PM		
Temperature: 24.5 ºC	Air Pressure: 1012 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

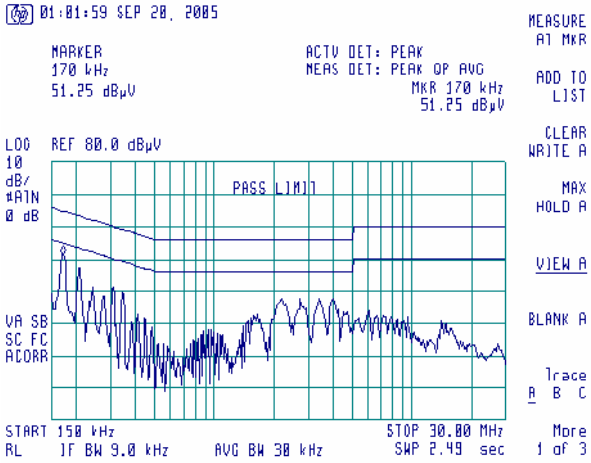
Plot 8.1.7 Conducted emission measurements

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Transmit 169.8 MHz
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.8 Conducted emission measurements

LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Transmit 169.8 MHz
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



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:	10/19/2005 6:13:43 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.2.1.

Table 8.2.1 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.

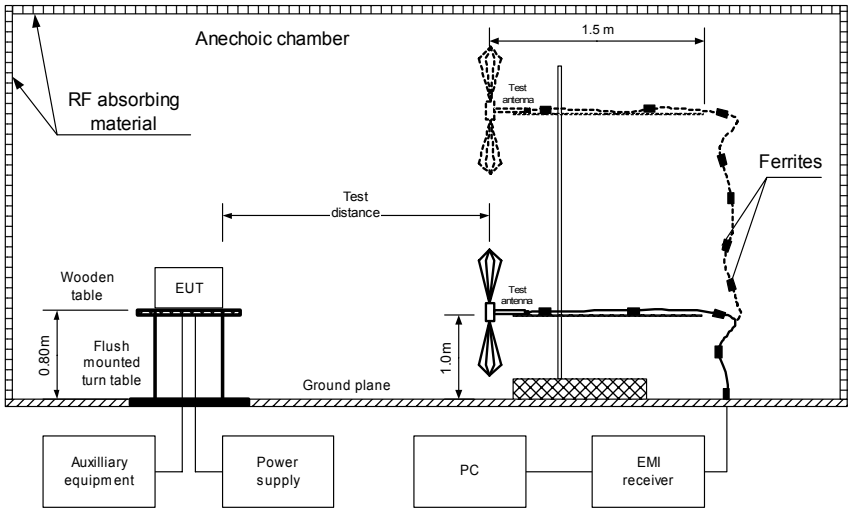
8.2.2 Test procedure for measurements in semi-anechoic chamber

8.2.2.1 The EUT was set up as shown in Figure 8.2.1, energized and the performance check was conducted.

8.2.2.2 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.

8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment



Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	10/19/2005 6:13:43 PM		
Temperature: 23 ºC	**Air Pressure:** 1022 hPa	**Relative Humidity:** 44 %	**Power Supply:** 120 VAC
Remarks:			

Table 8.2.2 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*				
32.470000	42.30	36.98	40.00	-3.02	Vertical	1.0	267	Pass
108.775000	38.29	34.23	43.50	-9.27	Vertical	1.0	274	
215.262500	40.98	31.01	43.50	-12.49	Horizontal	1.3	277	
292.418696	45.49	43.00	46.00	-3.00	Horizontal	1.0	360	
465.340000	40.33	39.36	46.00	-6.64	Vertical	1.0	67	
598.270000	43.06	41.08	46.00	-4.92	Vertical	1.1	295	
600.235000	34.63	32.55	46.00	-13.45	Vertical	1.0	149	
731.250000	39.42	36.56	46.00	-9.44	Vertical	1.1	116	
930.677500	41.48	39.61	46.00	-6.39	Vertical	1.0	281	
997.140750	41.70	40.06	54.00	-13.94	Horizontal	2.0	355	

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

Reference numbers of test equipment used

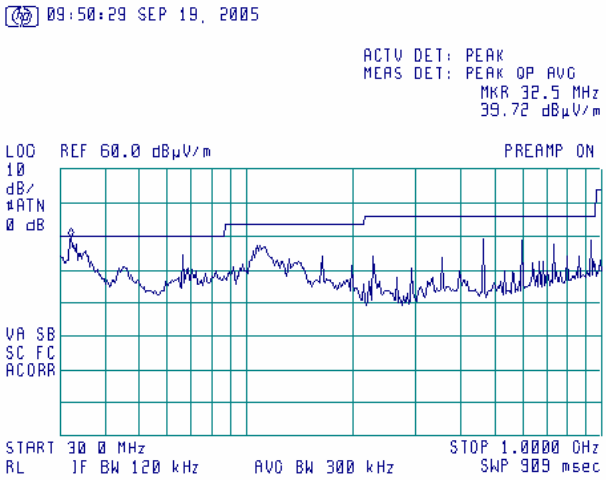
HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604	HL 2009	

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:	10/19/2005 6:13:43 PM		
Temperature: 23 ºC	Air Pressure: 1022 hPa	Relative Humidity: 44 %	Power Supply: 120 VAC
Remarks:			

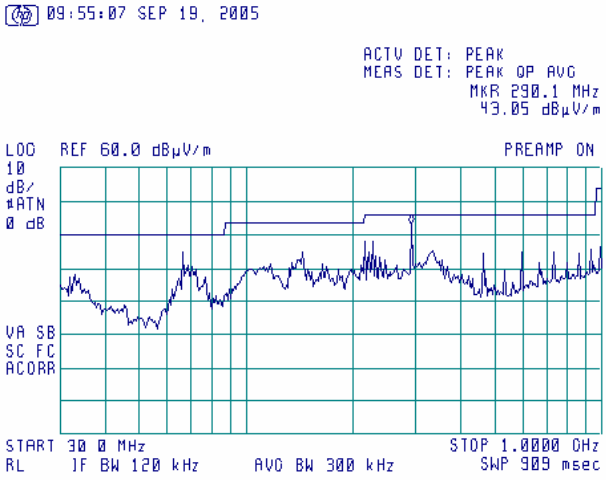
Plot 8.2.1 Radiated emission measurements in 30- 1000 MHz range, vertical antenna polarization

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



Plot 8.2.2 Radiated emission measurements in 30- 1000 MHz range, horizontal antenna polarization

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



Test specification:	Section 15.111, Conducted emission at receiver antenna port		
Test procedure:	ANSI C63.4, Section 12.1.5		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:40:26 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

8.3 Spurious emissions at RF antenna connector

8.3.1 General

This test was performed to measure spurious emissions at RF antenna connector of receiver operated within 30 to 960 MHz band or a citizens band (CB) receiver which was tested for compliance with radiated emission limits with the antenna port connected to resistive termination. Specification test limits are given in Table 8.3.1.

Table 8.3.1 Spurious emission limits

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

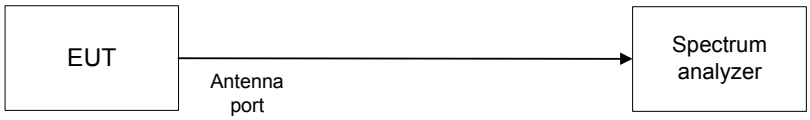
* - harmonic of the highest frequency the EUT generates, uses, operates or tunes to.
** - harmonic of the local oscillator frequency.

8.3.2 Test procedure

8.3.2.1 The EUT was set up as shown in Figure 8.3.1, energized and its proper operation was checked.

8.3.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 8.3.2 and associated plots.

Figure 8.3.1 Spurious emission test setup



Test specification:	Section 15.111, Conducted emission at receiver antenna port		
Test procedure:	ANSI C63.4, Section 12.1.5		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:40:26 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Table 8.3.2 Spurious emission test results

INVESTIGATED FREQUENCY RANGE:	30 – 1000 MHz
RECEIVER TYPE:	Other than CB or superheterodyne
EUT OPERATING MODE:	Receive
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	100 kHz
VIDEO BANDWIDTH:	300 kHz

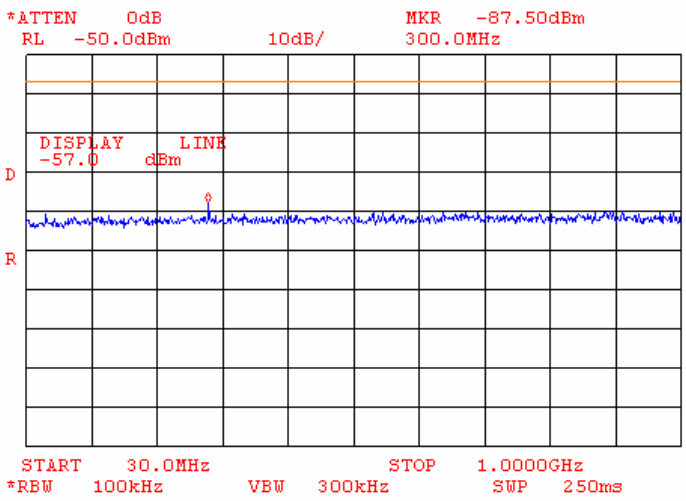
Frequency, MHz	Spurious emission, dBm	Limit, dBm	Margin, dB	Verdict
299.875	-85.33	-57.0	-28.33	Pass

Reference numbers of test equipment used

HL 1424	HL 2399						

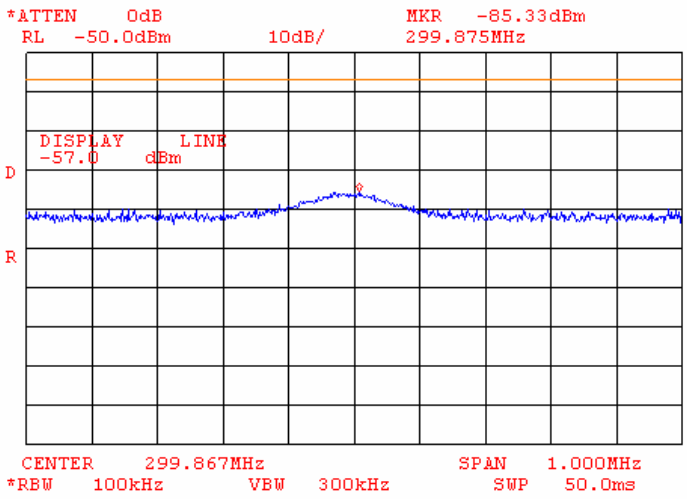
Full description is given in Appendix A.

Plot 8.3.1 Spurious emission measurements in 30 – 1000 MHz range.



Test specification:	Section 15.111, Conducted emission at receiver antenna port		
Test procedure:	ANSI C63.4, Section 12.1.5		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	9/25/2005 3:40:26 PM		
Temperature: 24 °C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Plot 8.3.2 Spurious emission measurement at 300 MHz.



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0029	Antenna, Dipole, Tunable 200 -500 MHz	Electro-Metrics	TDS-25/30-1	297	29-Jan-05	29-Jan-06
0446	Antenna, Loop active, 10kHz-30MHz	EMCO	6502	2857	28-Jun-05	28-Jun-06
0447	LISN, 16/2, 300V RMS	HL	LISN 16 - 1	066	03-Nov-04	03-Nov-05
0493	Oven temperature -45…175 deg C	Thermotron	S-1.2 Mini-Max	14016	23-Sep-04	23-Sep-05
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	26-Sep-04	26-Sep-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
0670	Oscilloscope, Digital storage 500 MHz, 2 Gs/s, 4 ch with Telecom Mask Tester	LeCroy Corporation	LC 334A	Ic3340238 7	16-Aug-05	16-Aug-06
0672	Shielded Room 4,6(L) x 4,2(W) x 2,4(H) m	HL	SR - 3	027	16-Aug-05	16-Aug-06
0758	Power supply, dual, 36 V, 1 A	Horizon Electronics	DHR 36-1	5361231	16-Aug-05	16-Aug-06
0787	Transient Limiter	Hewlett Packard	11947A	3107A018 77	26-Jun-05	26-Jun-06
0788	Power splitter/combiner 5-500 MHz	Mini-Circuits	ZFSC-2-1	923705	01-Jul-05	01-Jul-06
0808	Analyzer Spectrum 100 Hz to 2.2 GHz	Anritsu	MS2601B	M178731	26-Jun-05	26-Jun-06
0892	Multimeter Digital	Tabor Electronics	DM 4021	232757	20-Jul-05	20-Jul-06
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies (HP)	8564EC	3946A002 19	26-Jun-05	26-Jun-06
1430	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL1432	Agilent Technologies (HP)	8542E	3807A002 62,3705A0 0217	26-Jun-05	26-Jun-06
1502	Cable RF, 6 m	Belden	M17/167 MIL-C-17	1502	26-Jun-05	26-Jun-06
1508	Cable RF, 2 m	Telequis	RG-58 C/U	1508	11-Sep-05	11-Sep-06
1653	Analyzer EMC 9 kHz - 1.5 GHz	Agilent Technologies (HP)	E7401A	US394402 81	11-Sep-05	11-Sep-06
1907	Power Splitter / Combiner, 5-500 MHz	Mini-Circuits	ZFSC-2-1	1907	11-Sep-05	11-Sep-06

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
1947	Cable 18GHz, 6.5 m, blue	Rhophase Microwave Limited	NPS-1803A-6500-NPS	T4974	11-Sep-05	11-Sep-06
1956	Cable, 0.5m BNC/BNC	Telequis	RG-58	1956	11-Sep-05	11-Sep-06
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W, N-type	EMC Test Systems	3115	9911-5964	11-Sep-05	11-Sep-06
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	11-Sep-05	11-Sep-06
2014	Attenuator, Manual Step, 0-99/1 dB, 0-4 GHz, 2 W	Weinschel	AC9004-99-11	16924	11-Sep-05	11-Sep-06
2061	Load 50 Ohm, 35 W, DC-1 GHz Load 50 Ohm, 35 W, DC-1 Ghz	Telewave	TWL-35	2061	08-Dec-04	08-Dec-05
2254	Cable 40GHz, 0.8 m, blue	Rhophase Microwave Limited	KPS-1503A-800-KPS	W4907	24-Jun-05	24-Jun-06
2399	Cable 40GHz, 1.5 m, blue	Rhophase Microwave Limited	KPS-1503A-1500-KPS	X2945	24-Jun-05	24-Jun-06
2400	Cable 40GHz, 1.5 m, green	Rhophase Microwave Limited	KPS-1503A-1500-KPS	X2946	24-Jun-05	24-Jun-06
2524	Attenuator, 10 dB, DC-18 GHz	Midwest Microwave	263-10	2524	03-Jan-05	03-Jan-06
2634	Power Supply, 0-36.0 VDC, 0-12.0 A	Nemic-Lambda	UP36-12	2634	29-Aug-05	29-Aug-06

10 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.

11 APPENDIX C Test facility description

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

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

Person for contact: Mr. Alex Usoskin, CEO.

12 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
47CFR part 15: 2005	Radio Frequency Devices
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 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

13 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
LISN	line impedance stabilization network
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

14 APPENDIX F Test equipment correction factors

Correction factor
Line impedance stabilization network
Model LISN 16 - 1
Hermon Laboratories

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.

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

Frequency, MHz	Magnetic Antenna Factor, dB(S/m)	Electric Antenna Factor, dB(1/m)
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.7
0.750	-41.9	9.6
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.1
4.000	-41.4	10.1
5.000	-41.5	10.0
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

Antenna factor in dB(S/m) is to be added to receiver meter reading in dB(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).

Antenna factor

Biconilog antenna EMCO, model 3141, serial number 1011, HL 0604

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

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(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, HL 1984

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

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

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

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	30	0.33	≤ 6.5	±0.12
2	50	0.40		
3	100	0.57		
4	300	0.97		
5	500	1.25		
6	800	1.59		
7	1000	1.81		
8	1200	1.97		
9	1400	2.15		
10	1600	2.28		
11	1800	2.43		
12	2000	2.61		
13	2200	2.75		
14	2400	2.89		
15	2600	2.97		
16	2800	3.21	≤ 6.5	±0.12
17	3000	3.32		
18	3300	3.47		
19	3600	3.62		
20	3900	3.84		
21	4200	3.92		±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, 6 m, model: M17/167 MIL-C-17, HL 1502

Frequency, MHz	Cable loss, dB
0.1	0.02
1	0.07
3	0.15
5	0.17
10	0.26
30	0.43
50	0.57
80	0.72
100	0.81
300	1.48
500	2.00
800	2.70
1000	3.09

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

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

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

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

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

Cable loss
Cable 40 GHz, 0.8 m, blue, model: KPS-1503A-800-KPS, S/N W4907, HL 2254

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

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

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

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