

TEST REPORT

ACCORDING TO: FCC CFR 47 PART 15 Subpart C, sections 15.231, 15.209 and
RSS-210, Issue 7, Annex 1; ICES-003 Issue 4:2004

FOR:

Visonic Ltd.

Wireless alarm control system

PowerMax Pro with GSM module

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1 Applicant information

Client name: Visonic Ltd.
Address: 24 Habarzel street, Tel Aviv 61920, Israel
Telephone: +972 3645 6714
Fax: +972 3645 6788
E-mail: aelshtein@visonic.com
Contact name: Mr. Arick Elshtein

2 Equipment under test attributes

Product name: Wireless alarm control system
Product type: Transceiver
Model(s): PowerMax Pro with GSM module
Receipt date: 8/20/2008

3 Manufacturer information

Manufacturer name: Visonic Ltd.
Address: 24 Habarzel street, Tel Aviv 61920, Israel
Telephone: +972 3645 6714
Fax: +972 3645 6788
E-Mail: aelshtein@visonic.com
Contact name: Mr. Arick Elshtein

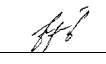
4 Test details

Project ID: 19017
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 8/20/2008
Test completed: 11/30/2008
Test specification(s): FCC Part 15, subpart C, §§15.231, 15.209; subpart B;
RSS-210 Issue 7:2007, Annex 1; RSS-Gen Issue 2:2007; ICES-003 issue 4:2004

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Part 15, Section 231(a) / RSS-210, Section A1.1.1, Periodic operation requirements	Not required
FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions	Pass
FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	Pass
FCC Part 15, Section 207 / RSS-Gen, Section 7.2.2, Conducted emission	Pass
FCC Part 15, Section 203 / RSS-Gen, Section 7.1.4, Antenna requirements	Not required
Unintentional emissions	
FCC Part 15, Section 107 / RSS-Gen, Section 7.1.6 / ICES-003, Section 5.3 Conducted emission at AC power port	Pass
FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Section 5.5 Radiated emission	Pass
FCC Part 15, Section 111 / RSS-210, Section 7.2.3, Conducted emission at receiver antenna port	Not required

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

	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer Mr. S. Samokha, test engineer	November 30, 2008	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	December 14, 2008	
Approved by:	Mr. M. Nikishin, EMC and radio group manager	January 4, 2008	

6 EUT description

6.1 General information

The PowerMax Pro is a wireless alarm control system that provides protection against burglary, fire and tampering, powered by build-in AC/DC power supply. The product includes GSM modem (FCC certified for modular approval), security radio operating at 315MHz with separate antenna and proximity reader transceiver operating at 125 kHz.

6.2 Ports and lines

Port type	Port description	Connected		Connector type	Qty.	Cable type	Cable length	Indoor / outdoor
		From	To					
Power	AC mains	EUT	AC mains	Terminal block	1	Unshielded	2 m	Indoor
Signal	RS 232	EUT	Web communicator	RJ 45	1	Unshielded	2 m*	Indoor
Signal	RS 232	EUT	GSM unit	RJ 45	1	Unshielded	2 m*	Indoor
Telecom	PSTN	EUT	Line simulator	RJ 11	1	Unshielded	3 m**	Outdoor
Signal	Phone	EUT	Telephone set	RJ 11	1	Unshielded	3 m	Indoor
Signal	Zone 29, 30	EUT	Termination	Terminal block	2	Unshielded	3 m**	Indoor
Signal	V+	EUT	Open circuit	Terminal block	1	Unshielded	3 m**	Indoor
Signal	12+	EUT	Open circuit	Terminal block	1	Unshielded	3 m**	Indoor
Signal	-HOLD	EUT	Open circuit	Terminal block	1	Unshielded	3 m**	Indoor
Signal	EXT Siren	EUT	Open circuit	Terminal block	1	Unshielded	3 m**	Indoor
Signal	INT Siren	EUT	Open circuit	Terminal block	1	Unshielded	3 m**	Indoor
Signal	PGM	EUT	Open circuit	Terminal block	1	Unshielded	3 m**	Indoor

* May be up to 12 m.

** May be longer than 30 m.

6.3 Auxiliary equipment

Description	Manufacturer	Model number	Serial number
Line simulator	Hermon Labs	LS-01	1856
Web communicator	Visonic	NA	NA
GSM unit	Visonic	NA	NA
Telephone set	Typical		

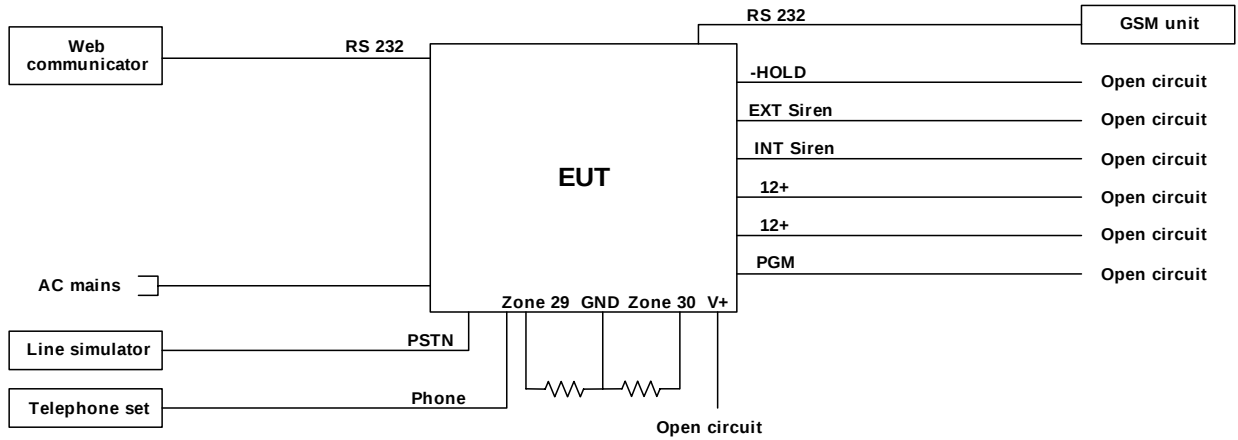
6.4 Operating frequencies

Source	Frequency, MHz					
Clock	4.19	16.0	NA	NA	NA	NA
Tx	315	NA	NA	NA	NA	NA
Rx	315	NA	NA	NA	NA	NA
Tx/Rx	0.127	NA	NA	NA	NA	NA

6.5 Changes made in the EUT

No changes were implemented.

6.6 Test configuration



6.7 Transmitter characteristics

6.7.1 Transmitter operating at 315 MHz

Type of equipment				
Stand-alone (Equipment with or without its own control provisions)				
X	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		
Operating frequency		315 MHz		
Maximum rated output power		At transmitter 50 Ω RF output connector dBm		
		Effective radiated power (for equipment with no RF connector) -19.4 dBm		
Is transmitter output power variable?		X	No	
		Yes	continuous variable	
			stepped variable with stepsize	dB
			minimum RF power	dBm
			maximum RF power	dBm
Antenna connection				
unique coupling	standard connector	X	integral	
			with temporary RF connector	
			X without temporary RF connector	
Antenna characteristics				
Type	Manufacturer	Model number	Gain	
Wire	Visonic Ltd.	NA	NA	
Type of modulation		ASK		
Modulating test signal (baseband)		ID code		
Maximum transmitter duty cycle		0.005 %		
Transmitter power source				
Battery	Nominal rated voltage	Battery type		
X AC mains	Nominal rated voltage	Frequency	60 Hz	
Common power source for transmitter and receiver		X	yes no	

6.7.2 Transmitter operating at 125 kHz

Type of equipment					
Stand-alone (Equipment with or without its own control provisions)					
X	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			
Operating frequency		127 kHz			
Is transmitter output power variable?		X	No		
		Yes	continuous variable		
			stepped variable with stepsize		
			minimum RF power		
			maximum RF power		
		dB			
		dBm			
		-21.7 dBm			
Antenna connection					
unique coupling	standard connector	X	integral	with temporary RF connector	
				X	without temporary RF connector
Antenna characteristics					
Type	Manufacturer	Model number		Gain	
Printed	Visonic Ltd.	NA		NA	
Type of modulation		ASK			
Modulating test signal (baseband)		ID code			
Maximum transmitter duty cycle		100%			
Transmitter power source					
Battery	Nominal rated voltage		Battery type		
X	AC mains	Nominal rated voltage	120 VAC	Frequency	60 Hz
Common power source for transmitter and receiver			X	yes	no

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

7 Transmitter tests

7.1 Field strength of emissions, transmitter operating at 127 kHz

7.1.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.1.1 and Table 7.1.2.

Table 7.1.1 Radiated fundamental emission limits

Fundamental frequency, KHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
127.4	125.52	105.52

Table 7.1.2 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)		
	Peak	Quasi Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**
0.090 – 0.110	NA	108.5 – 106.8**	NA
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**
0.490 – 1.705	NA	73.8 – 63.0**	NA
1.705 – 30.0*		69.5	
30 – 88		40.0	
88 – 216		43.5	
216 – 960		46.0	
960 - 1000		54.0	
Above 1000	74.0	NA	54.0

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

$$\text{Lim}_{S_2} = \text{Lim}_{S_1} + 40 \log(S_1/S_2),$$

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

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

Note 1: The fundamental emission limit in dB(μV/m) was calculated as follows:

$$\text{Lim}_{AVR} = 20 \times \log(56.81818 \times F - 6136.3636) \text{ - within } 130 - 174 \text{ MHz band;}$$

$$\text{Lim}_{AVR} = 20 \times \log(41.6667 \times F - 7083.3333) \text{ - within } 260 - 470 \text{ MHz band,}$$

where F is the carrier frequency in MHz.

The limit for spurious emissions was 20 dB lower than fundamental emission limit.

The above limits provided in terms of average values, peak limit was 20 dB above the average limit.

Note 2: The above field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

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

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

7.1.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.

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

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

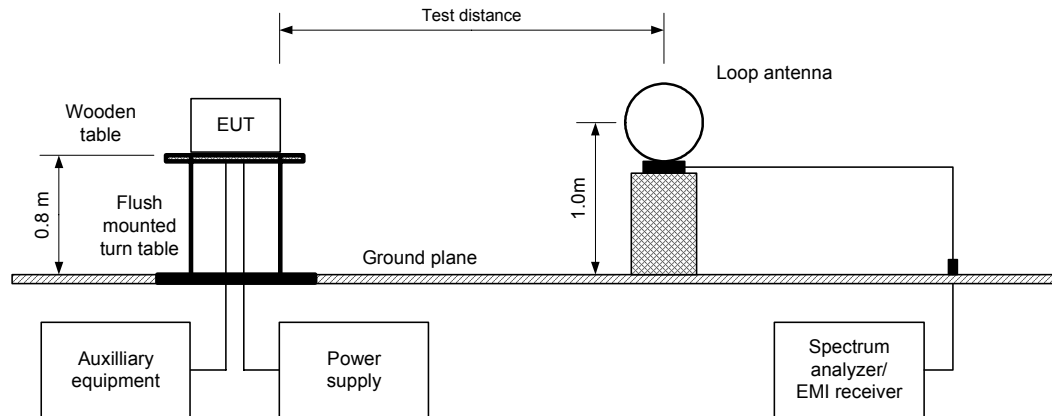
7.1.3.1 The EUT was set up as shown in Figure 7.1.2, energized and the performance check was conducted.

7.1.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

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

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

Figure 7.1.1 Setup for spurious emission field strength measurements below 30 MHz

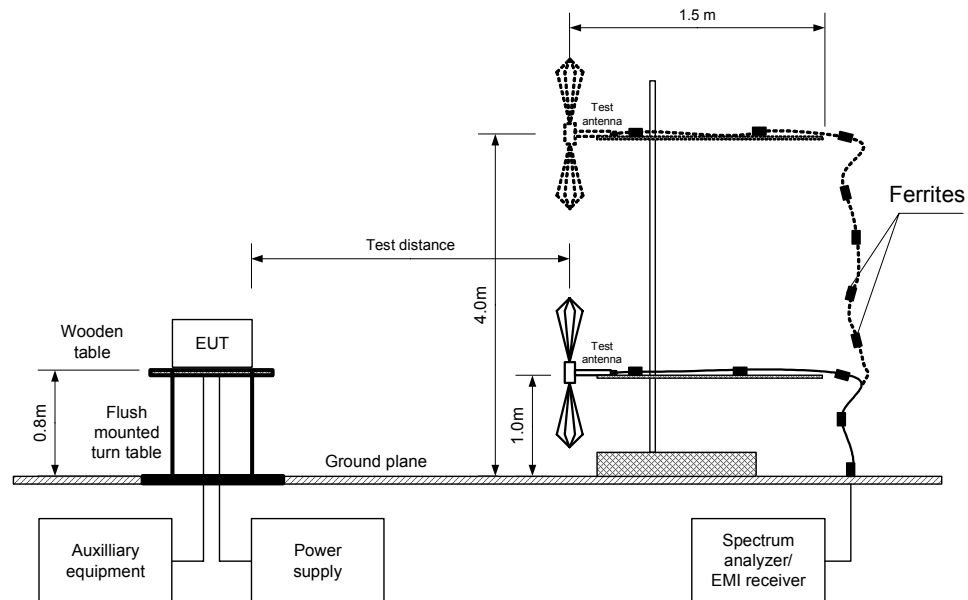


Photograph 7.1.1 Setup for spurious emission field strength measurements below 30 MHz



Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

Figure 7.1.2 Setup for spurious emission field strength measurements above 30 MHz



Photograph 7.1.2 Setup for spurious emission field strength measurements from 30 to 1000 MHz





Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

Table 7.1.3 Field strength of fundamental emission and spurious emissions

TEST DISTANCE:	3 m
EUT POSITION:	Typical (Vertical)
MODULATION:	ASK
MODULATING SIGNAL:	ID code
BIT RATE:	3 kbps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 - 1000 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	1 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz) ≥ Resolution bandwidth
VIDEO BANDWIDTH:	Active loop (9 kHz – 30 MHz) Biconilog (30 MHz – 1000 MHz)
TEST ANTENNA TYPE:	

Frequency kHz	Antenna		Azimuth, degrees*	Peak field strength			Avr factor, dB	Average field strength			Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission											
127.4	Vert	1.0	0	73.5	125.52	-52.02	0	73.3	105.52	-32.22	Pass
Spurious emissions											
No emissions were found											Pass

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin = dB below (negative if above) specification limit.

Reference numbers of test equipment used

HL 0446	HL 1425	HL 2697	HL 2882	HL 3119			
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Full description is given in Appendix A.

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

Table 7.1.4 Restricted bands according to FCC 15, Section 205

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.290 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.420 - 16.423	156.7 - 156.9	1660 - 1710	5350 - 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 - 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

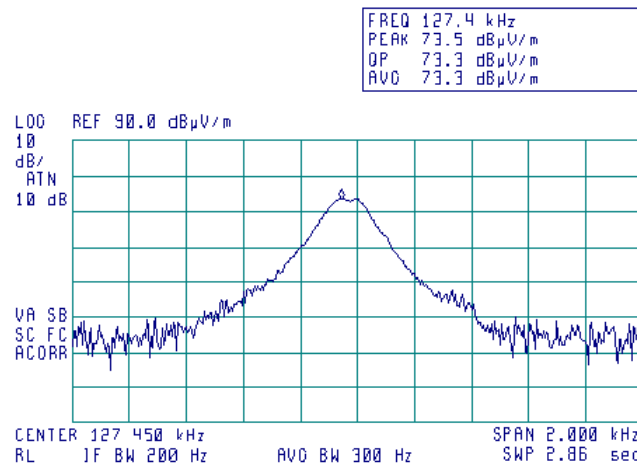
Table 7.1.5 Restricted bands according to RSS-210, Section 2.7

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.291 - 8.294	16.80425 - 16.80475	399.9 - 410	3260 - 3267	10.6 - 12.7
2.1735 - 2.190	8.362 - 8.366	25.5 - 25.67	608 - 614	3332 - 3339	13.25 - 13.4
3.020 - 3.026	8.37625 - 8.38675	37.5 - 38.25	960 - 1427	3345.8 - 3358	14.47 - 14.5
4.125 - 4.128	8.41425 - 8.41475	73 - 74.6	1435 - 1626.5	3500 - 4400	15.35 - 16.2
4.17725 - 4.17775	12.290 - 12.293	74.8 - 75.2	1645.5 - 1646.5	4500 - 5150	17.7 - 21.4
4.20725 - 4.20775	12.51975 - 12.52025	108 - 138	1660 - 1710	5350 - 5460	22.01 - 23.12
5.677 - 5.683	12.57675 - 12.57725	156.52475 - 156.52525	1718.8 - 1722.2	7250 - 7750	23.6 - 24.0
6.215 - 6.218	13.36 - 13.41	156.7 - 156.9	2200 - 2300	8025 - 8500	31.2 - 31.8
6.26775 - 6.26825	16.42 - 16.423	240 - 285	2310 - 2390	9000 - 9200	36.43 - 36.5
6.31175 - 6.31225	16.69475 - 16.69525	322 - 335.4	2655 - 2900	9300 - 9500	Above 38.6

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

Plot 7.1.1 Radiated emission measurements at the fundamental frequency

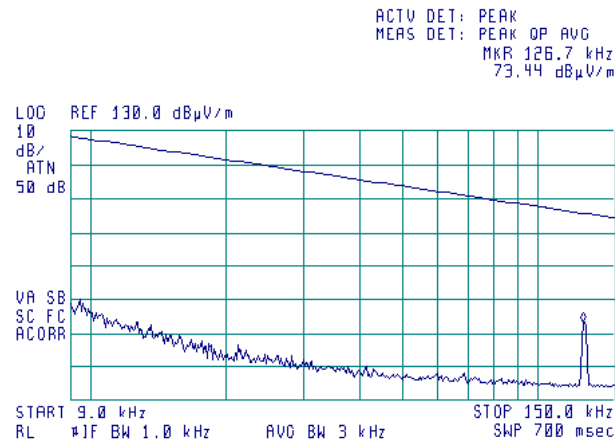
TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
EUT POSITION: Typical (Vertical)



Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

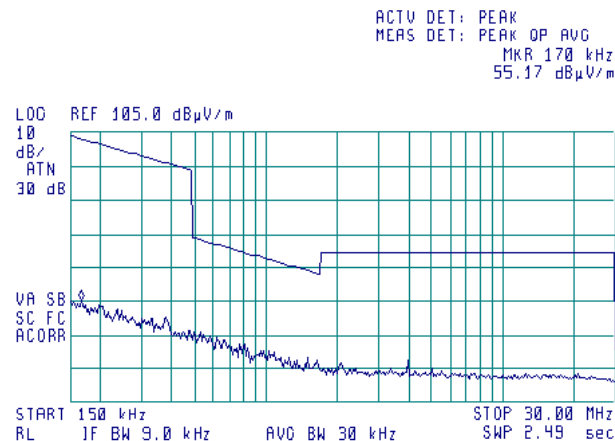
Plot 7.1.2 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Plot 7.1.3 Radiated emission measurements from 0.15 to 30 MHz

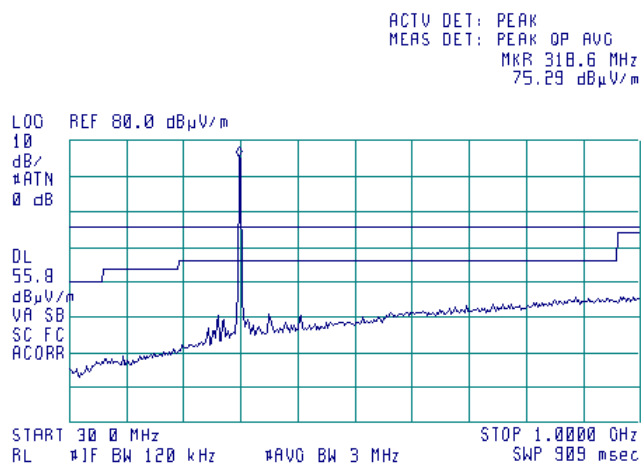
TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 1:33:25 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 127 kHz			

Plot 7.1.4 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Vertical)



NOTE: 318.6 MHz – fundamental frequency of transmitter 315 MHz

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

7.2 Field strength of emissions, transmitter operating at 315 MHz

7.2.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.1.1 and Table 7.1.2.

Table 7.2.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
315	95.62	75.62

Table 7.2.2 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)				
	Within restricted bands			Outside restricted bands	
	Peak	Quasi Peak	Average	Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	95.62	75.62
0.090 – 0.110	NA	108.5 – 106.8**	NA		
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**		
0.490 – 1.705	NA	73.8 – 63.0**	NA		
1.705 – 30.0*		69.5			
30 – 88		40.0			
88 – 216		43.5			
216 – 960		46.0			
960 – 1000		54.0			
Above 1000	74.0	NA	54.0		

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

$$\text{Lim}_{S2} = \text{Lim}_{S1} + 40 \log(S_1/S_2),$$

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

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

Note 1: The fundamental emission limit in dB(μV/m) was calculated as follows:

$$\text{Lim}_{AVR} = 20 \times \log(56.81818 \times F - 6136.3636) \text{ - within } 130 - 174 \text{ MHz band;}$$

$$\text{Lim}_{AVR} = 20 \times \log(41.6667 \times F - 7083.3333) \text{ - within } 260 - 470 \text{ MHz band,}$$

where F is the carrier frequency in MHz.

The limit for spurious emissions was 20 dB lower than fundamental emission limit.

The above limits provided in terms of average values, peak limit was 20 dB above the average limit.

Note 2: The above field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

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

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

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

7.2.2.3 The worst test results (the lowest margins) were recorded in Table 7.2.3, Table 7.2.5 and shown in the associated plots.

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

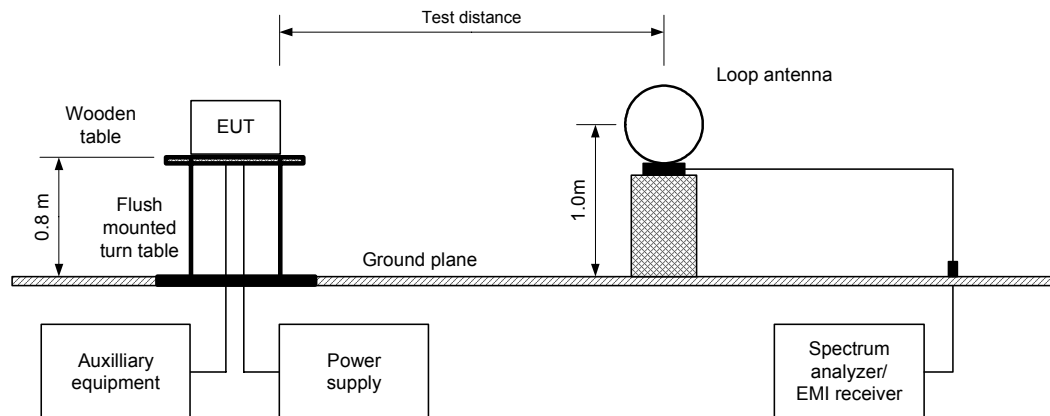
7.2.3.1 The EUT was set up as shown in Figure 7.2.2, energized and the performance check was conducted.

7.2.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.2.3.3 The worst test results (the lowest margins) were recorded in Table 7.2.3, Table 7.2.5 and shown in the associated plots.

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

Figure 7.2.1 Setup for spurious emission field strength measurements below 30 MHz

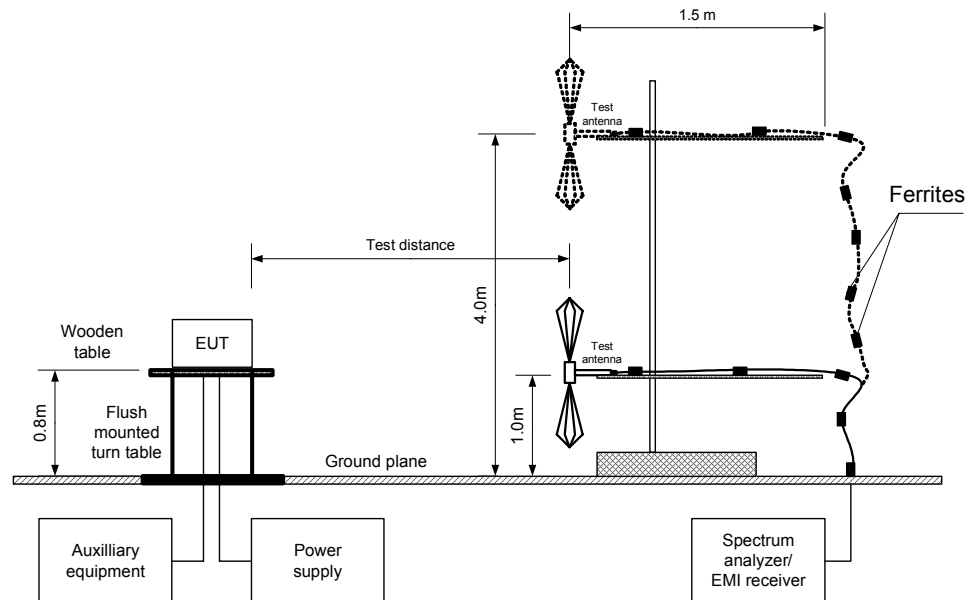


Photograph 7.2.1 Setup for spurious emission field strength measurements below 30 MHz



Test specification:		FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

Figure 7.2.2 Setup for spurious emission field strength measurements above 30 MHz



Photograph 7.2.2 Setup for spurious emission field strength measurements from 30 to 1000 MHz



Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

Table 7.2.3 Field strength of fundamental emission, spurious emissions outside restricted bands and within restricted bands at frequencies above 1 GHz

TEST DISTANCE: 3 m
EUT POSITION: Typical (Vertical)
MODULATION: ASK
MODULATING SIGNAL: ID code
BIT RATE: 3 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
INVESTIGATED FREQUENCY RANGE: 0.009 -3150 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1 kHz (9 kHz – 150 kHz)
9.0 kHz (150 kHz – 30 MHz)
120 kHz (30 MHz – 1000 MHz)
1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

F, MHz	Antenna		Azimuth, degrees*	Peak field strength			Avr factor, dB	Average field strength			Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission											
315	Hor	1.1	164	75.79	95.62	-19.83	-6.22	69.57	75.62	-6.05	Pass
Spurious emissions											
No emissions were found											Pass

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin = dB below (negative if above) specification limit.

Table 7.2.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
0.788	1.613	NA	NA	NA	-6.22

*- Average factor was calculated as follows
for pulse train shorter than 100 ms:
$$\text{Average factor} = 20 \times \log_{10} \left(\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{Burst duration}}{\text{Train duration}} \times \text{Number of bursts within pulse train} \right)$$

for pulse train longer than 100 ms:
$$\text{Average factor} = 20 \times \log_{10} \left(\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{Burst duration}}{100 \text{ ms}} \times \text{Number of bursts within 100 ms} \right)$$

Reference numbers of test equipment used

HL 0446	HL 1425	HL 2697	HL 2882	HL 3119			
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Full description is given in Appendix A.

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

Table 7.2.5 Field strength of emissions below 1 GHz within restricted bands

TEST DISTANCE: 3 m
 EUT POSITION: Typical (Vertical)
 MODULATION: ASK
 MODULATING SIGNAL: ID code
 BIT RATE: 3 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 120 kHz (30 MHz – 1000 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconical (30 MHz – 200 MHz)
 Log periodic (200 MHz – 1000 MHz)
 Biconilog (30 MHz – 1000 MHz)

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

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

HL 0446	HL 1425	HL 2697	HL 2882	HL 3119			
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Full description is given in Appendix A.

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

Table 7.2.6 Restricted bands according to FCC 15, Section 205

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.290 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.420 - 16.423	156.7 - 156.9	1660 - 1710	5350 - 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 - 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

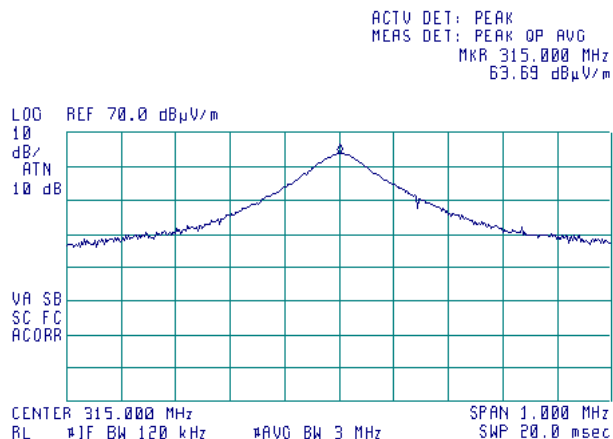
Table 7.2.7 Restricted bands according to RSS-210, Section 2.7

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.291 - 8.294	16.80425 - 16.80475	399.9 - 410	3260 - 3267	10.6 - 12.7
2.1735 - 2.190	8.362 - 8.366	25.5 - 25.67	608 - 614	3332 - 3339	13.25 - 13.4
3.020 - 3.026	8.37625 - 8.38675	37.5 - 38.25	960 - 1427	3345.8 - 3358	14.47 - 14.5
4.125 - 4.128	8.41425 - 8.41475	73 - 74.6	1435 - 1626.5	3500 - 4400	15.35 - 16.2
4.17725 - 4.17775	12.290 - 12.293	74.8 - 75.2	1645.5 - 1646.5	4500 - 5150	17.7 - 21.4
4.20725 - 4.20775	12.51975 - 12.52025	108 - 138	1660 - 1710	5350 - 5460	22.01 - 23.12
5.677 - 5.683	12.57675 - 12.57725	156.52475 - 156.52525	1718.8 - 1722.2	7250 - 7750	23.6 - 24.0
6.215 - 6.218	13.36 - 13.41	156.7 - 156.9	2200 - 2300	8025 - 8500	31.2 - 31.8
6.26775 - 6.26825	16.42 - 16.423	240 - 285	2310 - 2390	9000 - 9200	36.43 - 36.5
6.31175 - 6.31225	16.69475 - 16.69525	322 - 335.4	2655 - 2900	9300 - 9500	Above 38.6

Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

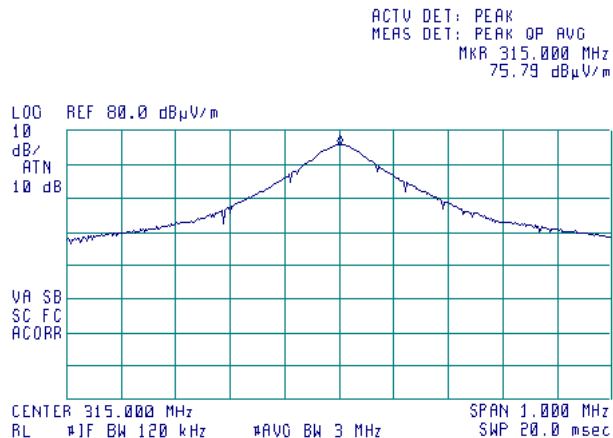
Plot 7.2.1 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Plot 7.2.2 Radiated emission measurements at the fundamental frequency

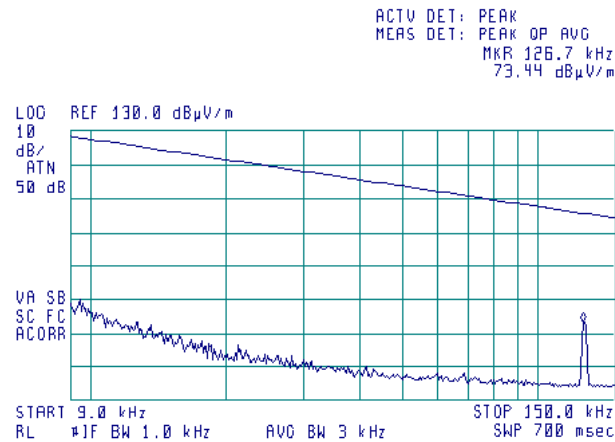
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical (Vertical)



Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

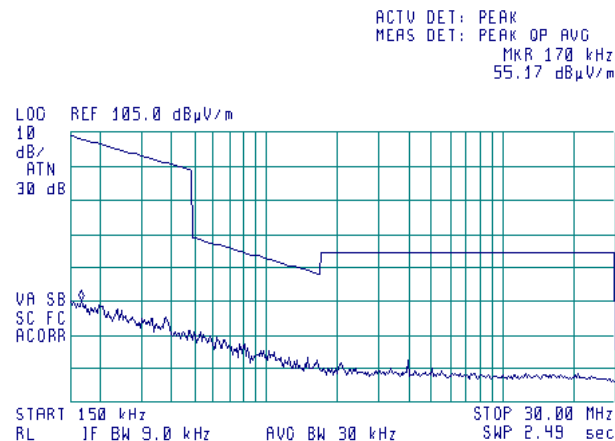
Plot 7.2.3 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Plot 7.2.4 Radiated emission measurements from 0.15 to 30 MHz

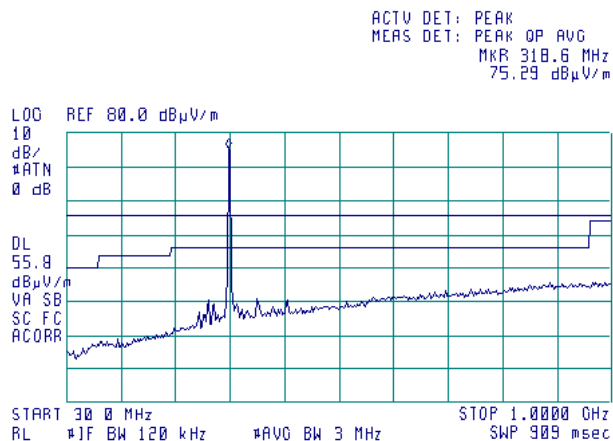
TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

Plot 7.2.5 Radiated emission measurements from 30 to 1000 MHz

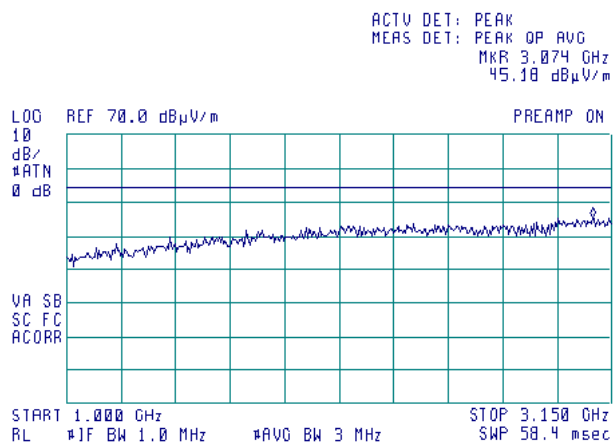
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Vertical)



NOTE: 318.6 MHz – transmitter fundamental frequency

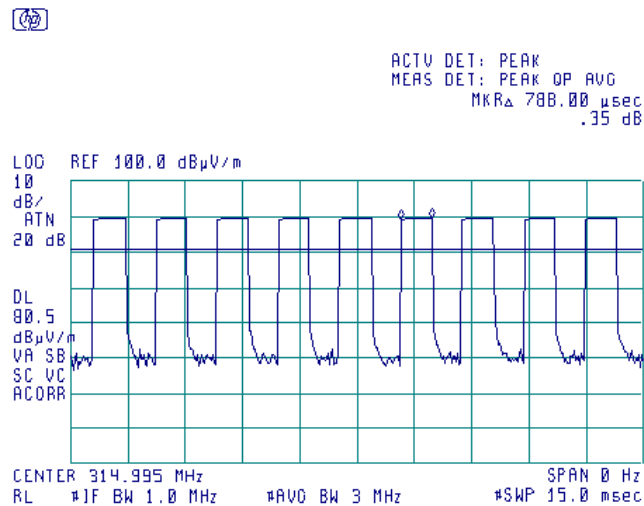
Plot 7.2.6 Radiated emission measurements from 1000 to 3150 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Vertical)

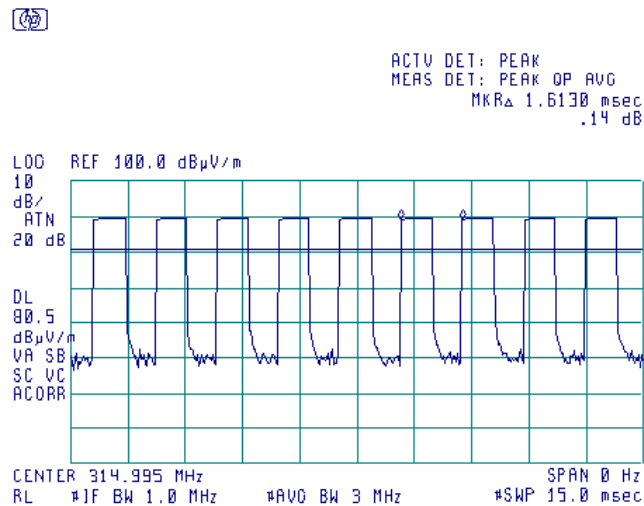


Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.1.2, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 6:28:49 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks: Tx at 315 MHz			

Plot 7.2.7 Transmission pulse duration



Plot 7.2.8 Transmission pulse period



Test specification: FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	
Test procedure: ANSI C63.4, Section 13.1.7	
Test mode: Compliance	Verdict: PASS
Date & Time: 11/11/2008 3:16:05 PM	
Temperature: 25°C	Air Pressure: 1008 hPa
Relative Humidity: 50 %	
Power Supply: 120 VAC	
Remarks:	

7.3 Occupied bandwidth test

7.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, % of the carrier frequency
70 - 900	20.0	0.25
Above 900		0.50

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

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 was set to transmit modulated carrier.

7.3.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.3.2 and associated plot.

Figure 7.3.1 Occupied bandwidth test setup



Test specification:		FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date & Time:		11/11/2008 3:16:05 PM	
Temperature: 25°C	Air Pressure: 1008 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Photograph 7.3.1 Occupied bandwidth test setup



Test specification:	FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth			
Test procedure:	ANSI C63.4, Section 13.1.7			
Test mode:	Compliance	Verdict:		PASS
Date & Time:	11/11/2008 3:16:05 PM			
Temperature: 25°C	Air Pressure: 1008 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC	
Remarks:				

Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 10 kHz
VIDEO BANDWIDTH: 30 kHz
MODULATION ENVELOPE REFERENCE POINTS: 20 dBc
MODULATION: ASK
MODULATING SIGNAL: ID code

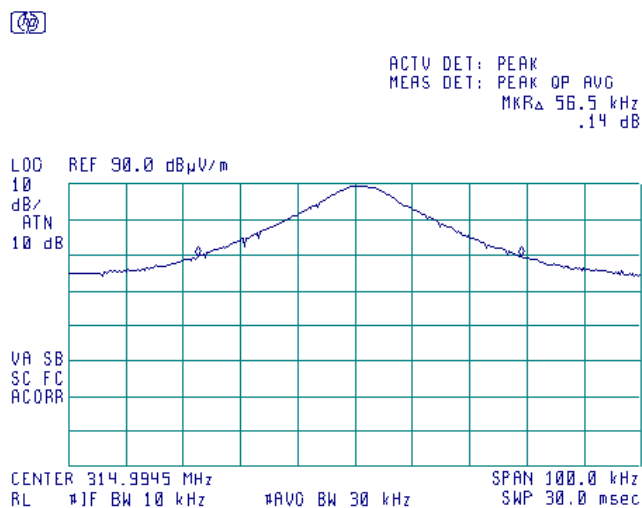
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
315	56.5	0.25	787.5	-731	Pass

Reference numbers of test equipment used

HL 0521	HL 0604	HL 1003	HL 3132					
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Full description is given in Appendix A.

Plot 7.3.1 Occupied bandwidth test result



Test specification:	FCC Part 15, Section 207 / RSS-Gen, Section 7.2.2, Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/30/2008 8:42:37 AM		
Temperature: 24°C	Air Pressure: 1011 hPa	Relative Humidity: 48%	Power Supply: 120 VAC
Remarks:			

7.4 Conducted emissions

7.4.1 General

This test was performed to measure the common mode conducted emissions at the EUT power port. The specification test limits are given in Table 7.4.1.

Table 7.4.1 Limits for conducted emissions

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

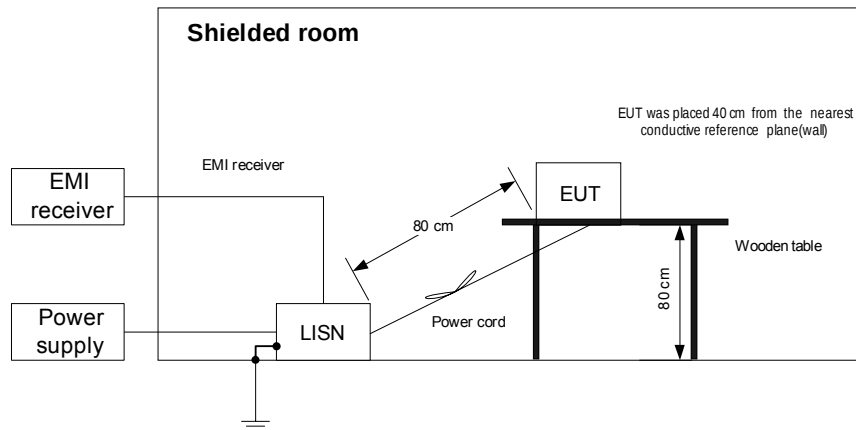
* - The limit decreases linearly with the logarithm of frequency.

7.4.2 Test procedure

- 7.4.2.1 The EUT was set up as shown in Figure 7.4.1 and the associated photographs, energized and the EUT performance was checked.
- 7.4.2.2 The measurements were performed at the EUT power terminals with the LISN connected to the EMI receiver in the frequency range referred to in Table 7.4.2. The unused coaxial connector of the LISN was terminated with 50 Ohm.
- 7.4.2.3 The position of the EUT cables was varied to find the highest emission.
- 7.4.2.4 The worst test results with respect to the limits were recorded in Table 7.4.2 and shown in the associated plots.

Test specification:		FCC Part 15, Section 207 / RSS-Gen, Section 7.2.2, Conducted emission	
Test procedure:		ANSI C63.4, Section 13.1.3	
Test mode:		Compliance	Verdict: PASS
Date & Time:		11/30/2008 8:42:37 AM	
Temperature: 24°C	Air Pressure: 1011 hPa	Relative Humidity: 48%	Power Supply: 120 VAC
Remarks:			

Figure 7.4.1 Setup for conducted emission measurements, table-top EUT



Photograph 7.4.1 Setup for conducted emission measurements



Test specification:	FCC Part 15, Section 207 / RSS-Gen, Section 7.2.2, Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	11/30/2008 8:42:37 AM		
Temperature: 24°C	Air Pressure: 1011 hPa	Relative Humidity: 48%	Power Supply: 120 VAC
Remarks:			

Table 7.4.2 Conducted emission test results

LINE: AC mains
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*		
0.150500	48.31	44.30	65.98	-21.68	27.82	55.98	-28.16	L1	Pass
0.293175	43.55	41.14	60.48	-19.34	33.27	50.48	-17.21		
0.647055	38.43	34.42	56.00	-21.58	28.32	46.00	-17.68		
1.020000	42.09	38.70	56.00	-17.30	26.18	46.00	-19.82		
1.452964	40.61	36.87	56.00	-19.13	30.66	46.00	-15.34		
1.970000	49.76	43.89	56.00	-12.11	27.95	46.00	-18.05		
0.162500	45.00	40.13	65.39	-25.26	19.26	55.39	-36.13	L2	Pass
0.290000	43.94	39.81	60.58	-20.77	31.11	50.58	-19.47		
1.030000	42.51	39.14	56.00	-16.86	26.24	46.00	-19.76		
1.456475	41.48	37.58	56.00	-18.42	31.33	46.00	-14.67		
1.967500	48.54	44.13	56.00	-11.87	29.04	46.00	-16.96		
5.564750	40.25	38.41	60.00	-21.59	36.35	50.00	-13.65		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

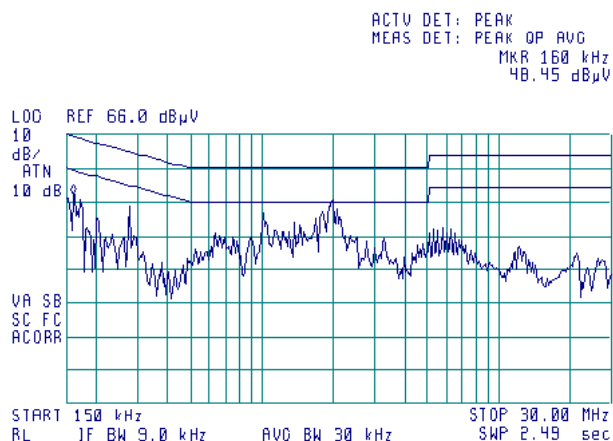
HL 0521	HL0787	HL 1500	HL 2888				
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Full description is given in Appendix A.

Test specification:		FCC Part 15, Section 207 / RSS-Gen, Section 7.2.2, Conducted emission	
Test procedure:		ANSI C63.4, Section 13.1.3	
Test mode:		Compliance	Verdict: PASS
Date & Time:		11/30/2008 8:42:37 AM	
Temperature: 24°C	Air Pressure: 1011 hPa	Relative Humidity: 48%	Power Supply: 120 VAC
Remarks:			

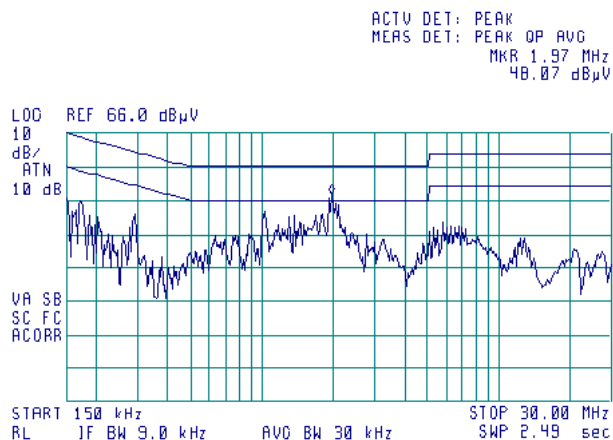
Plot 7.4.1 Conducted emission measurements

LINE: L1
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK
Operation Transmit mode



Plot 7.4.2 Conducted emission measurements

LINE: L2
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK
Operation Transmit mode



Test specification:	FCC Part 15, Section 107 / RSS-Gen, Section 7.1.6 / ICES-003, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 4:11:01 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

8 Unintentional emissions

8.1 Conducted emissions

8.1.1 General

This test was performed to measure the common mode conducted emissions at the EUT power port. The specification test limits are given in Table 8.1.1.

Table 8.1.1 Limits for conducted emissions according to FCC Part 15, Section 107 and ICES-003, Section 5

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

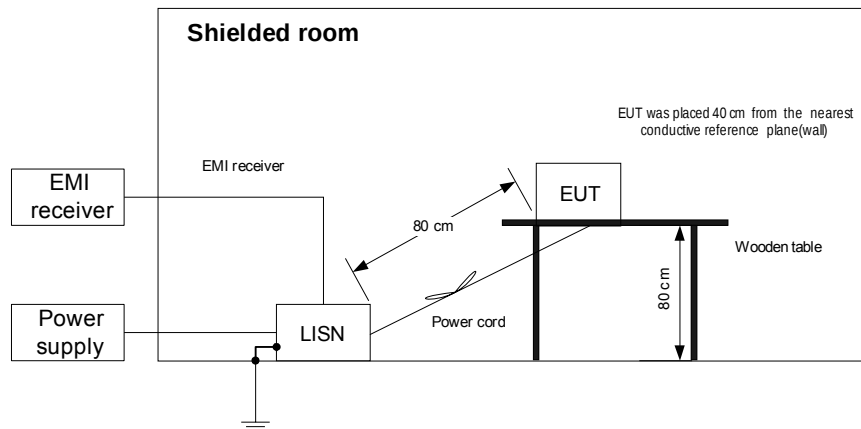
* - The limit decreases linearly with the logarithm of frequency.

8.1.2 Test procedure

- 8.1.2.1** The EUT was set up as shown in Figure 8.1.1 and the associated photographs, energized and the EUT performance was checked.
- 8.1.2.2** The measurements were performed at the EUT power terminals with the LISN connected to the EMI receiver in the frequency range referred to in Table 8.1.2. The unused coaxial connector of the LISN was terminated with 50 Ohm.
- 8.1.2.3** The position of the EUT cables was varied to find the highest emission.
- 8.1.2.4** The worst test results with respect to the limits were recorded in Table 8.1.2 and shown in the associated plots.

Test specification:	FCC Part 15, Section 107 / RSS-Gen, Section 7.1.6 / ICES-003, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 4:11:01 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

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



Photograph 8.1.1 Setup for conducted emission measurements



Test specification:	FCC Part 15, Section 107 / RSS-Gen, Section 7.1.6 / ICES-003, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 4:11:01 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Table 8.1.2 Conducted emission test results

LINE: AC mains
 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*		
0.150500	48.31	44.30	65.98	-21.68	27.82	55.98	-28.16	L1	Pass
0.293175	43.55	41.14	60.48	-19.34	33.27	50.48	-17.21		
0.647055	38.43	34.42	56.00	-21.58	28.32	46.00	-17.68		
1.020000	42.09	38.70	56.00	-17.30	26.18	46.00	-19.82		
1.452964	40.61	36.87	56.00	-19.13	30.66	46.00	-15.34		
1.970000	49.76	43.89	56.00	-12.11	27.95	46.00	-18.05		
0.162500	45.00	40.13	65.39	-25.26	19.26	55.39	-36.13	L2	Pass
0.290000	43.94	39.81	60.58	-20.77	31.11	50.58	-19.47		
1.030000	42.51	39.14	56.00	-16.86	26.24	46.00	-19.76		
1.456475	41.48	37.58	56.00	-18.42	31.33	46.00	-14.67		
1.967500	48.54	44.13	56.00	-11.87	29.04	46.00	-16.96		
5.564750	40.25	38.41	60.00	-21.59	36.35	50.00	-13.65		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

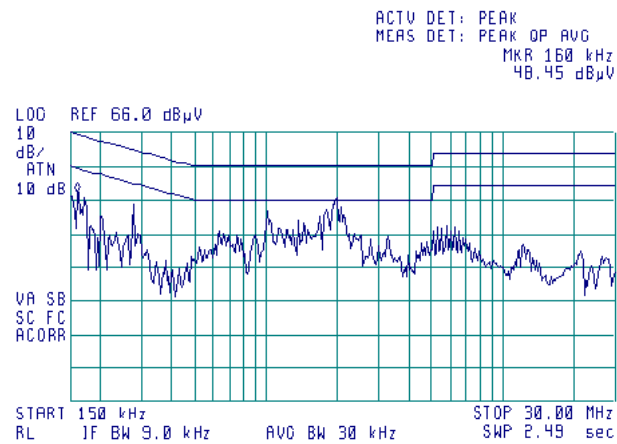
HL 0787	HL 1500	HL 2888					
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Full description is given in Appendix A.

Test specification:	FCC Part 15, Section 107 / RSS-Gen, Section 7.1.6 / ICES-003, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	11/27/2008 4:11:01 PM		
Temperature: 25°C	Air Pressure: 1015 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

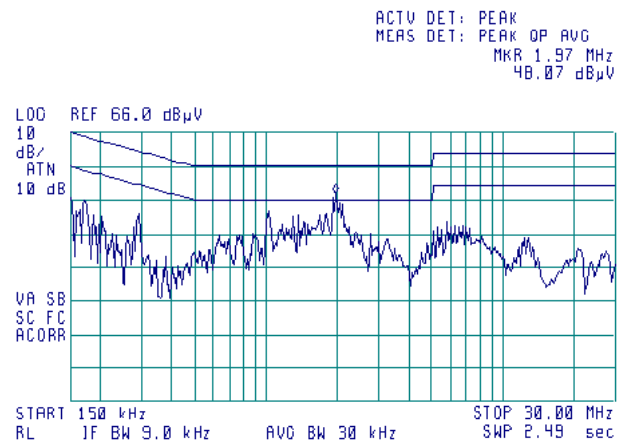
Plot 8.1.1 Conducted emission measurements

LINE: L1
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK
Operation ARM mode



Plot 8.1.2 Conducted emission measurements

LINE: L2
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK
Operation ARM mode



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	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 according to FCC Part 15, Section 109 are given in Table 8.2.1, according to ICES-003, Section 5 in Table 8.2.2 and according to RSS-Gen, Section 7.2.3.2 in Table 8.2.3.

Table 8.2.1 Radiated emission limits according to FCC Part 15, Section 109

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*
960 - 5 th harmonic**	43.5*	54.0	49.5	60.0*

Table 8.2.2 Radiated emission limits according to ICES-003, Section 5

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 - 230	30	40.5*	40	50.5*
230 - 1000	37	47.5*	47	57.5*

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

Table 8.2.3 Radiated emission limits according to RSS-Gen, Section 7.2.3.2

Frequency, MHz	Field strength limit at 3 m test distance, dB(μV/m)
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 - 3 rd harmonic**	54.0

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

Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

8.2.2 Test procedure for measurements in semi-anechoic chamber

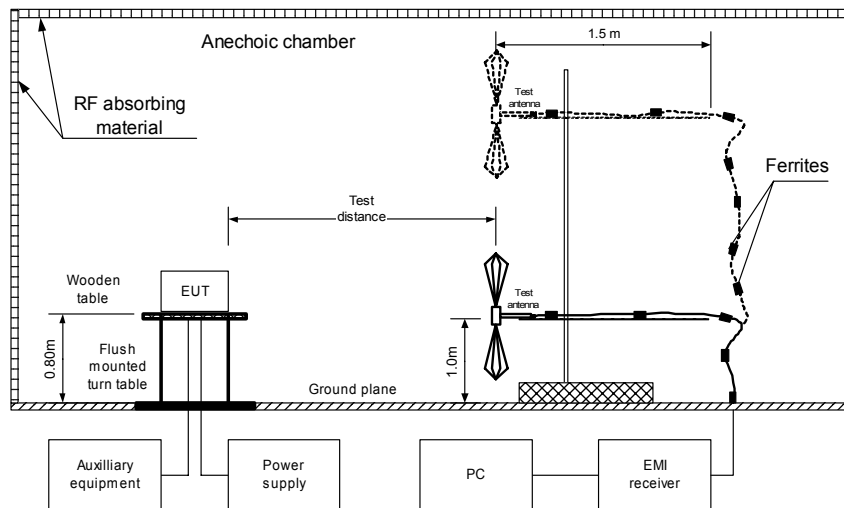
- 8.2.2.1** The EUT was set up as shown in Figure 8.2.1 and associated photograph/s, energized and the performance check was conducted.
- 8.2.2.2** The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, 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 provided in the associated tables and plots.

8.2.3 Test procedure for measurements at OATS

- 8.2.3.1** The EUT was set up as shown in Figure 8.2.1 and associated photograph/s, energized and the performance check was conducted.
- 8.2.3.2** Preliminary measurements were performed in the anechoic chamber at 3 m test distance. The specified frequency range was investigated with biconical and log periodic antennas connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed, its polarization was switched from vertical to horizontal and the EUT cables position was varied.
- 8.2.3.3** The EUT was set up as shown in Figure 8.2.2, energized and the performance check was conducted.
- 8.2.3.4** Final measurements were performed at the open area test site at 10 m test distance. The EUT wires and cables were arranged to produce maximum emission as it was found during preliminary measurements. The frequencies yield the worst test results (the lowest margins) during preliminary testing were investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m and its polarization was changed from vertical to horizontal. At frequencies where high ambient noise was encountered, the final measurements were taken in the anechoic chamber at 3 m distance.
- 8.2.3.5** The worst test results (the lowest margins) were provided in the associated tables and plots.

Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

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

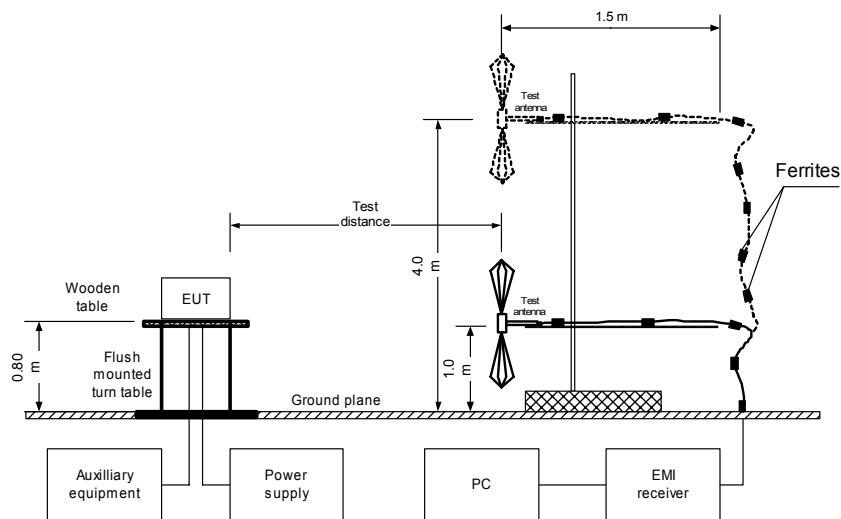


Photograph 8.2.1 Setup for preliminary radiated emission measurements



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

Figure 8.2.2 Setup for radiated emission measurements at OATS, table-top equipment



Photograph 8.2.2 Setup for final radiated emission measurements, general view



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

Photograph 8.2.3 Setup for final radiated emission measurements, EUT cabling



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

Table 8.2.4 Radiated emission test results according to FCC Part 15, Section 109

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Stand-by and Receive
TEST SITE: OATS
TEST DISTANCE: 3 m
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*				
74.607500	24.72	17.46	29.50	-12.04	Hor	1.2	340	Pass
76.046750	23.68	14.95	29.50	-14.55	Vert	1.2	301	
77.054250	22.86	11.77	29.50	-17.73	Vert	1.2	291	
77.054250	25.23	12.44	29.50	-17.06	Hor	1.2	277	
81.008500	29.88	17.50	29.50	-12.00	Vert	1.2	355	
82.475000	27.74	15.87	29.50	-13.63	Vert	1.2	5	
111.602500	19.02	11.25	29.50	-18.25	Hor	1.2	26	

TEST SITE: OATS
TEST DISTANCE: 3 m
FREQUENCY RANGE: 1000 MHz – 10000 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak emission, dB(μV/m)	Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
2010.6375	49.74	41.62	54.0	-14.0	Hor	1.0	0	Pass
5033.7875	53.31	48.97	54.0	-8.21	Vert	1.2	197	

Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

Table 8.2.5 Radiated emission test results according to ICES-003, Section 5

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Stand-by
TEST SITE: OATS
TEST DISTANCE: 10 m
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*				
74.607500	24.72	17.46	30.0	-12.54	Hor	1.2	340	Pass
76.046750	23.68	14.95	30.0	-15.05	Vert	1.2	301	
77.054250	22.86	11.77	30.0	-18.23	Vert	1.2	291	
77.054250	25.23	12.44	30.0	-17.56	Hor	1.2	277	
81.008500	29.88	17.50	30.0	-12.50	Vert	1.2	355	
82.475000	27.74	15.87	30.0	-14.13	Vert	1.2	5	
111.602500	19.02	11.25	30.0	-18.75	Hor	1.2	26	

*- Margin = Measured emission - specification limit.

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

Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

Table 8.2.6 Radiated emission test results according to RSS-Gen, Section 7.2.3.2

EUT SET UP: TABLE-TOP
EUT OPERATING MODE: Receive
TEST SITE: OATS
TEST DISTANCE: 10 m
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*				
74.607500	24.72	17.46	29.50	-12.04	Hor	1.2	340	Pass
76.046750	23.68	14.95	29.50	-14.55	Vert	1.2	301	
77.054250	22.86	11.77	29.50	-17.73	Vert	1.2	291	
77.054250	25.23	12.44	29.50	-17.06	Hor	1.2	277	
81.008500	29.88	17.50	29.50	-12.00	Vert	1.2	355	
82.475000	27.74	15.87	29.50	-13.63	Vert	1.2	5	
111.602500	19.02	11.25	29.50	-18.25	Hor	1.2	26	

TEST SITE: OATS
TEST DISTANCE: 3 m
FREQUENCY RANGE: 1000 MHz – 6000 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak emission, dB(μV/m)	Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
2010.6375	49.74	41.62	54.0	-14.0	Hor	1.0	0	Pass
5033.7875	53.31	48.97	54.0	-8.21	Vert	1.2	197	

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

HL 0032	HL 0034	HL 0415	HL 0521	HL 0554	HL 0604	HL 0784	HL 0812
HL 0813	HL 1552	HL 2432	HL 2911	HL 2909			

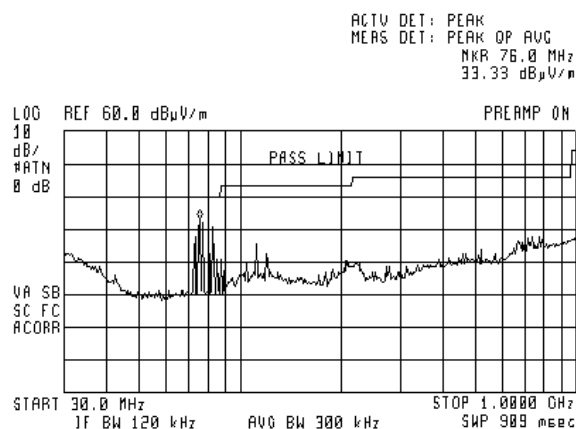
Full description is given in Appendix A.

Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

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

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

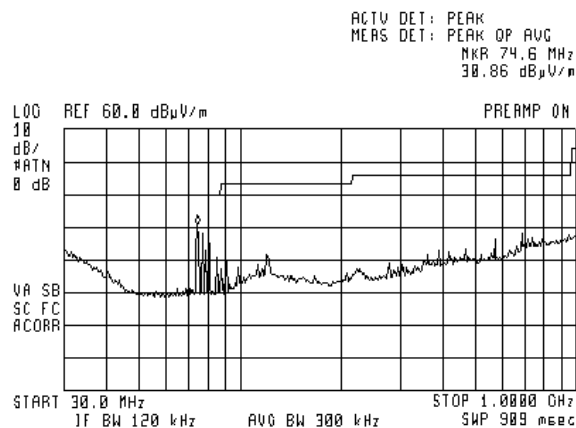
(42)



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

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

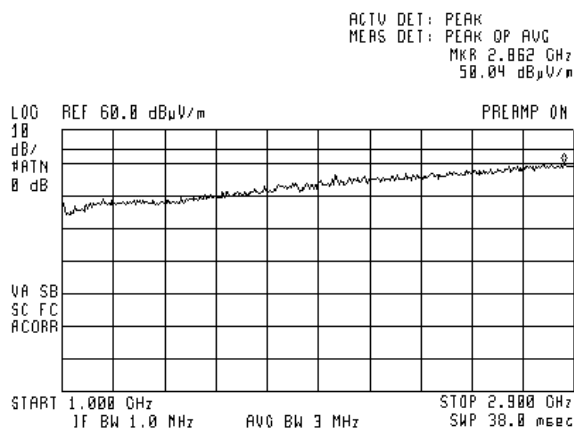
(42)



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

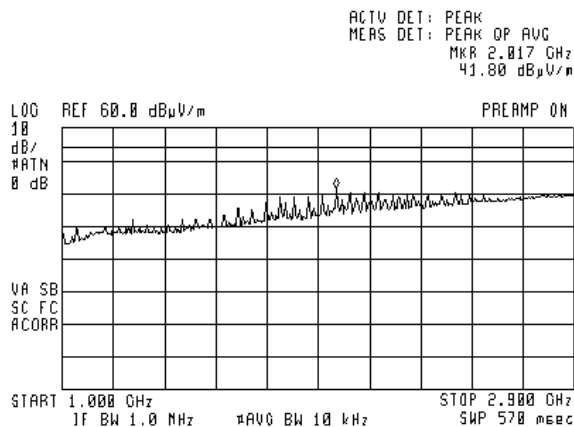
Plot 8.2.3 Radiated emission measurements in 1000 - 2900 MHz, vertical antenna polarization

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



Plot 8.2.4 Radiated emission measurements in 1000 - 2900 MHz, vertical antenna polarization

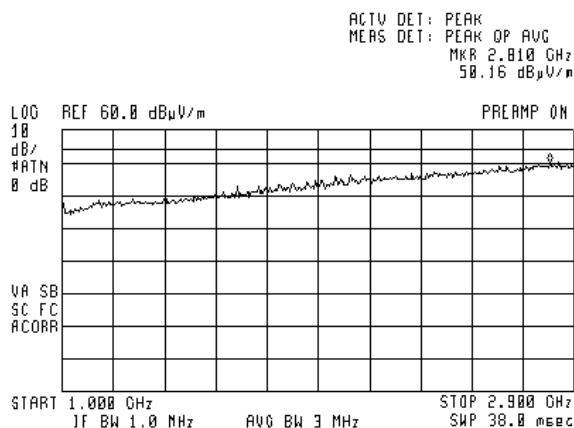
TEST SITE: Anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by
DETECTOR: Average



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

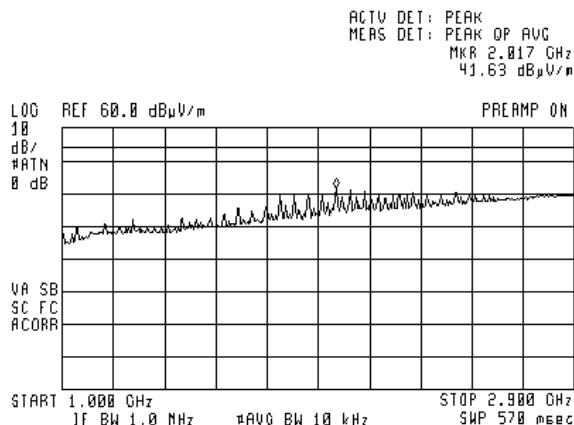
Plot 8.2.5 Radiated emission measurements in 1000 - 2900 MHz, horizontal antenna polarization

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



Plot 8.2.6 Radiated emission measurements in 1000 - 2900 MHz, horizontal antenna polarization

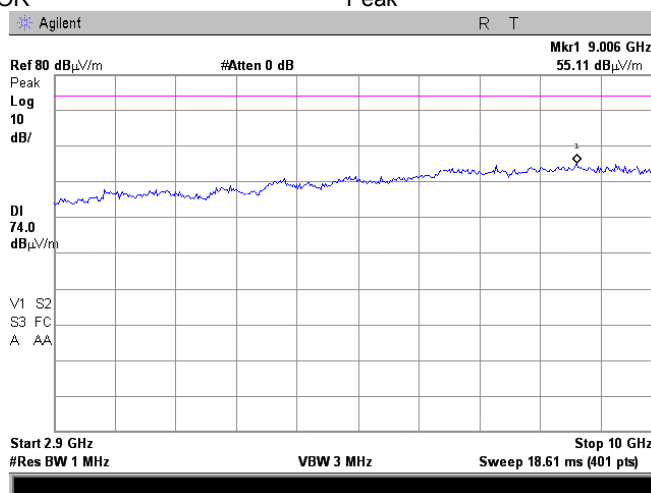
TEST SITE: Anechoic chamber
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
TEST DISTANCE: 3 m
DETECTOR: Average



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

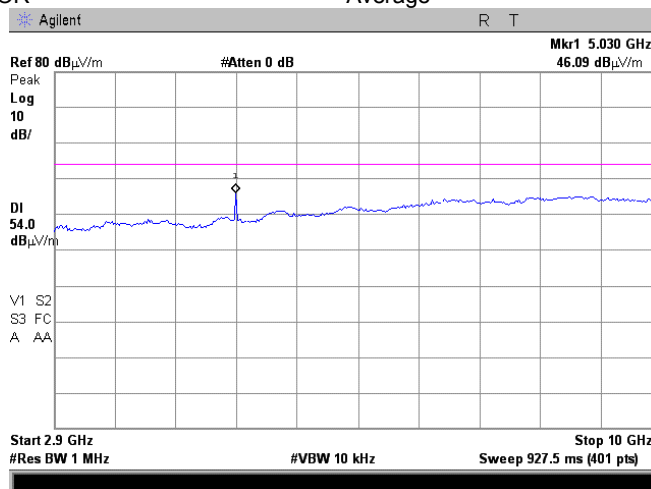
Plot 8.2.7 Radiated emission measurements in 2.9 - 10 GHz, vertical antenna polarization

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



Plot 8.2.8 Radiated emission measurements in 2.9 - 10 GHz, vertical antenna polarization

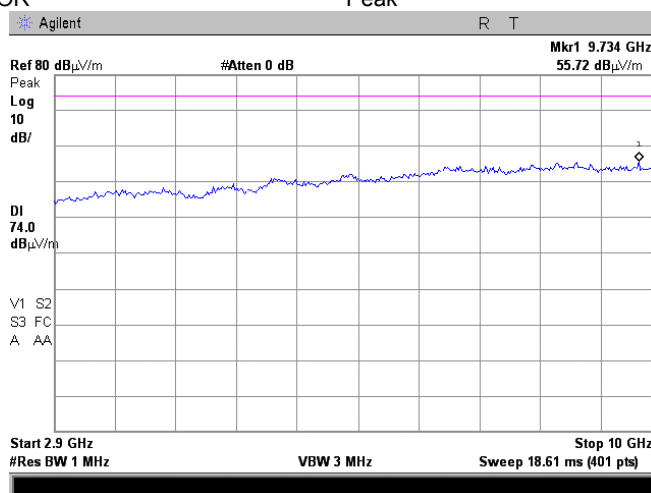
TEST SITE: Anechoic chamber
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
TEST DISTANCE: 3 m
DETECTOR: Average



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.2.3 / ICES-003, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / RSS-Gen, Section 4.10 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/23/2008 5:46:16 PM		
Temperature: 25°C	Air Pressure: 1009 hPa	Relative Humidity: 46 %	Power Supply: 120 VAC
Remarks:			

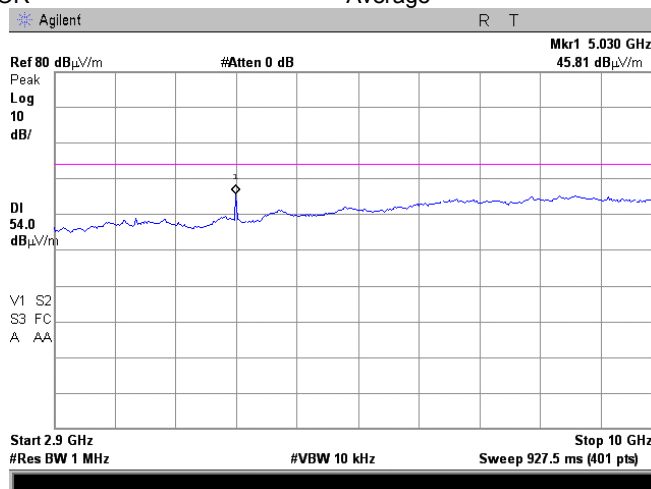
Plot 8.2.9 Radiated emission measurements in 2.9 - 10 GHz, horizontal antenna polarization

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



Plot 8.2.10 Radiated emission measurements in 2.9 - 10 GHz, horizontal antenna polarization

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



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0032	Antenna, Biconical, 20 - 200 MHz	Electro-Metrics	BIA 25/30	3577	25-Sep-07	25-Sep-09
0034	Antenna, Log Periodic, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	1988	25-Sep-07	25-Sep-09
0415	Cable, Coax, RF, RG-214	Hermon Laboratories	CC-3	056	02-Dec-08	02-Dec-09
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	29-Jun-08	29-Jun-09
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard Co	8546A	3617A 00319, 3448A002 53	29-Aug-08	29-Aug-09
0554	Amplifier, 2-18 GHz RF	Miteq	AFD4	104300	28-Feb-08	28-Feb-09
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	10-Jan-08	10-Jan-09
0784	Antenna X-WING BILOG, 20 MHz - 2 GHz	Schaffner-Chase EMC	CBL6140 A	1120	10-Jan-08	10-Jan-09
0812	Cable Coax, RG-214, 11.5 m, N-type connectors	Hermon Laboratories	C214-11	148	02-Dec-08	02-Dec-09
0813	Cable Coax, RG-214, 12 m, N-type connectors	Hermon Laboratories	C214-12	149	02-Dec-08	02-Dec-09
1003	Cable Coaxial, M17/164, 10 m	Hermon Laboratories	C17164-10	161	04-Sep-08	04-Sep-09
1425	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427	Agilent Technologies	8542E	3710A002 22, 3705A002 04	03-Sep-08	03-Sep-09
1552	Cable RF, 8 m	Alpha Wire	RG-214	1552	02-Dec-08	02-Dec-09
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	03-Mar-08	03-Mar-09
2697	Antenna, 30 MHz - 3.0 GHz	Sunol Sciences. Corp. Pleasanton, California USA	JB3	A022805	10-Jan-08	10-Jan-09
2882	Cable, 18 GHz N-type, M-F, 3 m	Bird	TC-MNFN-3.0	211539 001	11-Feb-08	11-Feb-09
2888	LISN Two-line V-Network 50 Ohm / 50 uH + 5 Ohm, 16A, MIL STD 461E, CISPR 16-1	Rolf Heine	NNB-2/16Z	02/10018	09-Jul-08	09-Jul-09
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	07-May-07	07-May-09
2911	Cable 18 GHz, 1.5 m, SMA-SMA	Gore	NA	89386	05-Oct-08	05-Oct-09
3119	Cable, 18 GHz N-type, M-F, 3 m	Bird	TC-MNFN-3.0	211539004	07-Dec-08	07-Dec-09
3132	Data Logger Hydra	Fluke	2625A	5834602	12-Mar-08	12-Mar-09

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 10 m measuring distance Horizontal polarization Vertical polarization	Biconilog antenna: ± 5.0 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.1 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 5.5 dB Biconical antenna: ± 5.5 dB Log periodic antenna: ± 5.6 dB Double ridged horn antenna: ± 5.8 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
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
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Occupied bandwidth	± 8.0 %

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

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

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

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 2186A-1 for OATS and IC 2186A-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, telecommunications, environmental, safety standards, and by AMTAC (UK) for safety of medical devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01).

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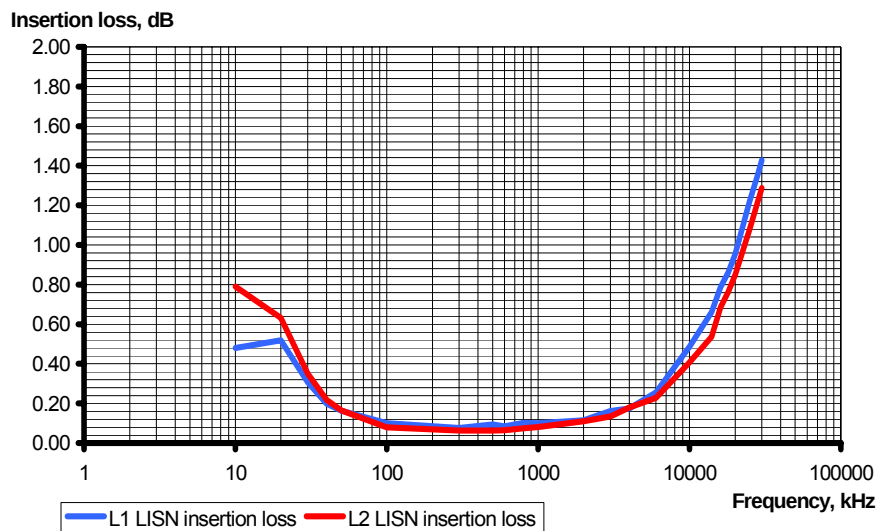
12 APPENDIX D Specification references

47CFR part 15: 2007	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.
RSS-210 Issue 7: 2007	Low Power Licence- Exempt Radiocommunication Devices
RSS-Gen Issue 2, September 2007	General Requirements and Information for the certification of Radiocommunication Equipment
ICES-003 Issue 4: 2004	Digital Apparatus
CAN/CSA-CEI/IEC CISPR 22: 2002	Information Technology Equipment- Radio Disturbance Characteristics- Limits and Methods of measurement
CISPR 16-1-1: 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus

13 APPENDIX E Test equipment correction factors

Correction factor
Line impedance stabilization network
Model NNB-2/16Z, Rolf Heine, HL 2888

Frequency, kHz	Insertion loss, dB		Measurement Uncertainty, dB
	L1	N	
10	0.48	0.79	±0.6
20	0.52	0.63	
30	0.31	0.35	
40	0.20	0.22	
50	0.16	0.17	
100	0.10	0.08	
300	0.08	0.06	
500	0.10	0.06	
600	0.09	0.07	
800	0.10	0.07	
1000	0.10	0.08	
2000	0.12	0.11	
3000	0.16	0.14	
4000	0.17	0.18	
6000	0.26	0.23	
10000	0.49	0.41	
14000	0.66	0.54	
16000	0.79	0.69	
18000	0.86	0.76	
20000	0.96	0.85	
25000	1.22	1.08	
28000	1.35	1.21	
30000	1.43	1.29	



Antenna factor
Biconical antenna
Electro-Metrics, model BIA-25/30
Ser.No.3577, HL 0032

Frequency MHz	Antenna Factor dB(1/m)	Frequency MHz	Antenna Factor dB(1/m)
20	15.1	115	16.7
25	14.6	120	14.1
30	13.7	125	13.1
35	11.8	130	13.0
40	11.4	135	12.9
45	11.7	140	12.7
50	11.4	145	12.5
55	10.5	150	14.3
60	10.3	155	14.8
65	8.9	160	14.7
70	7.6	165	15.1
75	7.3	170	15.6
80	7.3	175	16.5
85	7.8	180	16.7
90	9.4	185	17.3
95	10.6	190	17.9
100	11.8	195	17.6
105	12.5	200	17.9
110	13.7		

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

Antenna factor
Log periodic antenna
Electro-Metrics, model LPA-25/30
Ser.No.1988, HL 0034

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

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

Antenna factor
Active loop antenna
Model 6502, S/N 2857, HL 0446

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

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

Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011, HL 0604

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

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

Antenna factor
Biconilog antenna
CHASE Model CBL6140A
Serial no: 1120, HL 0784

Frequency, MHz	Antenna factor, dB
30.0	4.3
35.0	7.3
40.0	8.8
45.0	9.3
50.0	9.6
60.0	9.9
70.0	9.2
80.0	7.6
90.0	7.6
100.0	8.8
120.0	7.2
125.0	7.5
140.0	7.7
150.0	7.9
160.0	11.4
175.0	8.6
180.0	8.8
200.0	9.8
250.0	12.5
300.0	12.2
350.0	14.8
400.0	16.1
450.0	16.5
500.0	17.6
550.0	18.3
600.0	18.5
650.0	19.8
700.0	20.1
750.0	20.8
800.0	21.2
850.0	22.0
900.0	22.2
950.0	23.2
1000.0	23.8

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

Antenna factor
Double-ridged guide horn antenna
Model 3115, serial number: 00027177, HL 2432

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

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

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

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

Cable loss
Cable RG-214, HL 0813

No.	Frequency, MHz	Cable loss, dB
1	10	0.15
2	20	0.40
3	30	0.51
4	40	0.61
5	50	0.68
6	60	0.76
7	70	0.80
8	80	0.92
9	90	0.96
10	100	0.99
11	200	1.60
12	300	1.85
13	400	2.25
14	500	2.43
15	600	2.80
16	700	3.14
17	800	3.34
18	900	3.75
19	1000	4.05
20	1200	4.41
21	1400	4.81
22	1600	5.18
23	1800	5.58
24	2000	6.09
25	2500	7.27
26	2900	8.01

Cable loss
Cable coaxial, M17/164, model: C17164-10, s/n 161, HL 1003

No.	Frequency, MHz	Cable loss, dB	Tolerance, dB	Measurement uncertainty, dB
1	30	0.41	≤ 12.5	±0.12
2	50	0.52		
3	100	0.75		
4	300	1.45		
5	500	2.01		
6	800	2.71		
7	1000	3.14		
8	1200	3.56		
9	1400	3.93		
10	1600	4.31		
11	1800	4.63		
12	2000	4.97		
13	2200	5.32		
14	2400	5.65		
15	2600	6.01	≤ 12.5	±0.12
16	2800	6.42		
17	3000	6.76		
18	3300	7.12		
19	3600	7.53		±0.17
20	3900	7.95		
21	4200	8.32		
22	4500	8.72		
23	4800	9.14		
24	5100	9.59		
25	5400	10.00		
26	5700	10.49		
27	6000	11.07		
28	6500	11.80		

Cable loss
RF cable 8 m, model RG-214, HL 1552

No.	Frequency, MHz	Cable loss, dB	Measurement uncertainty, dB	Notes
1	0.010	0.01	±0.05	
2	0.1	0.01		
3	1	0.03		
4	10	0.12		
5	20	0.23		
6	30	0.30		
7	40	0.32		
8	50	0.34		
9	60	0.39		
10	70	0.43		
11	80	0.48		
12	90	0.50		
13	100	0.55		
14	200	0.78		
15	300	1.04		
16	400	1.16		
17	500	1.33		
18	600	1.51		
19	700	1.65		
20	800	1.77		
21	900	1.92		
22	1000	2.04		
23	1200	2.26		
24	1400	2.49		
25	1600	2.74		
26	1800	2.94		
27	2000	3.18		
28	2500	3.65		
29	2900	4.08		

Cable loss
Cable coaxial, Bird, 18 GHz, N-type, M-F, model TC-MNFN-3.0, S/N 211539 001
HL 2882

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.08	5750	1.78	12000	2.57
30	0.12	6000	1.84	12250	2.62
100	0.22	6250	1.87	12500	2.66
250	0.35	6500	1.92	12750	2.68
500	0.49	6750	1.96	13000	2.67
750	0.60	7000	2.01	13250	2.75
1000	0.68	7250	2.08	13500	2.77
1250	0.78	7500	2.12	13750	2.90
1500	0.85	7750	2.19	14000	3.00
1750	0.92	8000	2.22	14250	3.12
2000	0.98	8250	2.28	14500	2.98
2250	1.06	8500	2.29	14750	3.03
2500	1.11	8750	2.27	15000	2.99
2750	1.19	9000	2.28	15250	2.99
3000	1.25	9250	2.26	15500	2.98
3250	1.30	9500	2.29	15750	2.98
3500	1.34	9750	2.33	16000	2.99
3750	1.40	10000	2.34	16250	3.05
4000	1.45	10250	2.41	16500	3.11
4250	1.51	10500	2.46	16750	3.18
4500	1.54	10750	2.48	17000	3.23
4750	1.59	11000	2.48	17250	3.21
5000	1.63	11250	2.52	17500	3.22
5250	1.68	11500	2.53	17750	3.22
5500	1.72	11750	2.56	18000	3.25

Cable loss
Cable coaxial, Gore, 18 GHz, 1.5 m, SMA-SMA, S/N 89386
HL 2911

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.06	5750	1.32	12000	2.04
30	0.09	6000	1.34	12250	2.04
100	0.16	6250	1.41	12500	2.07
250	0.27	6500	1.43	12750	1.96
500	0.38	6750	1.46	13000	1.97
750	0.49	7000	1.49	13250	2.01
1000	0.55	7250	1.52	13500	2.04
1250	0.62	7500	1.56	13750	2.12
1500	0.68	7750	1.66	14000	2.16
1750	0.74	8000	1.69	14250	2.16
2000	0.78	8250	1.78	14500	2.28
2250	0.83	8500	1.73	14750	2.26
2500	0.88	8750	1.71	15000	2.22
2750	0.97	9000	1.72	15250	2.34
3000	1.00	9250	1.74	15500	2.41
3250	1.03	9500	1.76	15750	2.45
3500	1.05	9750	1.80	16000	2.57
3750	1.09	10000	1.89	16250	2.54
4000	1.14	10250	1.94	16500	2.55
4250	1.17	10500	1.99	16750	2.52
4500	1.21	10750	1.92	17000	2.42
4750	1.22	11000	1.96	17250	2.49
5000	1.24	11250	1.97	17500	2.62
5250	1.28	11500	2.02	17750	2.70
5500	1.30	11750	2.07	18000	2.76

Cable loss
Cable 18 GHz, N-type, M-F, 3 m, Bird Electronic Corp., model TC-MNFN-3.0, S/N 211539004
HL 3119

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.06	3600	1.34	7400	2.00	11200	2.48	15100	2.90
30	0.09	3700	1.36	7500	2.01	11300	2.45	15200	2.89
50	0.11	3800	1.37	7600	2.03	11400	2.51	15300	2.91
100	0.23	3900	1.39	7700	2.05	11500	2.45	15400	2.85
200	0.30	4000	1.39	7800	2.07	11600	2.49	15500	2.83
300	0.42	4100	1.42	7900	2.06	11700	2.51	15600	2.89
400	0.39	4200	1.45	8000	2.06	11800	2.50	15700	2.85
500	0.47	4300	1.47	8100	2.09	11900	2.52	15800	2.87
600	0.49	4400	1.49	8200	2.10	12000	2.48	15900	2.91
700	0.63	4500	1.51	8300	2.11	12100	2.53	16000	2.90
800	0.62	4600	1.53	8400	2.15	12200	2.54	16100	2.94
900	0.70	4700	1.55	8500	2.15	12300	2.56	16200	2.91
1000	0.70	4800	1.54	8600	2.17	12400	2.57	16300	2.96
1100	0.77	4900	1.57	8700	2.19	12500	2.57	16400	3.01
1200	0.78	5000	1.60	8800	2.20	12600	2.55	16500	3.01
1300	0.83	5100	1.60	8900	2.21	12700	2.50	16600	2.98
1400	0.86	5200	1.62	9000	2.22	12800	2.57	16700	3.00
1500	0.85	5300	1.65	9100	2.23	12900	2.57	16800	3.01
1600	0.94	5400	1.66	9200	2.25	13000	2.55	16900	3.06
1700	0.90	5500	1.69	9300	2.24	13100	2.62	17000	3.07
1800	0.90	5600	1.70	9400	2.28	13200	2.60	17100	3.09
1900	0.95	5700	1.72	9500	2.28	13300	2.67	17200	3.10
2000	0.97	5800	1.74	9600	2.27	13400	2.66	17300	3.11
2100	1.00	5900	1.75	9700	2.30	13500	2.71	17400	3.16
2200	1.02	6000	1.77	9800	2.30	13600	2.73	17500	3.15
2300	1.05	6100	1.79	9900	2.34	13700	2.73	17600	3.21
2400	1.08	6200	1.82	10000	2.32	13800	2.85	17700	3.21
2500	1.10	6300	1.83	10100	2.31	13900	2.83	17800	3.18
2600	1.13	6400	1.83	10200	2.31	14000	2.83	17900	3.25
2700	1.15	6500	1.87	10300	2.26	14100	2.83	18000	3.14
2800	1.17	6600	1.88	10400	2.32	14200	2.84		
2900	1.21	6700	1.90	10500	2.26	14300	2.90		
3000	1.22	6800	1.93	10600	2.26	14400	2.84		
3100	1.25	6900	1.92	10700	2.31	14600	2.88		
3200	1.27	7000	1.95	10800	2.24	14700	2.85		
3300	1.29	7100	1.96	10900	2.39	14800	2.92		
3400	1.28	7200	1.99	11000	2.41	14900	2.93		
3500	1.31	7300	2.00	11100	2.46	15000	2.83		

14 APPENDIX F 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(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	decibel referred to one microampere
dB Ω	decibel referred to one Ohm
DC	direct current
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
μ s	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	Ohm
PCB	printed circuit board
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
VA	volt-ampere
WB	wideband

END OF DOCUMENT