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Electrical

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TEST REPORT

ACCORDING TO: FCC CFR 47 PART 15 subpart C, section 15.231 and subpart B

FOR:

Electronics Line 3000 Ltd.

Wireless repeater

Model: EL2635

Report ID: ELERAD_FCC.16338.doc
Date of Issue: 3/15/2005

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1 Applicant information

Client name:	Electronics Line 3000 Ltd.
Address:	P.O.Box 3253, Amal street 58, Petah Tikva, Israel, 49130
Telephone:	+972 3921 1117
Fax:	+972 3921 2224
E-mail:	shaul@elecline.com
Contact name:	Mr. Shaul Aviezer

2 Equipment under test attributes

Product name:	Wireless repeater
Product type:	Transceiver
Model(s):	EL 2635
Receipt date	2/27/2005

3 Manufacturer information

Manufacturer name:	Electronics Line 3000 Ltd.
Address:	P.O.Box 3253, Amal street 58, Petah Tikva, Israel, 49130
Telephone:	+972 3921 1117
Fax:	+972 3921 2224
E-Mail:	shaul@elecline.com
Contact name:	Mr. Shaul Aviezer

4 Test details

Project ID:	16338
Location:	Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel
Test started:	2/27/2005
Test completed:	3/27/2005
Test specification(s):	FCC Part 15, subpart C, §15.231, §15.207; subpart B, §15.107, §15.109
Test suite:	FCC_15.231(a) (5/9/2004 8:40:20 PM, modified)

5 Tests summary

Test	Status
Transmitter characteristics	
Section 15.231(a), Periodic operation requirements	Pass
Section 15.231(b), Field strength of emissions	Pass
Section 15.231(c), Occupied bandwidth	Pass
Section 15.207(a), Conducted emission	Pass
Section 15.203, Antenna requirement	Pass
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	Not required

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mr. A. Adelberg, test engineer	March 27, 2005	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	March 27, 2005	
	Mr. M. Nikishin, EMC group leader	March 27, 2005	
Approved by:	Mr. A. Usoskin, C.E.O.	March 28, 2005	

6 EUT description

6.1 General information

The EL-2635 is a wireless repeater designed to extend the range of wireless devices of Electronics Line alarm system. The repeater is powered from mains via 120 VAC/9 VAC transformer or by 12 VDC with a 6V rechargeable backup battery pack.

6.2 Ports and lines

Port type	Port description	Connected		Connector type	Quantity	Cable type	Cable length
		From	To				
RF	antenna	EUT	antenna	SMA	1	NA	NA
Power	AC	EUT	transformer	Terminal block	1	Unshielded	1.5 m
Power	AC	transformer	mains	IEC 60320	1	Plug-in	NA

6.3 Support and test equipment

Description	Manufacturer	Model number	Part number
AC/AC transformer	Pittway	BE 30469001	1332

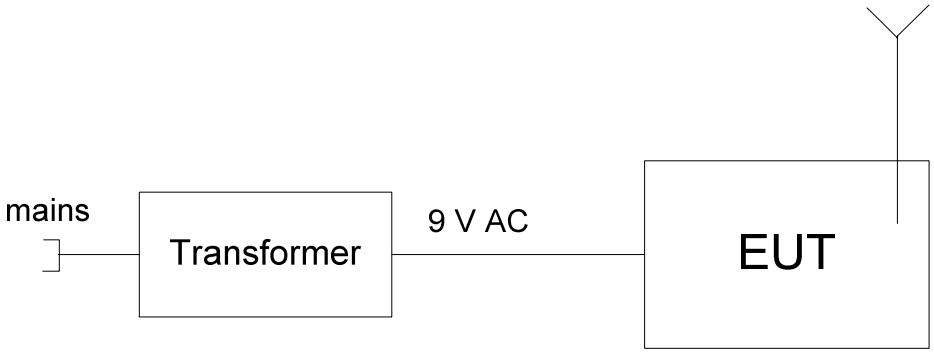
6.4 Operating frequencies

Source	Frequency, MHz	
Digital portion	crystal	8
Transmitter	LO	418

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**
X	fixed	Always at a distance more than 2 m from all people
	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	418 MHz
Operating frequency	418 MHz
RF channel spacing	NA

Maximum rated output power	At transmitter 50 Ω RF output connector	-16 dBm
	Effective radiated power (for equipment with no RF connector)	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	X	standard connector	integral	with temporary RF connector
				without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
¼ lambda	Electronics Line 3000 Ltd.	NA	0 dBi

Transmitter 99% power bandwidth	428 kHz				
Type of modulation	FSK				
Maximum transmitter duty cycle in normal use	%	**Tx ON time**	msec	**Period**	msec
Transmitter duty cycle supplied for test	100 %	**Tx ON time**	msec	**Period**	msec

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

Common power source for transmitter and receiver	yes

Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 2:47:28 PM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

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

7.1 Periodic operation requirements

7.1.1 General

The EUT was verified for compliance with periodic operation requirements listed below:

- Continuous transmissions such as voice, video and the radio control of toys are not permitted;
- A transmitter activated automatically shall cease transmission within 5 seconds after activation;
- Periodic transmissions, excluding polling or supervision transmissions, at regular predetermined intervals are not permitted;
- Polling or supervision transmissions, including data, to determine system integrity in security or safety applications shall not last longer than 2 seconds per hour.

The rationale for compliance with the above requirements was either test results or supplier declaration. The summary of results is provided in Table 7.1.1.

7.1.2 Test procedure for transmitter shut down test

7.1.2.1 The EUT was set up as shown in Figure 7.1.1.

7.1.2.2 The spectrum analyzer center frequency was adjusted to the EUT carrier, span set to zero and video triggered for transmission.

7.1.2.3 The transmitter was activated either manually or automatically. Once manually operated transmitter was activated, the switch was immediately released.

7.1.2.4 The transmission time was captured and shown in Plot 7.1.1.

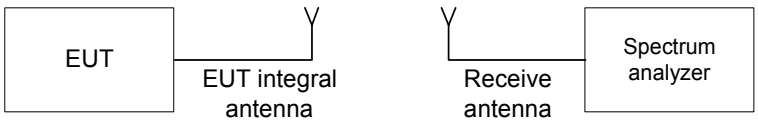
7.1.3 Test procedure for measurements of polling / supervision transmission duration

7.1.3.1 The EUT was set up as shown in Figure 7.1.1.

7.1.3.2 The spectrum analyzer center frequency was adjusted to the EUT carrier, span set to zero and video triggered for transmission.

7.1.3.3 The transmission time was captured and shown in Plot 7.1.2.

Figure 7.1.1 Setup for transmitter shut down test

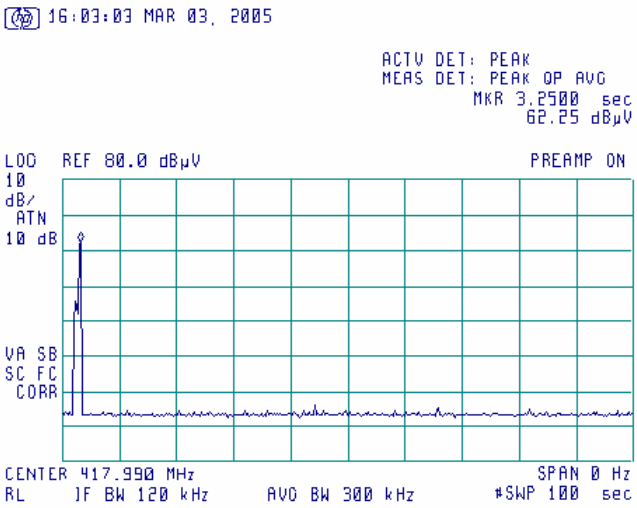


Test specification:	**Section 15.231(a), Periodic operation requirements**		
Test procedure:	Supplier declaration		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/13/2005 2:47:28 PM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 9 V AC
Remarks:			

Table 7.1.1 Periodic operation requirements

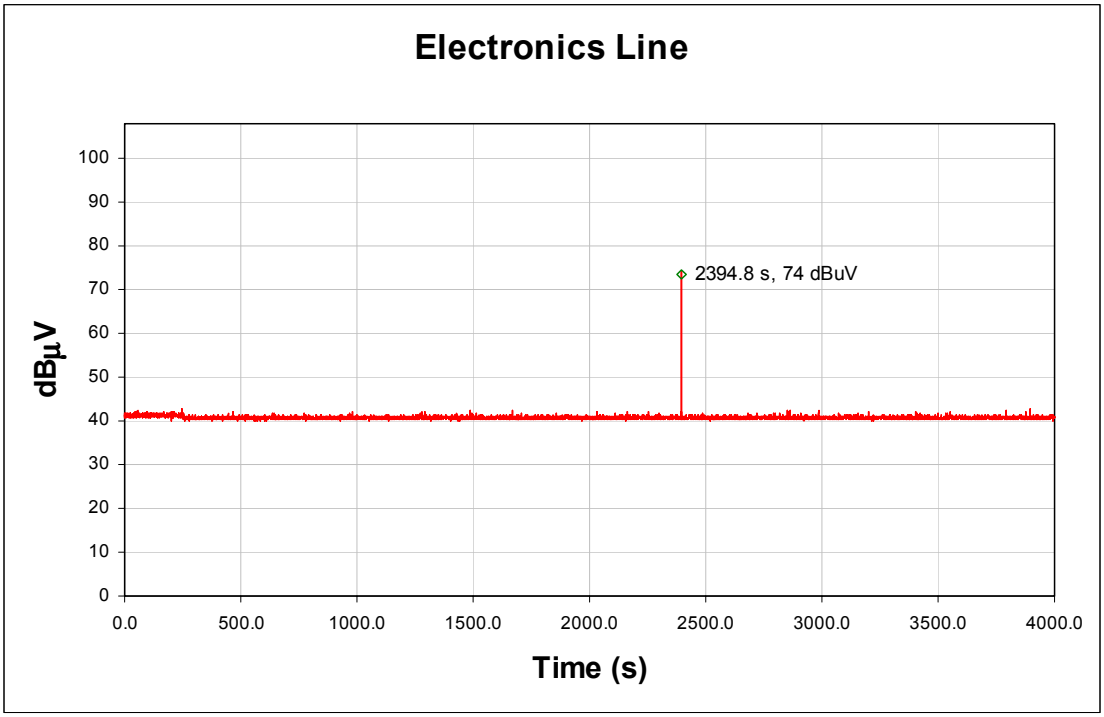
Requirement	Rationale	Verdict
Continuous transmissions are not permitted	Supplier declaration	Comply
A manually operated transmitter shall be deactivated within not more than 5 seconds of switch being released	NA	NA
Transmitter activated automatically shall cease transmission within 5 seconds	Plot 7.1.1	Comply
Periodic transmissions at regular predetermined intervals are not permitted	Supplier declaration	Comply
Total duration of polling or supervision transmissions shall not exceed 2 seconds per hour	Table 7.1.2	Comply

Plot 7.1.1 Transmitter shut down test result



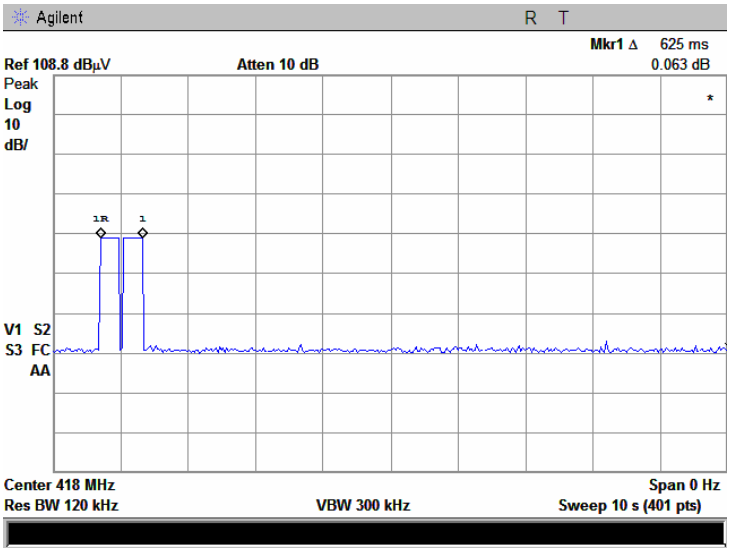
Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 2:47:28 PM		
Temperature: 19 °C	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

Plot 7.1.2 Polling / supervision transmission

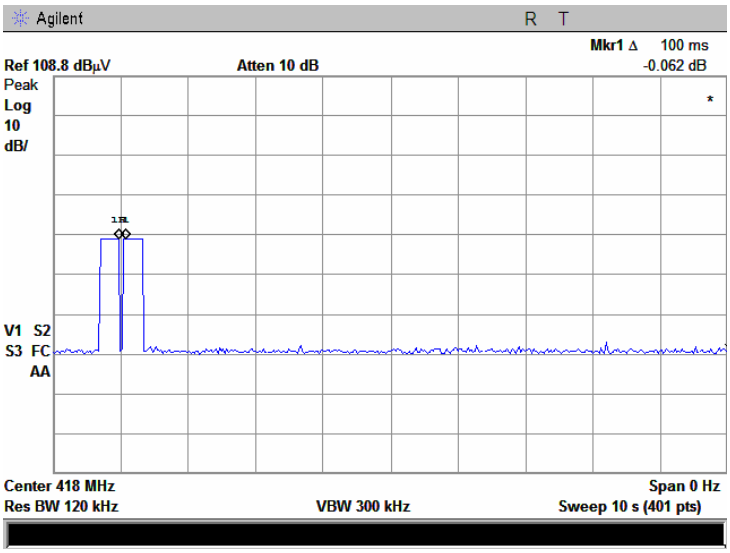


Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 2:47:28 PM		
Temperature: 19 °C	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

Plot 7.1.3 Polling / supervision transmission total duration



Plot 7.1.4 Polling / supervision transmission interruption duration



Test specification:	**Section 15.231(a), Periodic operation requirements**		
Test procedure:	Supplier declaration		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/13/2005 2:47:28 PM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 9 V AC
Remarks:			

Table 7.1.2 Total duration of polling / supervision transmissions

Duration, ms	Repetition period, ms	Maximum number of transmissions within 1 hour	Total duration within 1 hour, ms
525	NA	1	525

Test specification:	**Section 15.231(a), Periodic operation requirements**		
Test procedure:	Supplier declaration		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/13/2005 2:47:28 PM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 9 V AC
Remarks:			

7.2 Transmitter recognition test

7.2.1 General

This test was performed to verify the EUT repeats only recognized transmission and disregard transmission from unrecognized transmitter.

7.2.2 Test procedure for measurements

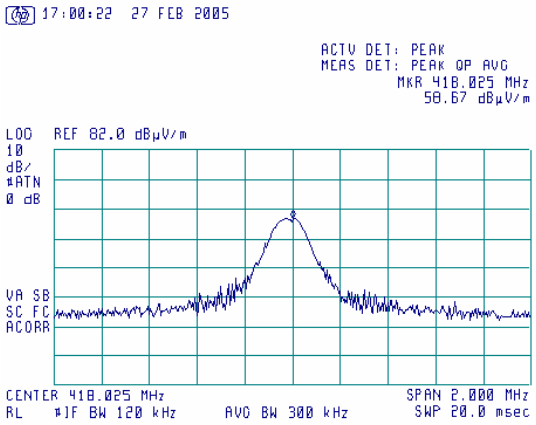
7.2.2.1 The EUT was set in normal operating mode and transmission from recognized transmitter was activated. Timing and frequency diagrams are provided in the associated plots.

7.2.2.2 Transmission from unrecognized transmitter was activated and it was verified that the EUT disregard unrecognized transmission. Timing and frequency diagrams are provided in the associated plots.

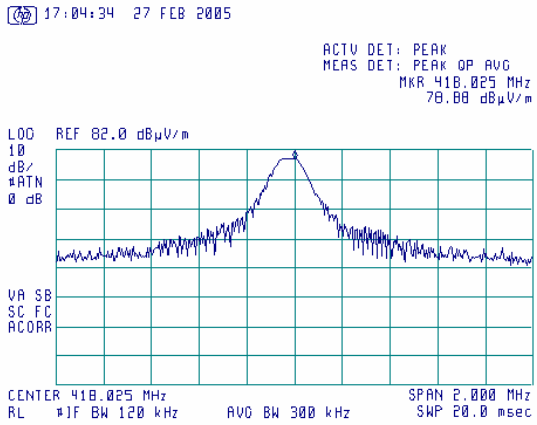
Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 2:47:28 PM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

Plot 7.2.1 Transmitter with recognized code test results, frequency domain

Transmitter emission

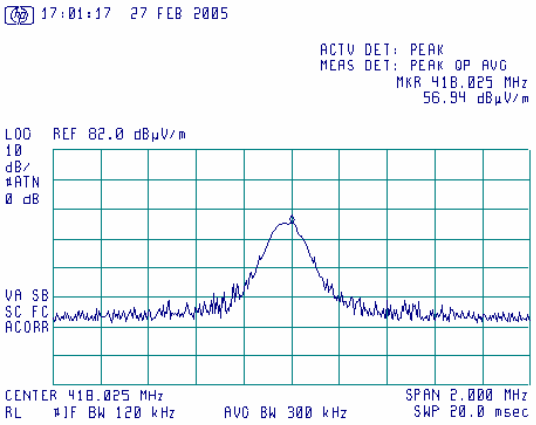


Repeater emission

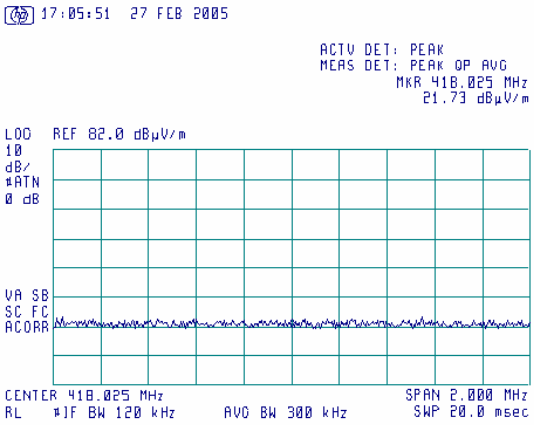


Plot 7.2.2 Transmitter with unrecognized code test results, frequency domain

Transmitter emission

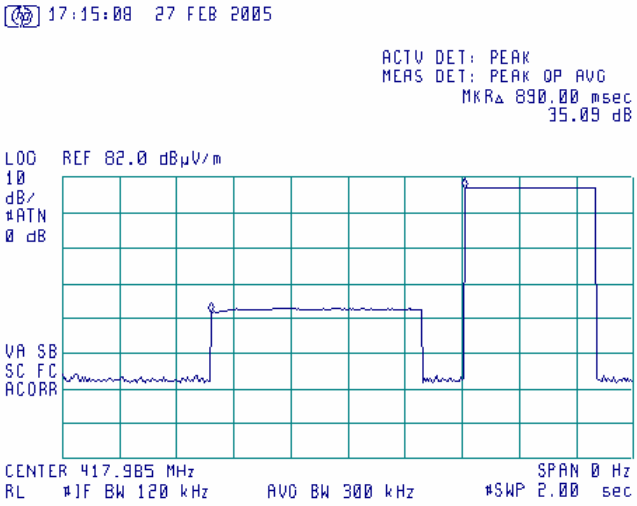


Repeater emission

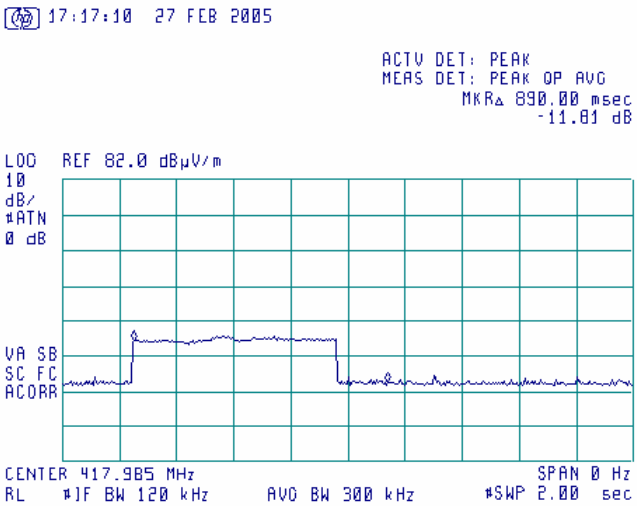


Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 2:47:28 PM		
Temperature: 19 °C	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

Plot 7.2.3 Transmitter with recognized code test results, time domain



Plot 7.2.4 Transmitter with unrecognized code test results, time domain



Reference numbers of test equipment used

HL 0521	HL 0589	HL 0604	HL 1430	HL 1653	HL 2009		

Full description is given in Appendix A.

Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

7.3 Field strength of emissions

7.3.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.3.1 and Table 7.3.2.

Table 7.3.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
418.0	100.3	80.3

Table 7.3.2 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 – 0.490*	NA	128.5 – 93.8**	NA	80.3	60.3
0.490 – 1.705*		73.8 – 63.0**			
1.705 – 30.0*		69.5**			
30 – 88		40.0			
88 – 216		43.5			
216 – 960		46.0			
960 – 1000		54.0			
Above 1000	74.0	NA	54.0		

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

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

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:

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

$$Lim_{AVR} = 20 \times \log(41.6667 \times F - 7083.3333)$$ - within 260 – 470 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:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

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

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and the performance check was conducted.

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

7.3.2.3 The worst test results (the lowest margins) were recorded in Table 7.3.3, Table 7.3.5 and shown in the associated plots.

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

7.3.3.1 The EUT was set up as shown in Figure 7.3.2, energized and the performance check was conducted.

7.3.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.3.3.3 The worst test results (the lowest margins) were recorded in Table 7.3.3, Table 7.3.5 and shown in the associated plots.

Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

Figure 7.3.1 Setup for spurious emission field strength measurements below 30 MHz

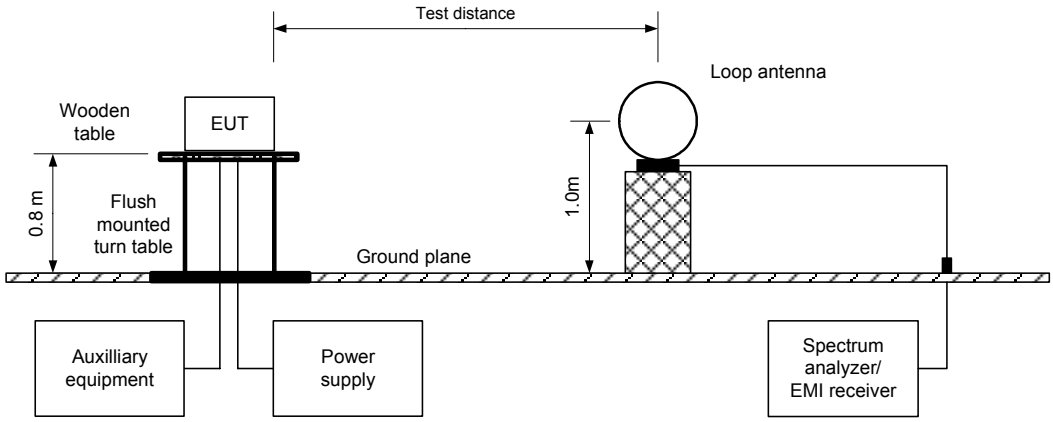
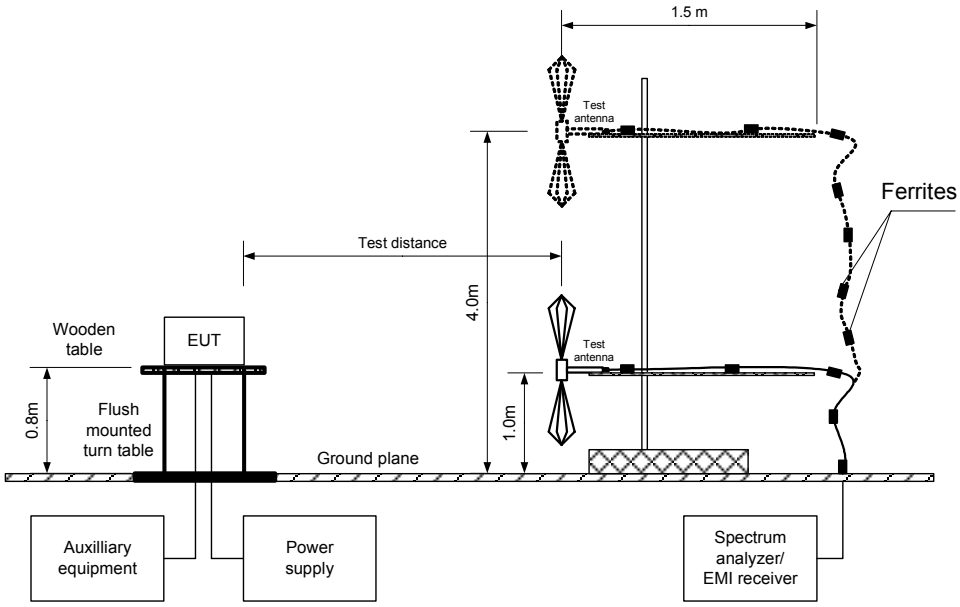


Figure 7.3.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 15.231(b), Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 9 V AC
Remarks:			

Table 7.3.3 Field strength of fundamental emission, spurious emissions outside restricted bands and within restricted bands at frequencies above 1 GHz

TEST DISTANCE:	3 m
EUT POZITION:	Typical (Vertical)
MODULATION:	FSK
MODULATING SIGNAL:	CW
BIT RATE:	NA
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 – 4200 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	0.2 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											
418.018	V	1.1	73	80.1	100.3	-20.2	0	80.1	80.3	-0.2	Pass
Spurious emissions											
All emissions were found 20 dB below the limit											Pass

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

Table 7.3.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
100%					0

Reference numbers of test equipment used

HL 0446	HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604
HL 1947	HL 2009	HL 2432					

Full description is given in Appendix A.

Test specification:	**Section 15.231(b), Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 9 V AC
Remarks:			

Table 7.3.5 Field strength of emissions below 1 GHz within restricted bands

TEST DISTANCE:	3 m
EUT POZITION:	Typical (Vertical)
MODULATION:	FSK
MODULATING SIGNAL:	CW
BIT RATE:	NA
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	0.2 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) 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*				
All emissions were found 20 dB below the limit								Pass

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

Table 7.3.6 Restricted bands

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

Reference numbers of test equipment used

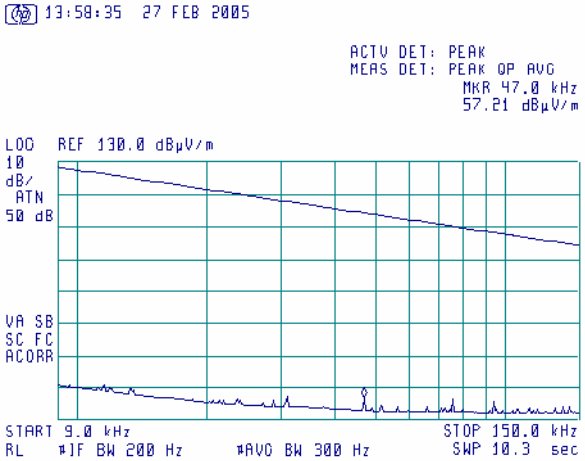
HL 0446	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604	HL 1947
HL 2009							

Full description is given in Appendix A.

Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

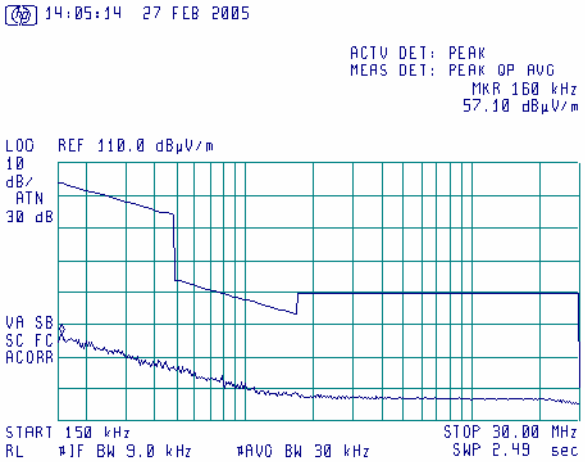
Plot 7.3.1 Radiated emission measurements from 9 to 150 kHz

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



Plot 7.3.2 Radiated emission measurements from 0.15 to 30 MHz

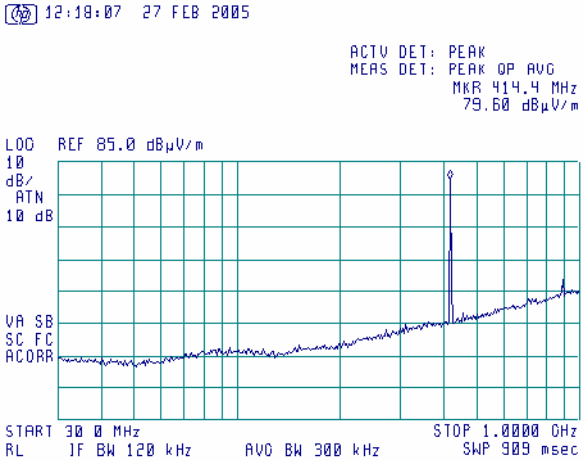
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POZITION: Typical (Vertical)



Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

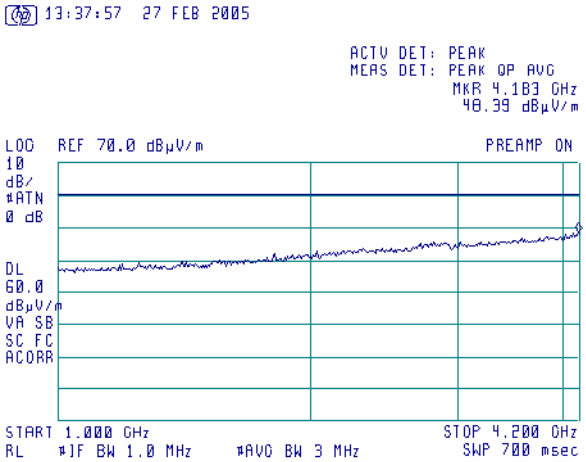
Plot 7.3.3 Radiated emission measurements from 30 to 1000 MHz

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



Plot 7.3.4 Radiated emission measurements from 1000 to 4200 MHz

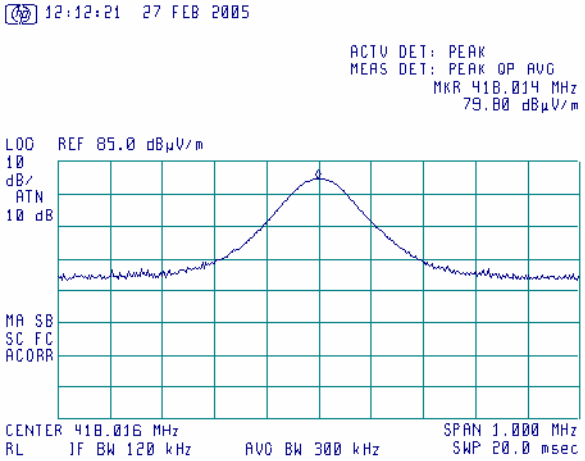
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POZITION: Typical (Vertical)



Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

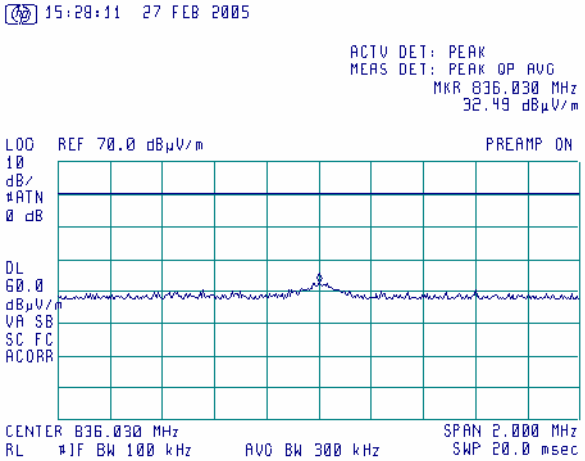
Plot 7.3.5 Radiated emission measurements at the fundamental frequency

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



Plot 7.3.6 Radiated emission measurements at the second harmonic frequency

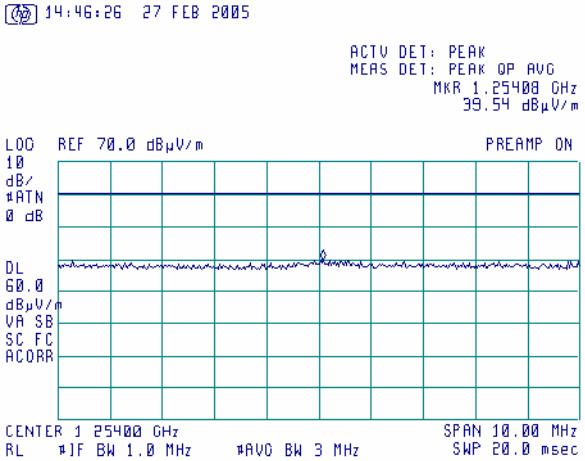
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POZITION: Typical (Vertical)



Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

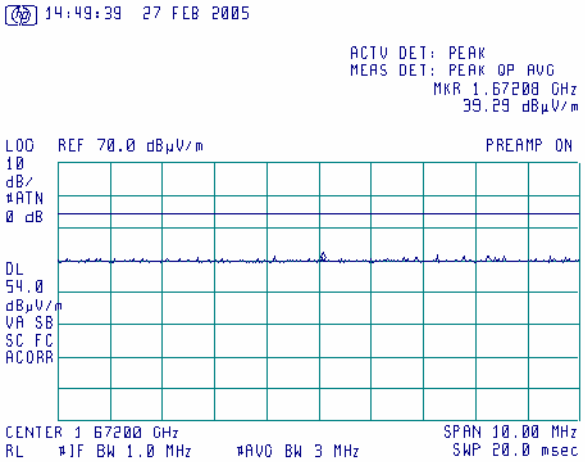
Plot 7.3.7 Radiated emission measurements at the third harmonic frequency

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



Plot 7.3.8 Radiated emission measurements at the forth harmonic frequency

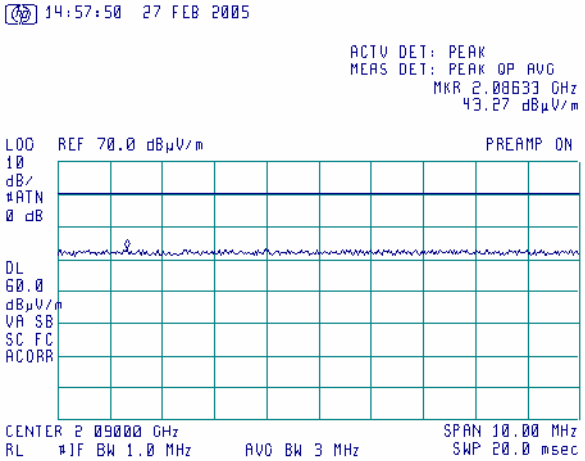
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POZITION: Typical (Vertical)



Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

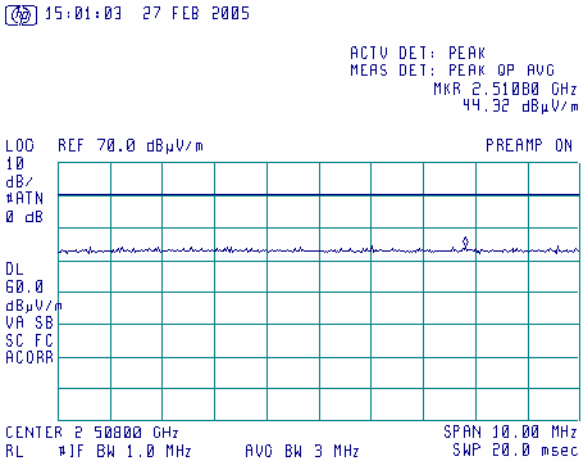
Plot 7.3.9 Radiated emission measurements at the fifth harmonic frequency

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



Plot 7.3.10 Radiated emission measurements at the sixth harmonic frequency

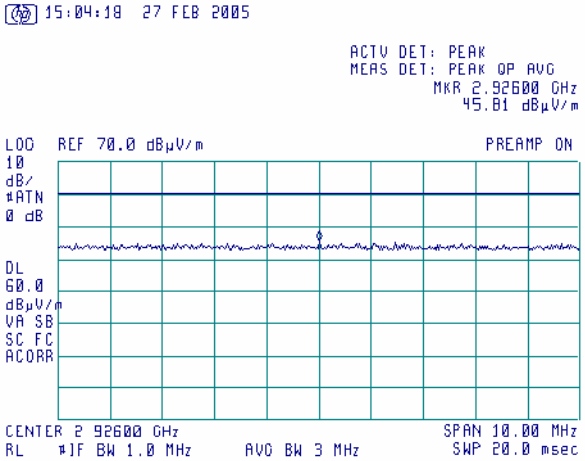
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POZITION: Typical (Vertical)



Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

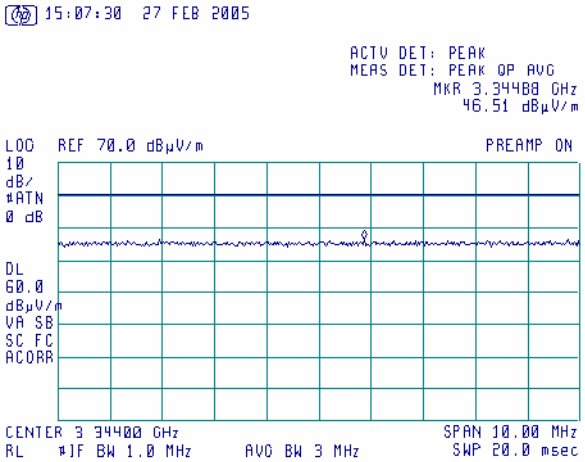
Plot 7.3.11 Radiated emission measurements at the seventh harmonic frequency

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



Plot 7.3.12 Radiated emission measurements at the eighth harmonic frequency

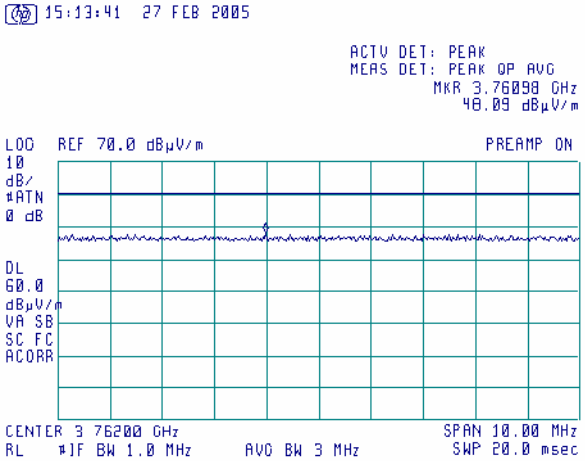
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POZITION: Typical (Vertical)



Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 10:06:20 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

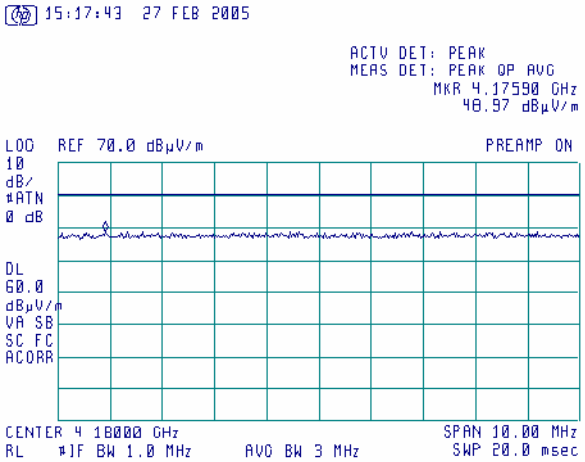
Plot 7.3.13 Radiated emission measurements at the ninth harmonic frequency

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



Plot 7.3.14 Radiated emission measurements at the tenth harmonic frequency

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



Test specification:	**Section 15.231(c), Occupied bandwidth**		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/7/2005 7:47:14 PM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 9 V AC
Remarks:			

7.4 Occupied bandwidth test

7.4.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.4.1. The test results are provided in Table 7.4.2 and associated plots.

Table 7.4.1 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.

7.4.2 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.

7.4.2.2 The EUT was set to transmit modulated carrier.

7.4.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.4.2 and associated plot.

Figure 7.4.1 Occupied bandwidth test setup

Test specification:	**Section 15.231(c), Occupied bandwidth**		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/7/2005 7:47:14 PM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 9 V AC
Remarks:			

Table 7.4.2 Occupied bandwidth test results

DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	120 kHz
VIDEO BANDWIDTH:	300 kHz
MODULATION ENVELOPE REFERENCE POINTS:	20 dBc
MODULATION:	FSK
MODULATING SIGNAL:	CW

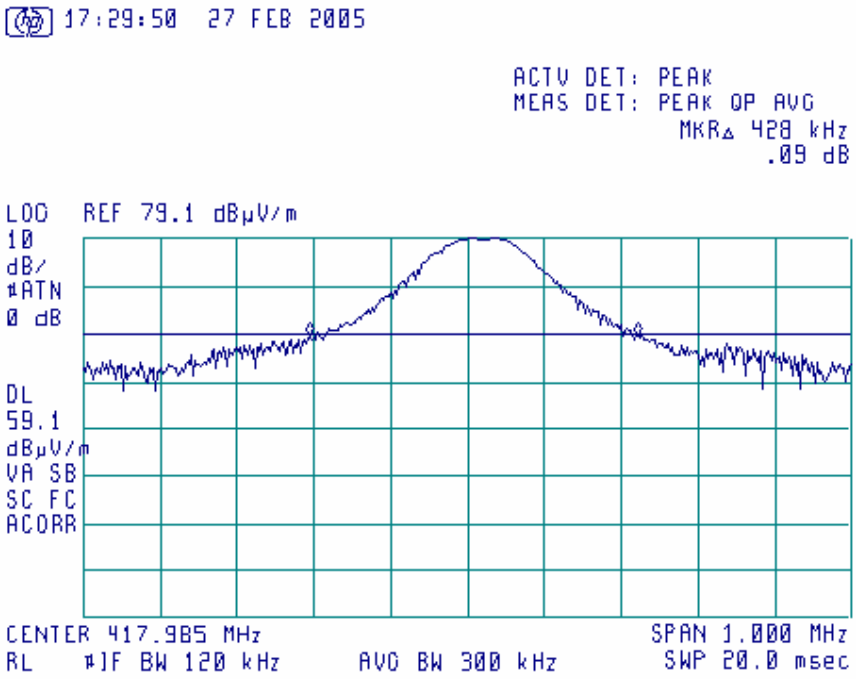
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
418.0	428.0	0.25	1045	-617	Pass

Reference numbers of test equipment used

HL 0521	HL 0589	HL 0604	HL 2009					

Full description is given in Appendix A.

Plot 7.4.1 Occupied bandwidth test result



Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/27/2005 10:07:45 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks: with PS			

7.5 Conducted emissions

7.5.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.5.1. The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

Table 7.5.1 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

28 The limit decreases linearly with the logarithm of frequency.

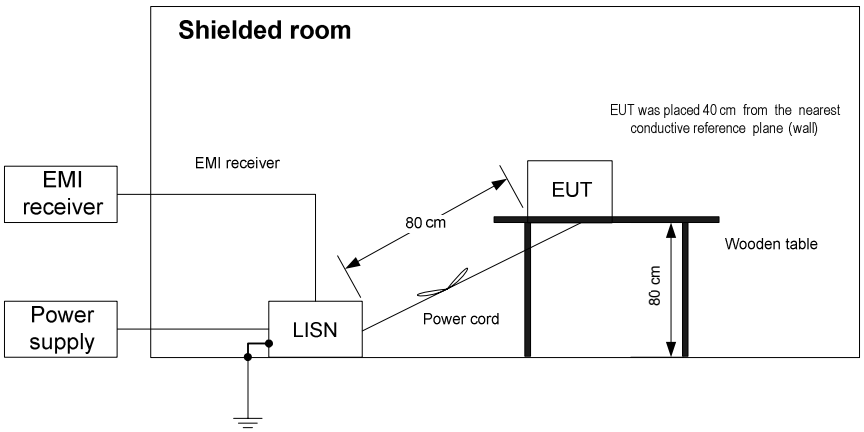
7.5.2 Test procedure

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

7.5.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.5.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

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

Figure 7.5.1 Setup for conducted emission measurements, table-top equipment



Test specification:	**Section 15.207(a), Conducted emission**		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/27/2005 10:07:45 AM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 120 VAC
Remarks: with PS			

Table 7.5.2 Conducted emission test results

LINE:	AC mains
EUT OPERATING MODE:	Transmit
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*		
0.15 – 30.0	All emissions were found more than 20 dB below the limit							L1	Pass
								L2	Pass

*- Margin = Measured emission – specification limit.

Reference numbers of test equipment used

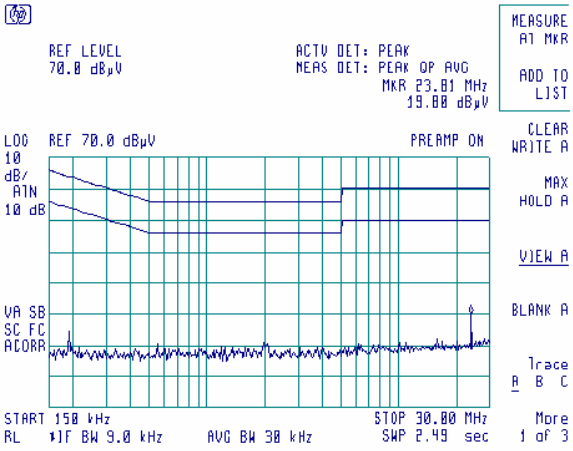
HL 0447	HL 0521	HL 0787	HL 1512				

Full description is given in Appendix A.

Test specification:	**Section 15.207(a), Conducted emission**		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	3/27/2005 10:07:45 AM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 120 VAC
Remarks: with PS			

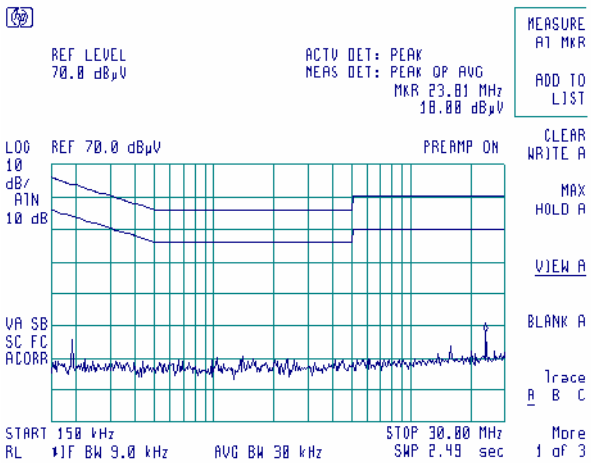
Plot 7.5.1 Conducted emission measurements

LINE: L1
EUT OPERATING MODE: Transmit
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 7.5.2 Conducted emission measurements

LINE: L2
EUT OPERATING MODE: Transmit
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.203, Antenna requirement		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	3/13/2005 2:11:56 PM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 9 V AC
Remarks:			

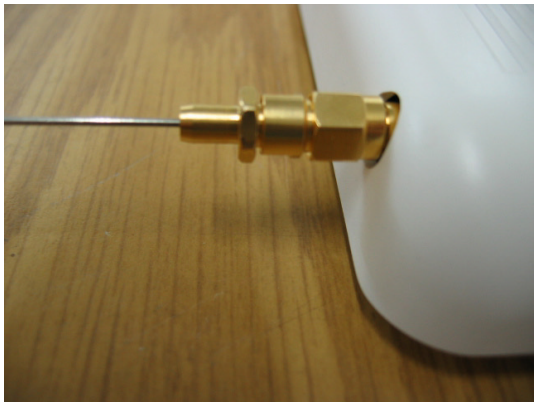
7.6 Antenna requirements

The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed for use with the EUT. This requirement does not apply to professionally installed transmitters.
The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 7.6.1.

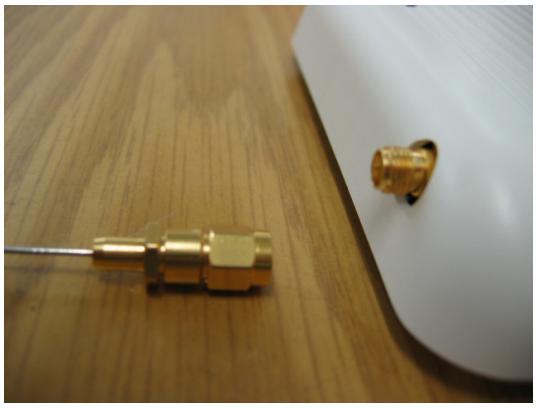
Table 7.6.1 Antenna requirements

Requirement	Rationale	Verdict
The transmitter requires professional installation	Supplier declaration	Comply

Photograph 7.6.1 Antenna assembly



Photograph 7.6.2 Antenna assembly



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:	3/27/2005 10:12:25 AM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 120 VAC
Remarks: with PS			

8 Emission 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

29 The limit decreases linearly with the logarithm of frequency.

8.1.2 Test procedure

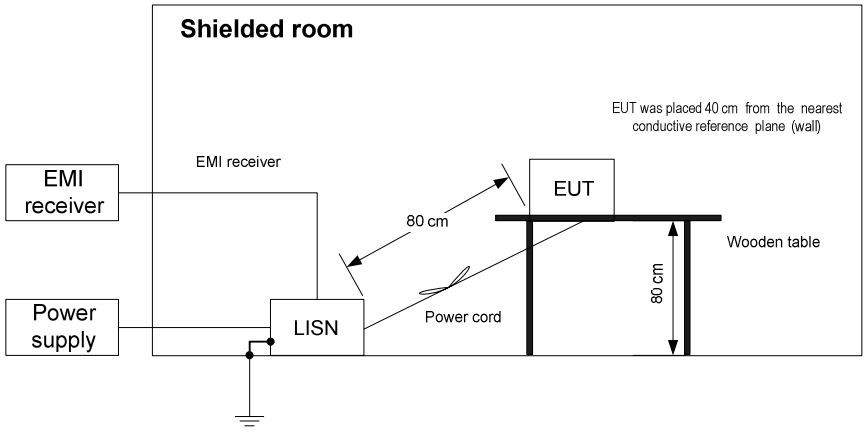
8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and the performance check was conducted.

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 8.1.1. 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.

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:	3/27/2005 10:12:25 AM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 120 VAC
Remarks: with PS			

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:	3/27/2005 10:12:25 AM		
Temperature: 19 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 45 %	**Power Supply:** 120 VAC
Remarks: with PS			

Table 8.1.2 Conducted emission test results

LINE: AC mains
EUT OPERATING MODE: Transmit
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*		
0.15 – 30.0	All emissions were found more than 20 dB below the limit							L1	Pass
								L2	Pass

*- Margin = Measured emission – specification limit.

Reference numbers of test equipment used

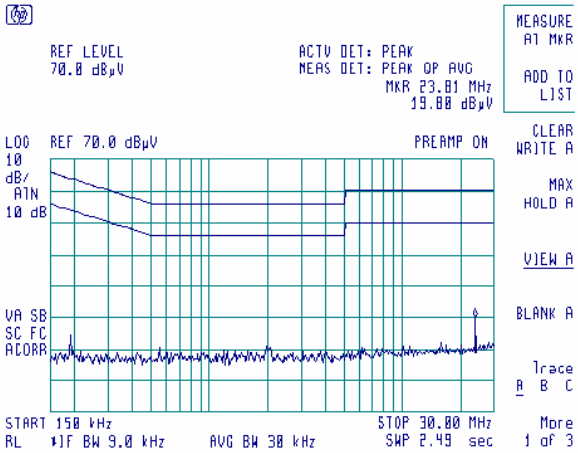
HL 0447	HL 0521	HL 0787	HL 1512				

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:	3/27/2005 10:12:25 AM		
Temperature: 19 ºC	Air Pressure: 1016 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks: with PS			

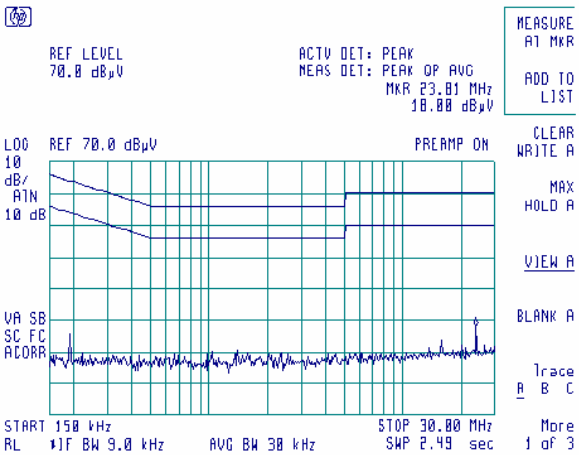
Plot 8.1.1 Conducted emission measurements

LINE: L1
EUT OPERATING MODE: Transmit
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.2 Conducted emission measurements

LINE: L2
EUT OPERATING MODE: Transmit
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



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*

30 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 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 360^0, 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

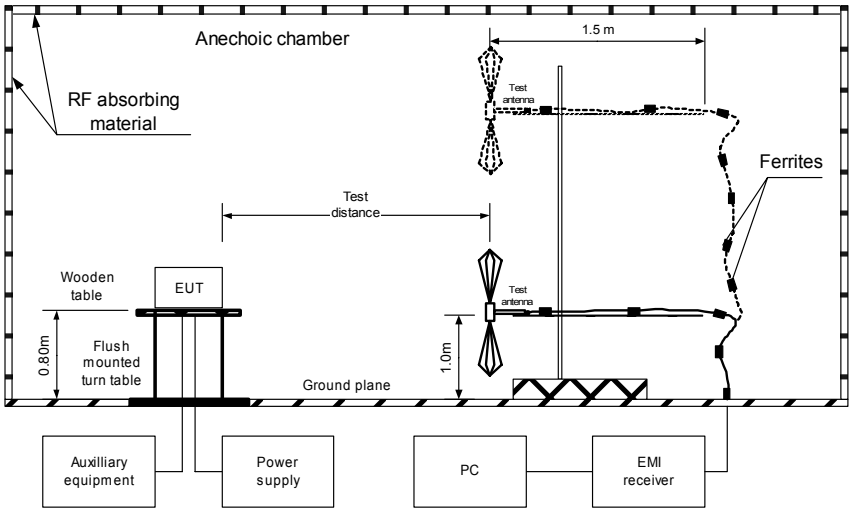


Table 8.2.2 Radiated emission test results

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*				
30 – 1000	All emissions were found more than 20 dB below the limit							Pass

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 4200 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak emission, dB(µV/m)	Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
1000 – 4200	No emissions were found							Pass

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

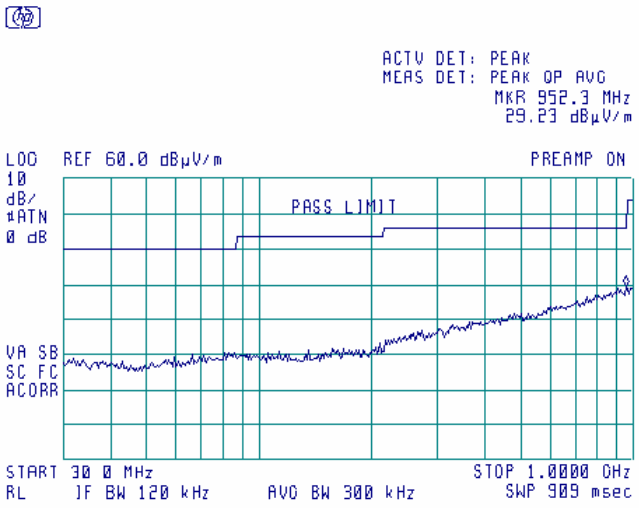
Reference numbers of test equipment used

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

Full description is given in Appendix A.

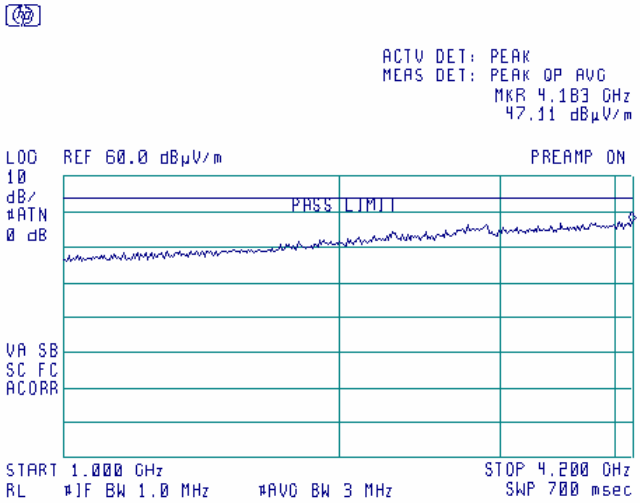
Plot 8.2.1 Radiated emission measurements in 30- 1000 MHz range, vertical and horizontal antenna polarization

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 1.0- 4.2 GHz range, vertical and horizontal antenna polarization

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



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0446	Antenna, Loop active, 10kHz-30MHz	EMCO	6502	2857	28-Jun-04	28-Jun-05
0447	LISN, 16/2, 300V RMS	HL	LISN 16 - 1	066	03-Nov-04	03-Nov-05
0465	Anechoic Chamber 9(L) x 6.5(W) x 5.5(H) m	HL	AC - 1	023	03-Nov-04	03-Nov-05
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	10-Oct-04	10-Oct-05
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	02-Dec-04	02-Dec-05
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
0787	Transient Limiter	Hewlett Packard	11947A	3107A018 77	27-Jan-05	27-Jan-06
1430	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL1432	Agilent Technologies (HP)	8542E	3807A002 62,3705A0 0217	27-Jan-05	27-Jan-06
1512	Cable RF, 8 m	Belden	M17/167 MIL-C-17	1512	23-Sep-04	23-Sep-05
1653	Analyzer EMC 9 kHz - 1.5 GHz	Agilent Technologies (HP)	E7401A	US394402 81	06-Feb-05	06-Feb-06
1947	Cable 18GHz, 6.5 m, blue	Rhophase Microwave Limited	NPS-1803A-6500-NPS	T4974	17-Oct-04	17-Oct-05
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W, N-type	EMC Test Systems	3115	9911-5964	22-Mar-05	22-Mar-06
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	02-Dec-04	02-Dec-05
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	23-Sep-04	23-Sep-05

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
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
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Duty cycle, timing (Tx ON / OFF) and average factor measurements	 ± 1.0 %
Occupied bandwidth	± 8.0 %

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).

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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 15: 2004	Radio Frequency Devices.
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 2001	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

13 APPENDIX E Abbreviations and acronyms

A	ampere
AC	alternating current
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
EUT	equipment under test
F	frequency
GHz	gigahertz
H	height
HL	Hermon laboratories
Hz	hertz
ITE	information technology equipment
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	Ohm
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

14 APPENDIX F Test equipment correction factors

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

Frequency, MHz	Correction factor, dB	Frequency, MHz	Correction factor, dB
0.01	5.0	3	0.1
0.02	2.2	4	0.1
0.03	1.1	6	0.2
0.04	0.7	10	0.3
0.05	0.5	12	0.4
0.1	0.2	16	0.5
0.2	0.1	18	0.6
0.4	0.1	20	0.7
0.6	0.1	25	0.9
0.8	0.1	28	1.2
1	0.1	30	1.3
2	0.1		

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
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(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 (EMCO), model 3115

Frequency, MHz	Antenna factor (s/n 9911-5964), dB(1/m)	Antenna factor (s/n 00027177), dB(1/m)
1000.0	24.5	24.7
1500.0	24.8	25.7
2000.0	27.6	27.8
2500.0	28.7	28.9
3000.0	30.8	30.7
3500.0	32.9	31.8
4000.0	32.7	33.0
4500.0	32.0	32.8
5000.0	33.6	34.2
5500.0	35.3	34.9
6000.0	35.7	35.2
6500.0	35.8	35.4
7000.0	36.2	36.3
7500.0	37.2	37.3
8000.0	37.2	37.5
8500.0	38.1	38.0
9000.0	38.6	38.3
9500.0	38.3	38.3
10000.0	38.4	38.7
10500.0	38.3	38.7
11000.0	38.8	38.9
11500.0	39.9	39.5
12000.0	39.6	39.5
12500.0	39.5	39.4
13000.0	40.5	40.5
13500.0	41.1	40.8
14000.0	41.5	41.5
14500.0	40.8	41.3
15000.0	39.5	40.2
15500.0	38.1	38.7
16000.0	38.1	38.5
16500.0	40.1	39.8
17000.0	42.6	41.9
17500.0	45.4	45.8
18000.0	48.7	49.1

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 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		