

TEST REPORT

ACCORDING TO: FCC CFR 47 PART 15 Subpart C, section 15.231(a)

FOR:

Visonic Technologies Ltd.

**Wireless Spatial Position
Detector**

Model: SPD-2000 NS

315 MHz

This report is in conformity with ISO/ IEC 17025. The A2LA logo endorsement applies only to the test methods and the standards that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested. This test report shall not be reproduced in any form except in full with the written approval of Hermon Laboratories Ltd.

Table of contents

1	Applicant information	3
2	Equipment under test attributes	3
3	Manufacturer information	3
4	Test details	3
5	Tests summary	4
6	EUT description	5
6.1	General information	5
6.2	Changes made in the EUT	5
6.3	Test configuration	5
6.4	EUT general view	5
7	Transmitter tests according to 47CFR part 15 subpart C requirements	6
7.1	Periodic operation requirements	6
7.2	Field strength of emissions	12
7.3	Occupied bandwidth test	28
7.4	Antenna requirements	30
7.5	Radiated emission measurements	31
8	APPENDIX A Test equipment and ancillaries used for tests	35
9	APPENDIX B Measurement uncertainties	36
10	APPENDIX C Test facility description	37
11	APPENDIX D Specification references	37
12	APPENDIX E Abbreviations and acronyms	38
13	APPENDIX F Test equipment correction factors	39

1 Applicant information

Client name: Visonic Technologies Ltd.
Address: Habarzel street 30, Tel Aviv, Israel, 69710
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 Spatial Position Detector
Product type: Transmitter
Model: SPD-2000 NS
Operating frequency: 315 MHz
Receipt date: 8/24/2005

3 Manufacturer information

Manufacturer name: Visonic Technologies Ltd.
Address: Habarzel street 30, Tel Aviv, Israel, 69710
Telephone: +972 3645 6714
Fax: +972 3645 6788
E-Mail: aelshtein@visonic.com
Contact name: Mr. Arick Elshtein

4 Test details

Project ID: 16646
Location: Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel
Test started: 8/24/2005
Test completed: 12/13/2006
Test specifications: FCC Part 15, subpart C, §15.231(a); subpart B, §15.109

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	Not required
Section 15.203, Antenna requirement	Pass
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Not required
Section 15.109, Radiated emission, Class B	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	December 13, 2006	
Reviewed by:	Ms. N. Averin, certification engineer	December 14, 2006	
Approved by:	Mr. M. Nikishin, EMC and radio group leader	December 14, 2006	

6 EUT description

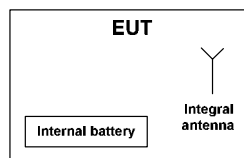
6.1 General information

The EUT is a fully supervised wireless detector designed for protection of paintings, statues and other artworks in museums or galleries and for protection of valuable painting at home. The detector can be also useful for property protection like PC, office equipment, hospital beds etc. The EUT operates at 315 MHz, is equipped with an integral antenna and is powered from 3 VDC internal battery.

6.2 Changes made in the EUT

No changes were implemented.

6.3 Test configuration



6.4 EUT general view



Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/15/2005 1:26:04 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
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 manually operated transmitter shall employ switch that will automatically deactivate the transmitter within not more than 5 seconds of being released;
- 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 automatically.

7.1.2.4 The transmission time was captured and shown in Table 7.1.2 and the associated plots.

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 in Table 7.1.3 and the associated plots.

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:	12/15/2005 1:26:04 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
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	Plots 7.1.1 – 7.1.5	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	Plots 7.1.6, 7.1.7	Comply

Table 7.1.2 Total duration of transmissions

Pulse duration*, ms	Pulse period, ms	Number of pulses within burst	Number of burst within transmission	Transmission duration, ms	Transmission limit, ms	Margin, ms	Verdict
30.15	49.28	6	3	542	5000	-4458	Comply

* – Pulse duration = pulse duration measured * Manchester code coefficient

Note: "Alarm", "Alarm restore" and "Tamper alarm" transmissions are identical.

Table 7.1.3 Total duration of supervision transmission

Pulse duration, ms	Number of pulses within hour	Supervision transmission, s	Supervision transmission (within 1 hour) limit, s	Margin, s	Verdict
300	5	1.5	2	-0.5	Comply

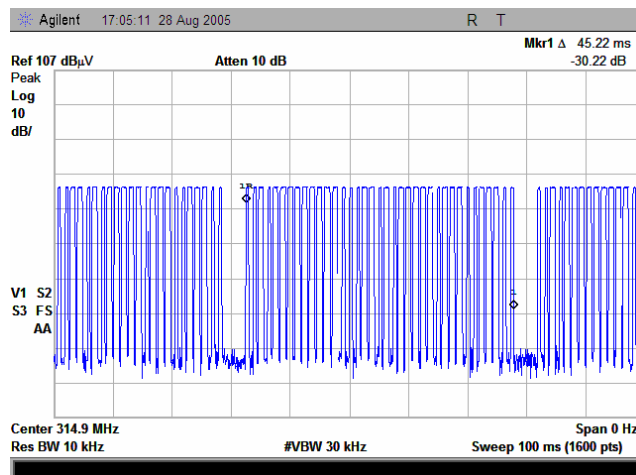
Reference numbers of test equipment used

HL 0337	HL 2780						
---------	---------	--	--	--	--	--	--

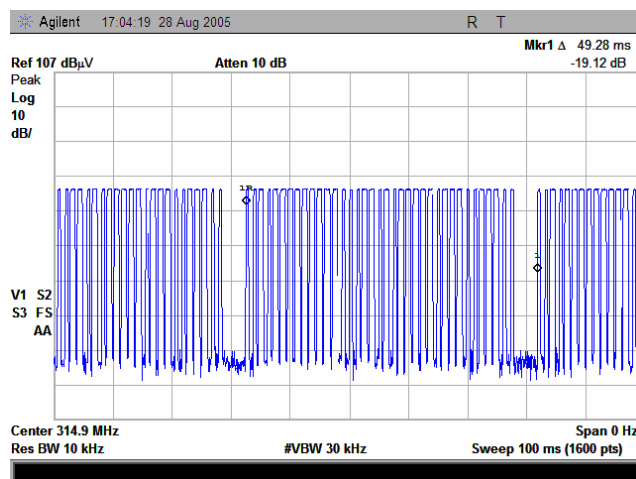
Full description is given in Appendix A.

Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/15/2005 1:26:04 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
Remarks:			

Plot 7.1.1 Pulse duration

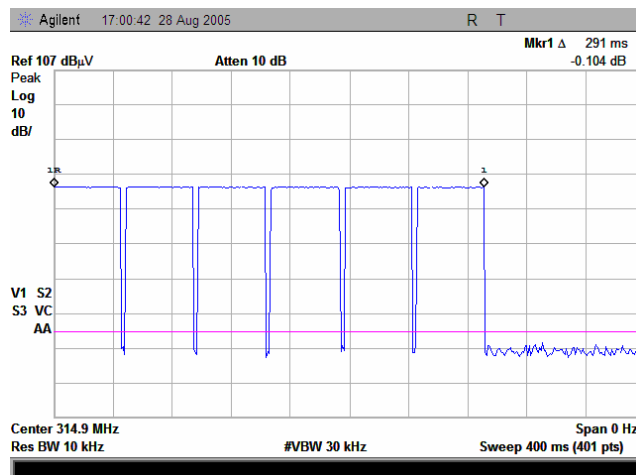


Plot 7.1.2 Pulse period

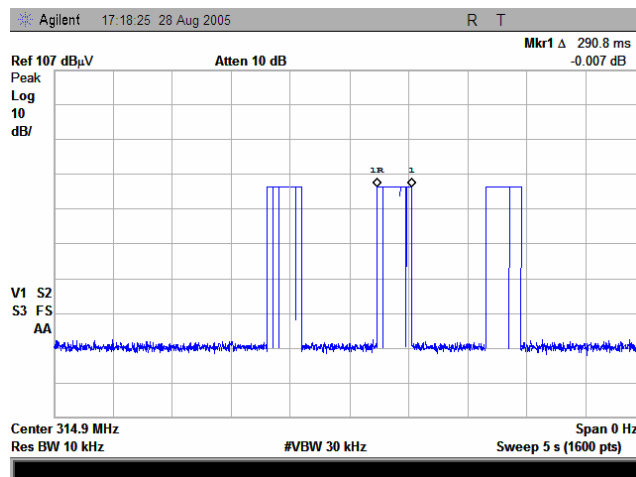


Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/15/2005 1:26:04 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
Remarks:			

Plot 7.1.3 Burst duration

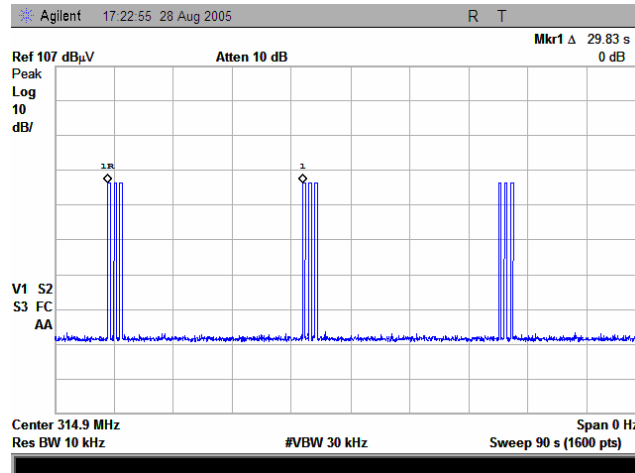


Plot 7.1.4 Transmission (three packets of bursts) duration

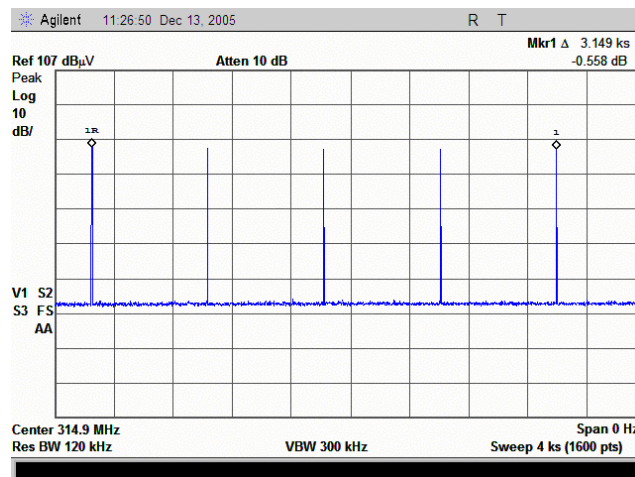


Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/15/2005 1:26:04 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
Remarks:			

Plot 7.1.5 Interval between transmissions

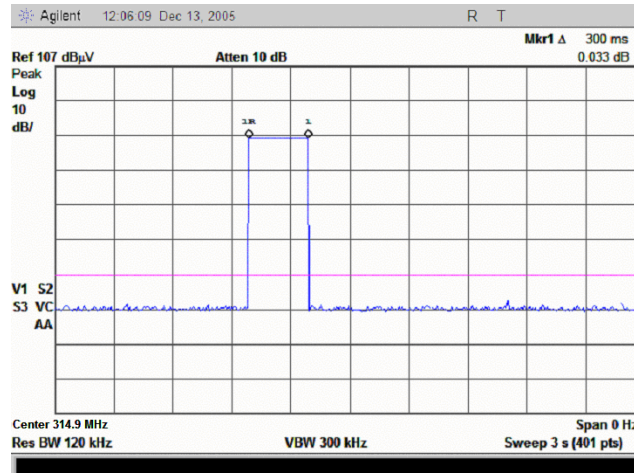


Plot 7.1.6 Five supervision pulses within 1 hour



Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/15/2005 1:26:04 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
Remarks:			

Plot 7.1.7 Supervision pulse duration



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:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

7.2 Field strength of emissions

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 7.2.1 and Table 7.2.2.

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**		
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.

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 measurements were performed in three EUT orthogonal positions. The worst test results were found in EUT position "Y" as 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 measurements were performed in three EUT orthogonal positions. The worst test results were found in EUT position "Y" as recorded in Table 7.2.3, Table 7.2.5 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:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

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

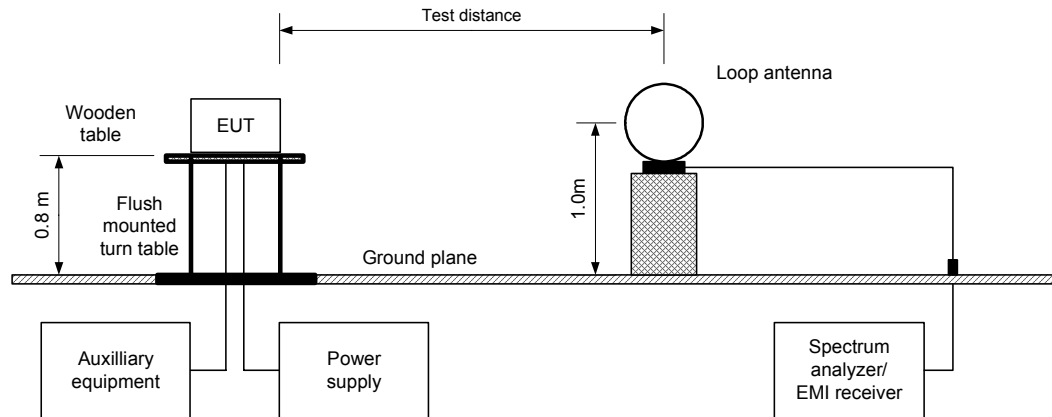
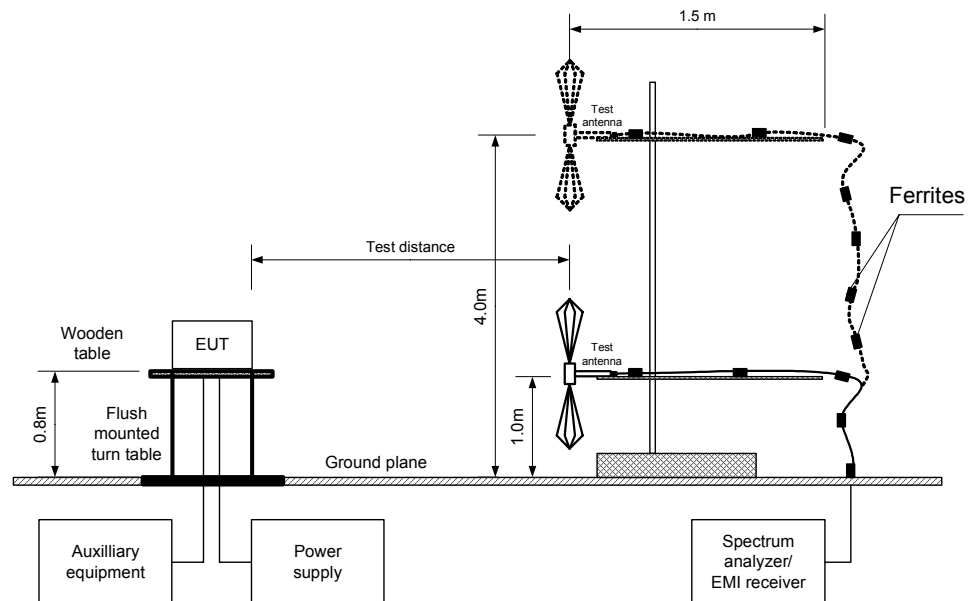


Figure 7.2.2 Setup for spurious emission field strength measurements above 30 MHz



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:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

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: Y-axis
 MODULATION: ASK
 MODULATING SIGNAL: ID code
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 - 3500 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)
 Log periodic (200 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											
314.982	H	1.0	54	73.27	95.62	-22.35	-4.26	69.01	75.62	-6.61	Pass
Spurious emissions											
629.966	V	1.2	144	27.10	75.62	-48.52	-4.26	22.84	55.62	-32.78	Pass
944.940	H	1.0	158	39.13	75.62	-36.49	-4.26	34.87	55.62	-20.75	
1260.000	H	1.0	359	43.27	75.62	-32.35	-4.26	39.01	55.62	-16.61	

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

**- Margin = Measured emission - specification limit.

Table 7.2.4 Average factor calculation

Transmission pulse		Transmission burst		Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms	
45.22	49.28	291	787.25	-4.26

*- 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:

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

Average factor calculation: $20 \times \log((45.22 \times 0.667 / 49.28) \times (291 / 100) \times (100 / 291)) = -4.26 \text{ dB}$, where (100 / 291) is number of bursts within 100 ms and 0.667 is Manchester code factor.

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:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

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

TEST DISTANCE: 3 m
 EUT POSITION: Y-axis
 MODULATION: ASK
 MODULATING SIGNAL: ID code
 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)
 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.

Table 7.2.6 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

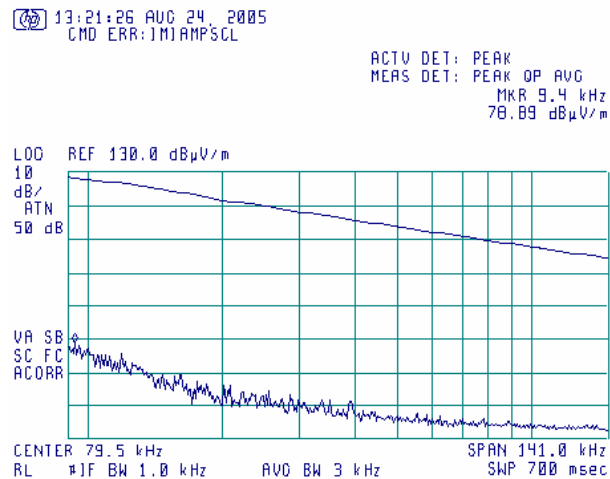
HL 0446	HL 0465	HL 0521	HL 0569	HL 0589	HL 0593	HL 0594	HL 1004
HL 1425	HL 1430	HL 1553	HL 1566	HL 1947	HL 1984	HL 2009	HL 2109
HL 2697							

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:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

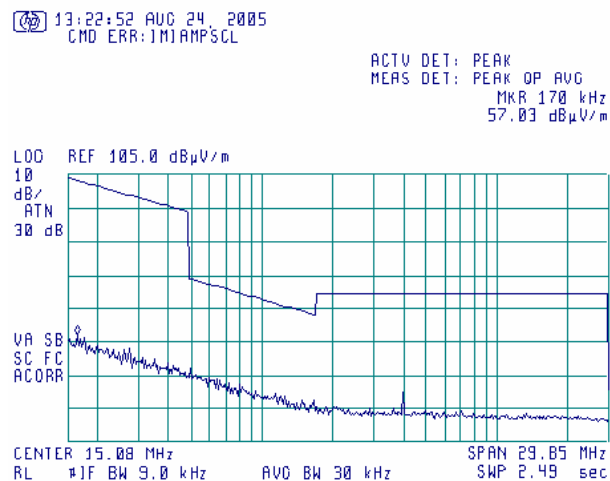
Plot 7.2.1 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis



Plot 7.2.2 Radiated emission measurements from 0.15 to 30 MHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis

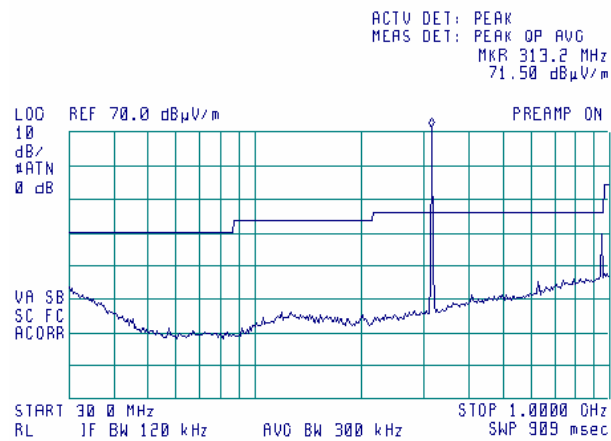


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.3 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Y-axis

10:33:53 AUG 24, 2005

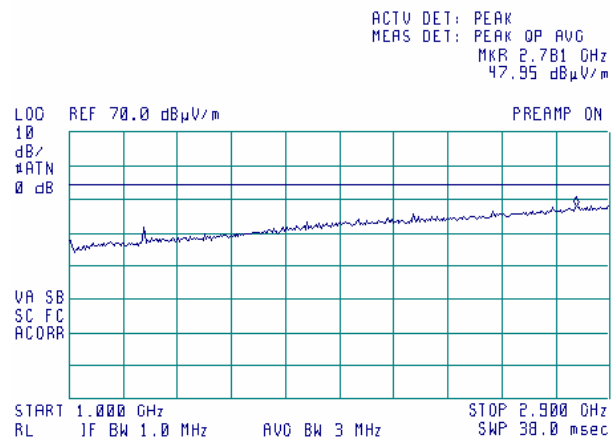


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.4 Radiated emission measurements from 1000 to 2900 MHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Y-axis

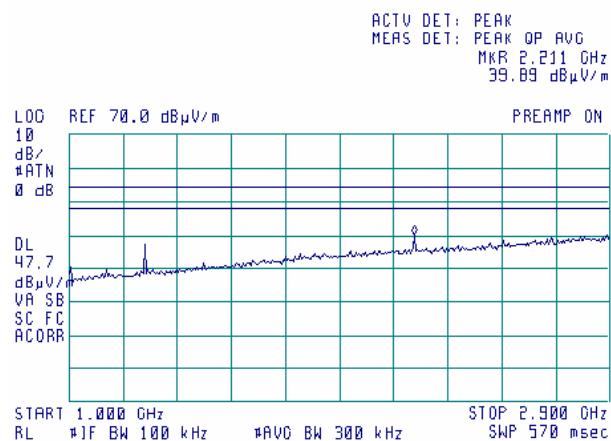
10:39:59 AUG 24, 2005



Plot 7.2.5 Radiated emission measurements from 1000 to 2900 MHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Y-axis

11:20:45 AUG 24, 2005

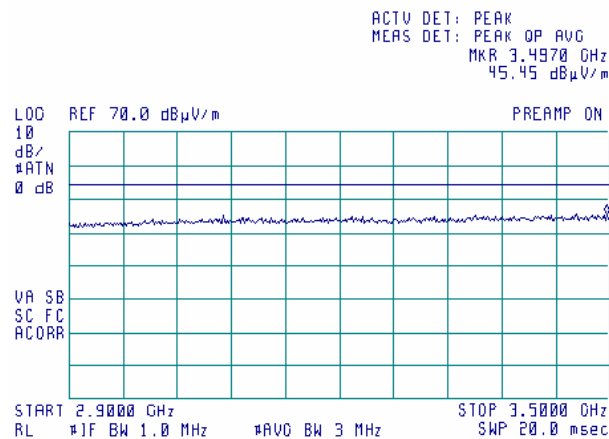


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.6 Radiated emission measurements from 2900 to 3500 MHz

TEST SITE: Semi Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Y-axis

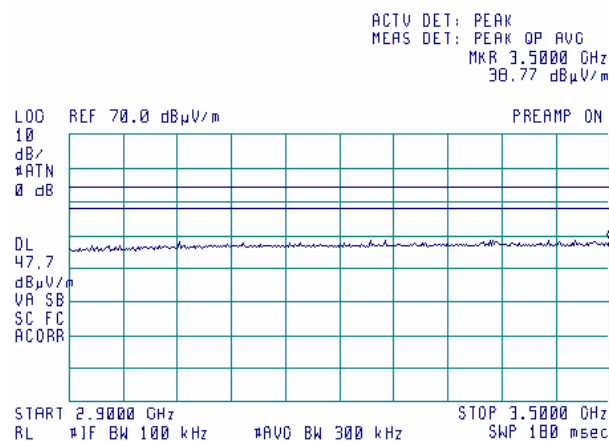
13:53:10 AUG 24, 2005



Plot 7.2.7 Radiated emission measurements from 2900 to 3500 MHz

TEST SITE: Semi Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Y-axis

14:22:38 AUG 24, 2005

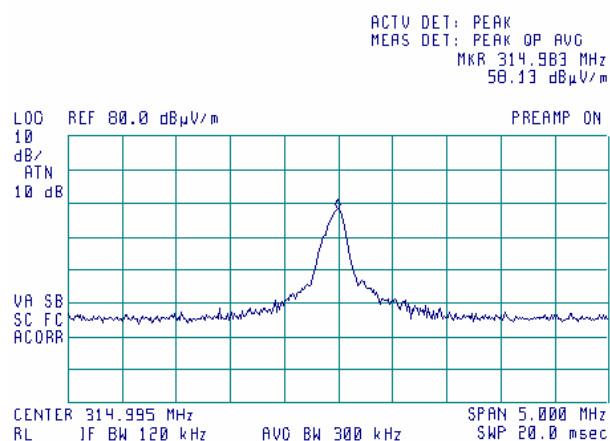


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.8 Radiated emission measurements at the fundamental frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis

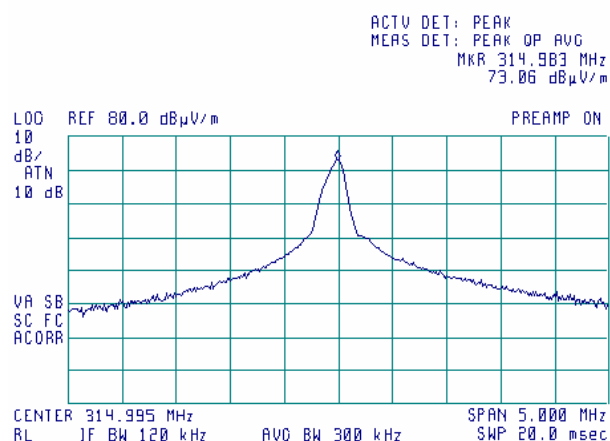
10:23:04 AUG 24, 2005



Plot 7.2.9 Radiated emission measurements at the fundamental frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Y-axis

10:15:30 AUG 24, 2005

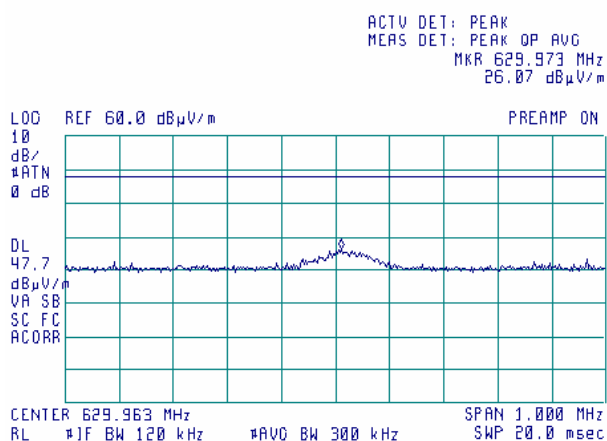


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.10 Radiated emission measurements at the second harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis

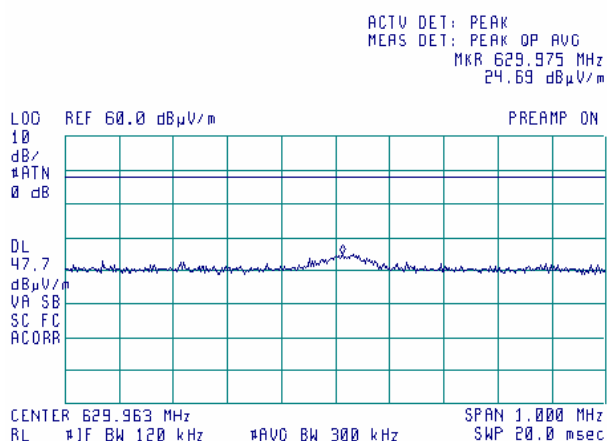
12:10:59 AUG 24, 2005



Plot 7.2.11 Radiated emission measurements at the second harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Y-axis

11:30:27 AUG 24, 2005

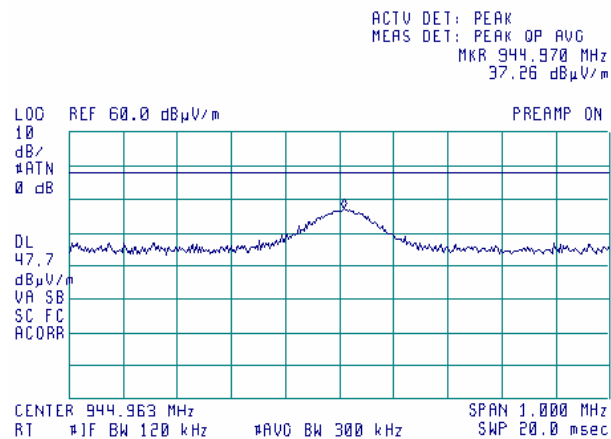


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.12 Radiated emission measurements at the third harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis

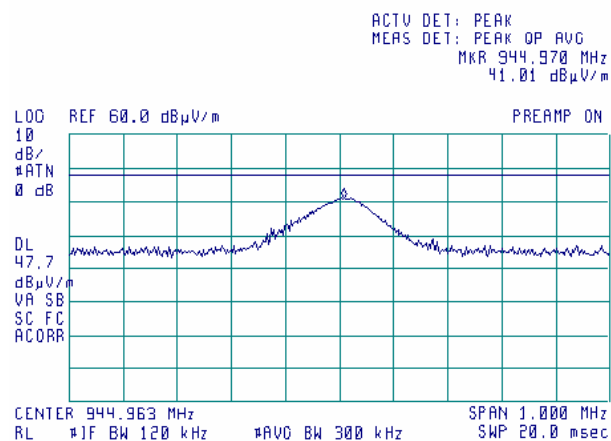
12:15:47 AUG 24, 2005



Plot 7.2.13 Radiated emission measurements at the third harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Y-axis

12:20:37 AUG 24, 2005

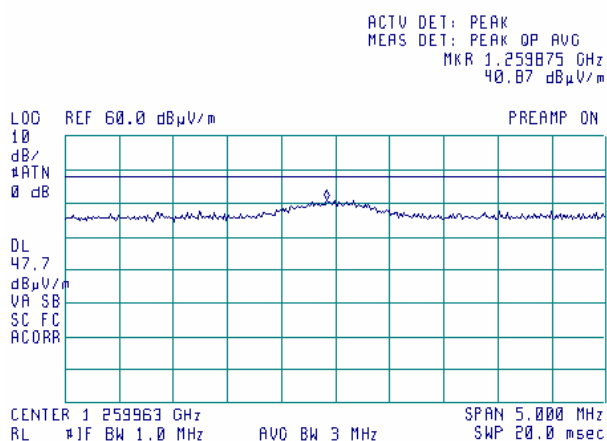


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.14 Radiated emission measurements at the forth harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis

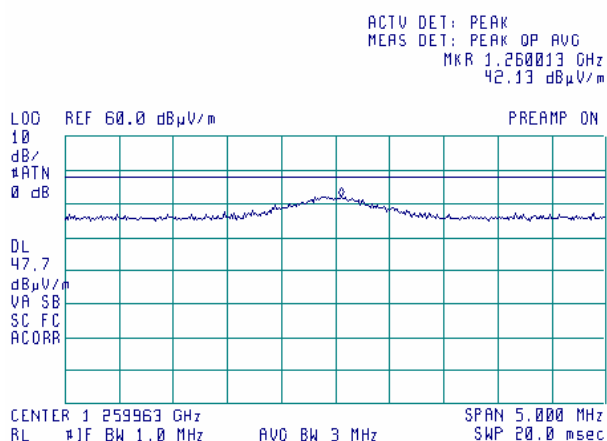
13:00:40 AUG 24, 2005



Plot 7.2.15 Radiated emission measurements at the forth harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Y-axis

13:01:39 AUG 24, 2005

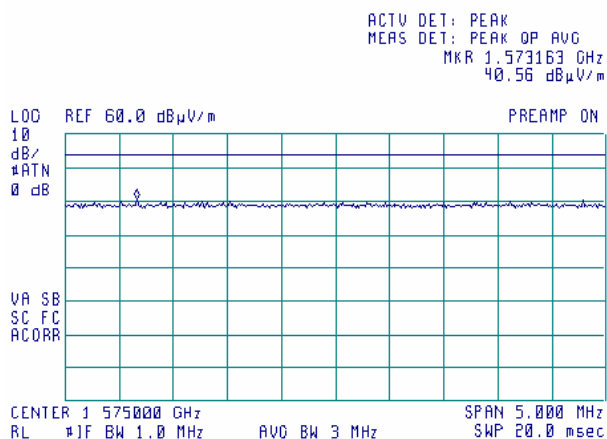


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.16 Radiated emission measurements at the fifth harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis

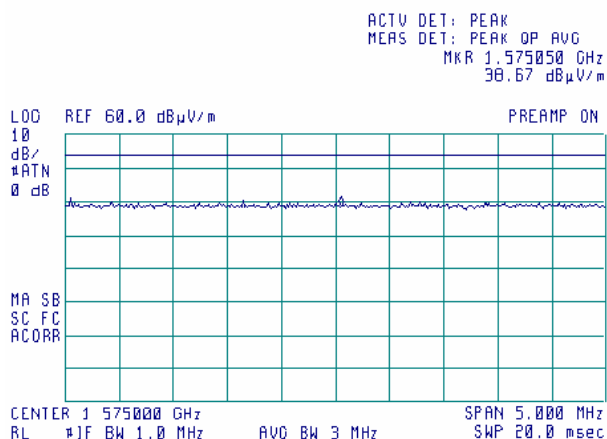
13:06:23 AUG 24, 2005



Plot 7.2.17 Radiated emission measurements at the fifth harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Y-axis

13:03:59 AUG 24, 2005

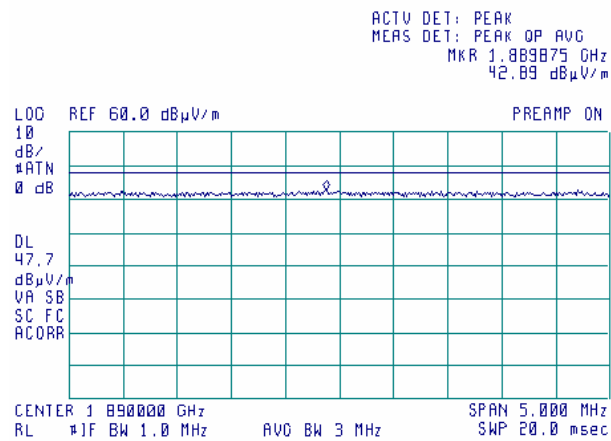


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.18 Radiated emission measurements at the sixth harmonic frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Y-axis

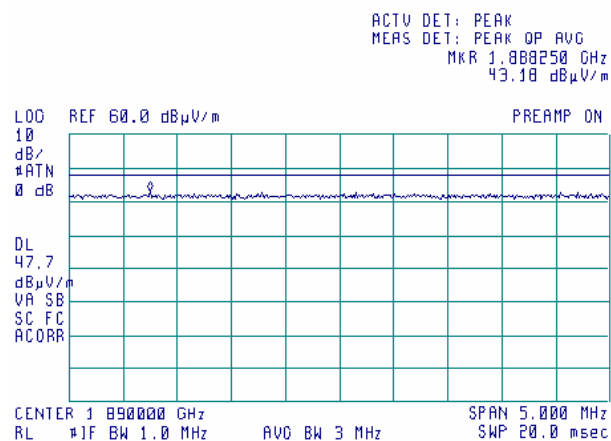
13:09:51 AUG 24, 2005



Plot 7.2.19 Radiated emission measurements at the sixth harmonic frequency

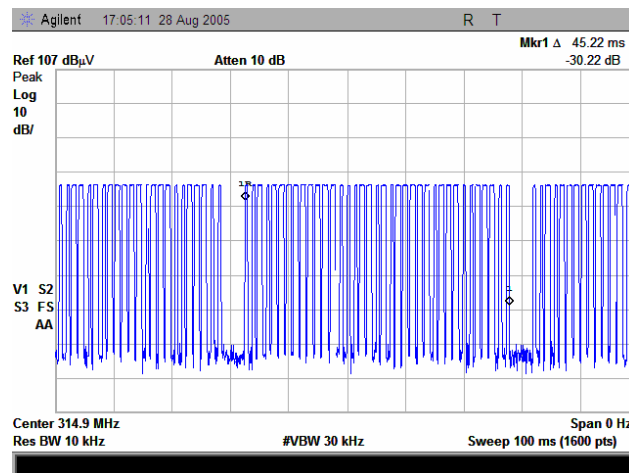
TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Y-axis

13:12:01 AUG 24, 2005

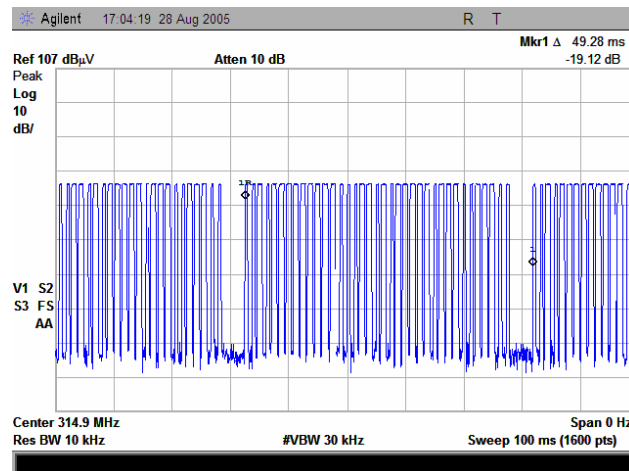


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.20 Transmission pulse duration

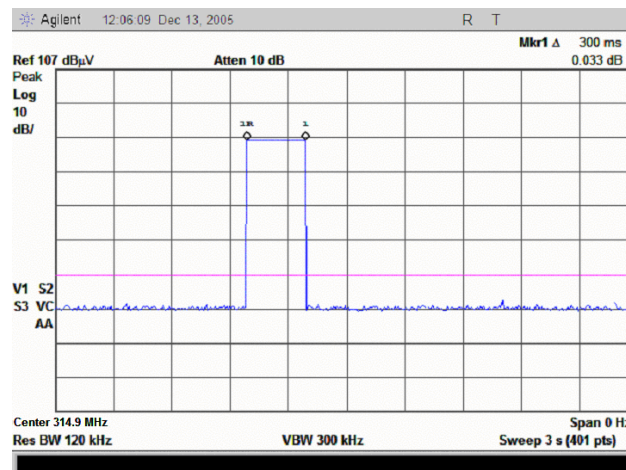


Plot 7.2.21 Transmission pulse period

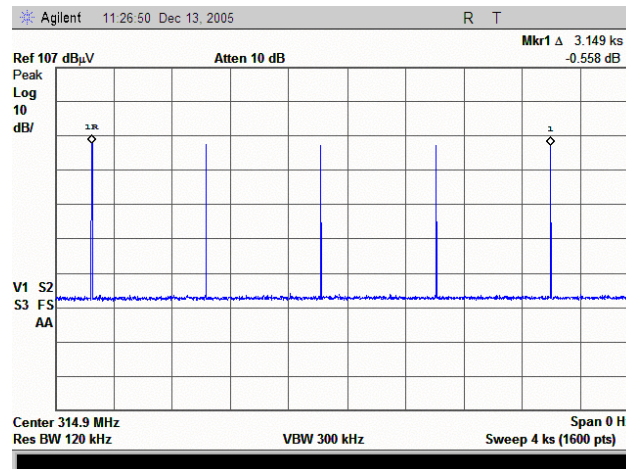


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/13/2006 4:57:44 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.22 Transmission burst duration



Plot 7.2.23 Transmission bursts within 1 hour



Note: transmission burst period is: $3149 / 4 = 787.25$ s

Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/29/2005 5:34:01 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
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. The test results are provided in Table 7.3.2 and associated plots.

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



Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 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	438	0.25	787.5	-349.5	Pass

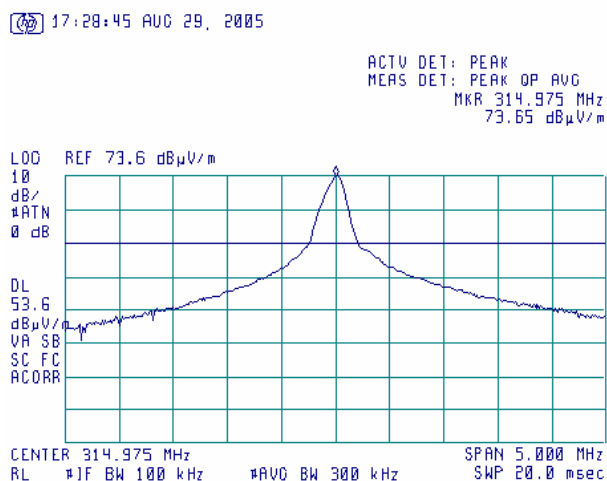
Reference numbers of test equipment used

HL 1425	HL 1553	HL 1566	HL 2697					
---------	---------	---------	---------	--	--	--	--	--

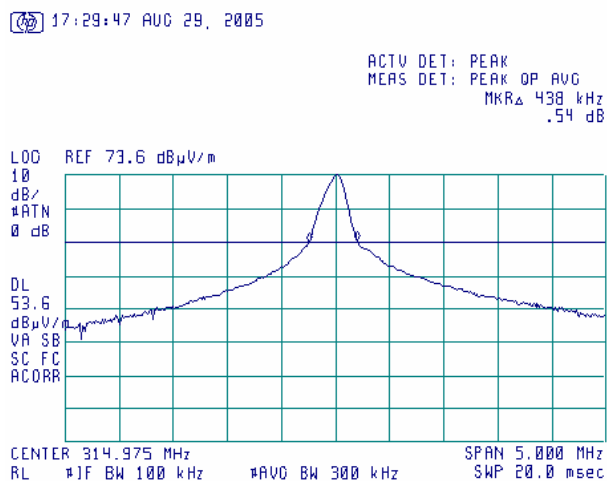
Full description is given in Appendix A.

Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/29/2005 5:34:01 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Plot 7.3.1 Occupied bandwidth test result



Plot 7.3.2 Occupied bandwidth test result



Test specification:	Section 15.203, Antenna requirement		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/29/2005 5:16:06 PM		
Temperature: 24 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

7.4 Antenna requirements

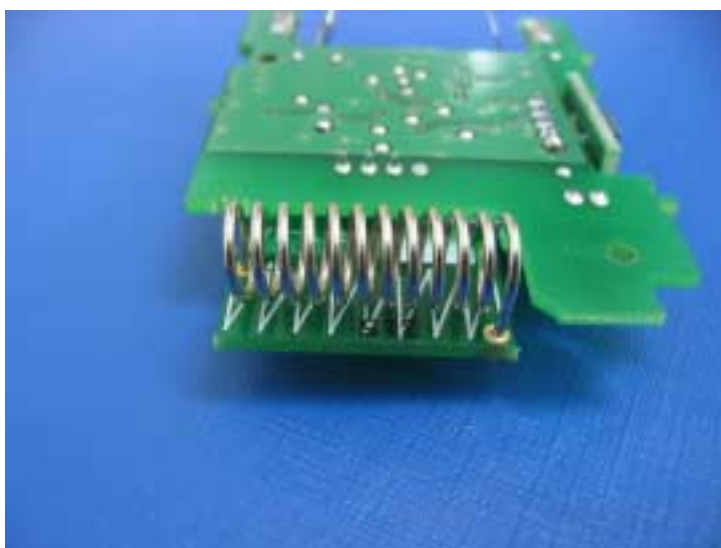
The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed 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 7.4.1.

Table 7.4.1 Antenna requirements

Requirement	Rationale	Verdict
The transmitter antenna is permanently attached	Visual inspection	Comply
The transmitter employs a unique antenna connector	NA	
The transmitter requires professional installation	NA	

Photograph 7.4.1 Antenna assembly



Test specification:	Section 15.109, Class B Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/11/2005 9:52:16 AM		
Temperature: 24 °C	Air Pressure: 1009 hPa	Relative Humidity: 33 %	Power Supply: 3 VDC
Remarks:			

7.5 Radiated emission measurements

7.5.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Radiated emission test limits

Frequency, MHz	Class B limit, dB(μV/m)		Class A limit, dB(μV/m)	
	10 m distance	3 m distance	10 m distance	3 m distance
30 - 88	29.5*	40.0	39.0	49.5*
88 - 216	33.0*	43.5	43.5	54.0*
216 - 960	35.5*	46.0	46.4	56.9*
Above 960	43.5*	54.0	49.5	60.0*

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $\text{Lim}_{S2} = \text{Lim}_{S1} + 20 \log (S_1/S_2)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

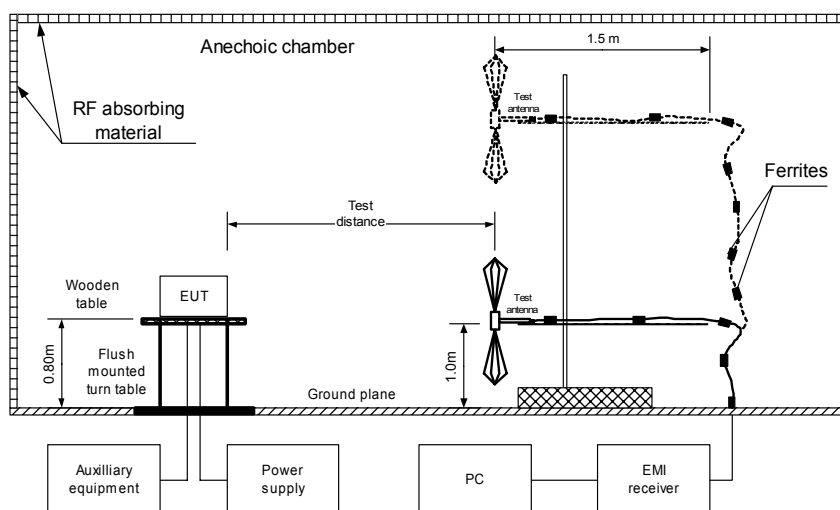
7.5.2 Test procedure

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 specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

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

Figure 7.5.1 Setup for radiated emission measurements in anechoic chamber, table-top EUT



Test specification:	Section 15.109, Class B Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/11/2005 9:52:16 AM		
Temperature: 24 °C	Air Pressure: 1009 hPa	Relative Humidity: 33 %	Power Supply: 3 VDC
Remarks:			

Table 7.5.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Standby
TEST SITE: ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTOR USED: PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

REGULATION BANDWIDTH: 120 KHz								
Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
No emissions were found								Pass

FREQUENCY RANGE: 1000 MHz – 2900 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak emission, dB(μV/m)	Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
No 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 1425	HL 1553	HL 1566	HL 2109	HL 2697			
---------	---------	---------	---------	---------	--	--	--

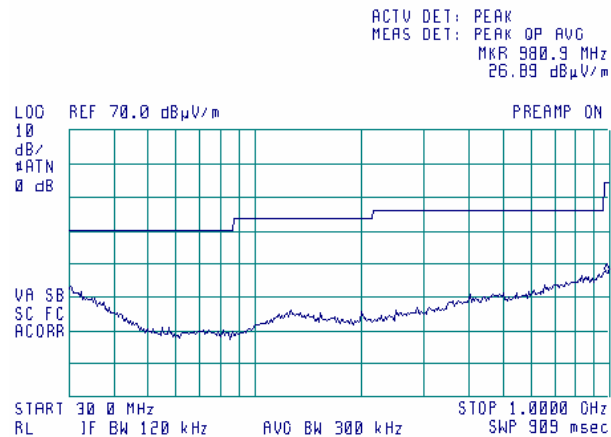
Full description is given in Appendix A.

Test specification:	Section 15.109, Class B Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/11/2005 9:52:16 AM		
Temperature: 24 °C	Air Pressure: 1009 hPa	Relative Humidity: 33 %	Power Supply: 3 VDC
Remarks:			

Plot 7.5.1 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: Standby

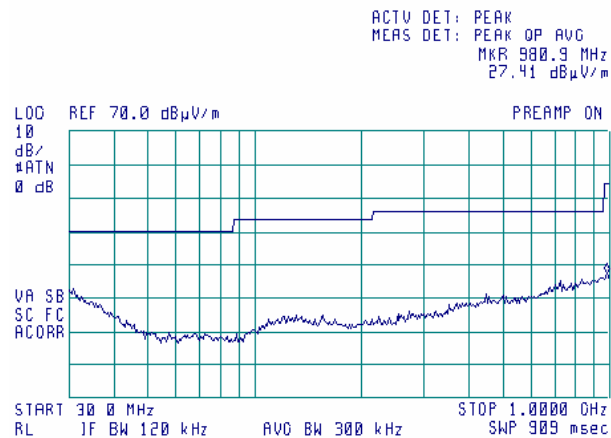
11:55:50 AUG 29, 2005



Plot 7.5.2 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: Standby

11:52:54 AUG 29, 2005

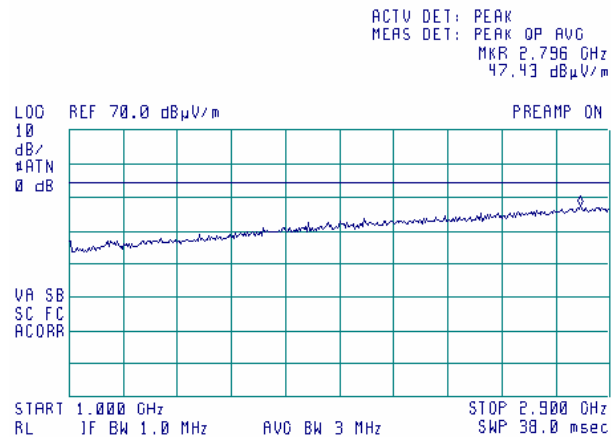


Test specification:	Section 15.109, Class B Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/11/2005 9:52:16 AM		
Temperature: 24 °C	Air Pressure: 1009 hPa	Relative Humidity: 33 %	Power Supply: 3 VDC
Remarks:			

Plot 7.5.3 Radiated emission measurements in 1000- 2900 MHz range, vertical antenna polarization

TEST SITE: Anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Standby

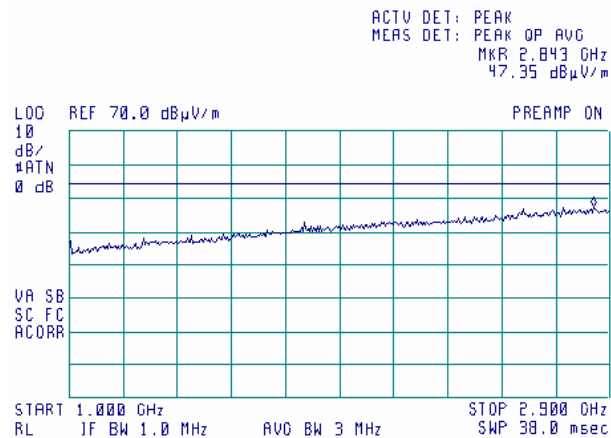
11:57:01 AUG 29, 2005



Plot 7.5.4 Radiated emission measurements in 1000- 2900 MHz range, horizontal antenna polarization

TEST SITE: Anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Standby

11:57:59 AUG 29, 2005



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0337	Probe Set, Hand held, 5 probes	Electro-Metrics	EHFP-30	238	12-Jun-06	12-Jun-07
0446	Antenna, Loop active, 10kHz-30MHz	EMCO	6502	2857	28-Jun-06	28-Jun-07
0465	Anechoic Chamber 9(L) x 6.5(W) x 5.5(H) m	HL	AC - 1	023	10-Oct-06	10-Oct-07
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A00319, 3448A00253	10-Oct-06	10-Oct-07
0569	Antenna, Log Periodic, 200-1000 MHz	Electro-Metrics	LPA25-30	1953	12-Jan-06	12-Jan-07
0589	Cable Coaxial, GORE A2P01POL118, 2.3 m	HL	GORE-3	176	10-Oct-06	10-Oct-07
0593	Antenna Mast, 1-4 m Pneumatic	Madgesh	AM-F1	101	03-Feb-06	03-Feb-07
0594	Turn Table for anechoic chamber flush mount d=1.2 m Pneumatic	HL	TT-WDC1	102	27-Jan-06	27-Jan-07
1004	Cable Coaxial , ANDREW PSWJ4 , 6m	HL	ANDREW-6	163	27-Jan-06	27-Jan-07
1425	EMI Receiver, 9 kHz - 2.9 GHz	Agilent Technologies (HP)	8542E	3710A00222, 3705A00204	27-Jan-06	27-Jan-07
1430	EMI Receiver, 9 kHz - 2.9 GHz	Agilent Technologies (HP)	8542E	3807A00262, 3705A00217	27-Jan-06	27-Jan-07
1553	Cable RF, 3.5 m	Alpha Wire	RG-214	1553	27-Jan-06	27-Jan-07
1566	Cable RF, 2 m	Huber-Suhner	Sucoflex 104PE	13094/4PE	27-Jan-06	27-Jan-07
1947	Cable 18GHz, 6.5 m, blue	Rhophase Microwave Limited	NPS-1803A-6500-NPS	T4974	27-Jan-06	27-Jan-07
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W, N-type	EMC Test Systems	3115	9911-5964	22-Mar-06	22-Mar-07
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	27-Jan-06	27-Jan-07
2109	Anechoic Chamber 6(L) x 5.5(W) x 2.95(H) m	HL	AC-2	2109	12-Dec-06	12-Dec-07
2697	Antenna, 30 MHz - 3.0 GHz	Sunol Sciences. Corp. Pleasanton, California USA	JB3	A022805	10-Mar-06	10-Mar-07
2780	EMS analyzer, 100 Hz to 26.5 GHz	Agilent Technologies (HP)	E7405A	MY4510246	11-Jun-06	11-Jun-07

9 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 %

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.

Person for contact: Mr. Alex Usoskin, CEO.

10 APPENDIX C Test facility description

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

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

Person for contact: Mr. Alex Usoskin, CEO.

11 APPENDIX D Specification references

47CFR part 15: 2006	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.

12 APPENDIX E Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(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

13 APPENDIX F Test equipment correction factors

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

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
Double-ridged wave guide horn antenna
Model 3115, S/N 9911-5964

Frequency, MHz	Antenna factor, dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.6
2500.0	28.9
3000.0	31.2
3500.0	32.0
4000.0	32.5
4500.0	32.7
5000.0	33.6
5500.0	35.1
6000.0	35.4
6500.0	34.9
7000.0	36.1
7500.0	37.8
8000.0	38.0
8500.0	38.1
9000.0	39.1
9500.0	38.3
10000.0	38.6
10500.0	38.2
11000.0	38.7
11500.0	39.5
12000.0	40.0
12500.0	40.4
13000.0	40.5
13500.0	41.1
14000.0	41.6
14500.0	41.7
15000.0	38.7
15500.0	38.2
16000.0	38.8
16500.0	40.5
17000.0	42.5
17500.0	45.9
18000.0	49.4

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).

Log periodic antenna factor

Electro-Metrics, model LPA-25/30, serial number 1953

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
200	15.2	625	25.2
225	15.1	650	25.8
250	16.3	675	27.2
275	17.2	700	27.6
300	19.6	725	27.6
325	18.4	750	27.6
350	19.0	775	28.0
375	20.0	800	28.2
400	20.9	825	29.4
425	21.3	850	29.9
450	22.1	875	30.0
475	22.7	900	30.4
500	23.2	925	30.6
525	23.9	950	30.8
550	24.2	975	31.6
575	24.6	1000	32.1
600	24.7		

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 calibration
Sunol Sciences Inc., model JB3, serial number A022805

Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain
30	-22.3	-22.5	0.01	620	19.7	6.3	4.27	1215	24.9	7.0	5.05	1910	28.3	7.1	5.08	2405	30.9	6.9	4.93
35	-18.5	-17.4	0.02	625	19.7	6.5	4.42	1220	24.9	7.0	4.99	1915	28.5	6.9	4.91	2410	30.9	6.9	4.89
40	-14.7	-12.5	0.06	630	19.6	6.6	4.57	1225	25.1	6.9	4.91	1920	28.6	6.8	4.74	2415	31.0	6.9	4.85
45	-11.3	-8.1	0.16	635	19.7	6.5	4.48	1230	26.2	6.8	4.82	1925	28.7	6.8	4.75	2420	31.0	6.8	4.82
50	-11.3	-8.1	0.16	640	19.9	6.4	4.40	1235	25.1	7.0	4.96	1930	28.7	6.8	4.76	2425	31.1	6.8	4.81
55	-9.9	-4.7	0.34	645	19.9	6.5	4.45	1240	25.0	7.1	5.09	1935	28.7	6.7	4.72	2430	31.0	6.8	4.87
60	-7.8	-2.1	0.62	655	19.9	6.6	4.60	1250	25.0	7.1	5.15	1940	28.8	6.7	4.69	2435	31.0	6.9	4.88
65	-8.5	-2.0	0.63	660	19.9	6.7	4.69	1255	25.0	7.2	5.25	1945	28.4	7.1	5.12	2440	31.2	6.8	4.74
70	-9.0	-1.9	0.64	665	19.9	6.7	4.70	1260	24.9	7.3	5.36	1955	28.5	7.0	5.07	2450	31.0	7.0	4.96
75	-13.7	-1.1	0.78	675	20.0	6.7	4.71	1265	25.0	7.3	5.31	1965	28.6	7.0	5.07	2455	31.0	7.0	5.01
80	-8.4	-0.2	0.97	675	20.1	6.7	4.71	1270	25.1	7.2	5.26	1965	28.5	7.1	5.17	2460	30.9	7.2	5.19
85	-8.0	0.8	1.20	680	20.1	6.7	4.71	1275	25.3	7.0	5.05	1970	28.4	7.3	5.33	2465	31.1	6.9	4.95
90	-8.2	1.1	1.29	685	20.1	6.8	4.79	1280	25.5	6.8	4.84	1975	28.4	7.2	5.28	2470	31.3	6.8	4.76
95	-9.2	0.5	1.13	690	20.1	6.9	4.88	1285	25.4	7.0	4.97	1980	28.5	7.2	5.22	2475	31.4	6.7	4.69
100	-10.6	-0.4	0.92	695	20.2	6.8	4.82	1290	25.3	7.1	5.10	1985	28.5	7.2	5.22	2480	31.3	6.8	4.79
105	-11.7	-1.1	0.78	700	20.3	6.8	4.76	1295	25.3	7.2	5.22	1990	28.6	7.2	5.21	2485	31.1	7.0	5.00
110	-12.6	-1.6	0.70	705	20.4	6.8	4.75	1300	25.2	7.3	5.33	1995	28.6	7.2	5.24	2490	31.1	7.0	4.99
115	-13.3	-1.9	0.65	710	20.5	6.8	4.75	1305	25.3	7.2	5.21	1995	28.6	7.2	5.27	2495	31.2	7.0	4.99
120	-13.9	-2.1	0.62	715	20.5	6.8	4.80	1310	25.5	7.1	5.09	1995	28.5	7.3	5.36	2500	30.9	7.2	5.27
125	-14.2	-2.0	0.63	720	20.5	6.9	4.85	1315	25.4	7.2	5.24	2000	28.5	7.4	5.45	2505	31.1	7.1	5.15
130	-14.2	-1.7	0.68	725	20.6	6.8	4.81	1320	25.3	7.3	5.36	1915	28.5	7.3	5.38	2510	31.0	7.2	5.22
135	-13.8	-1.0	0.79	730	20.7	6.8	4.77	1325	25.5	7.2	5.21	1920	28.6	7.3	5.31	2515	31.0	7.2	5.26
140	-13.4	-0.3	0.94	735	20.9	6.7	4.65	1330	25.6	7.0	5.06	1925	28.6	7.3	5.35	2520	31.2	7.0	5.05
145	-13.1	0.3	1.08	740	21.0	6.6	4.53	1335	25.7	7.1	5.07	1930	28.6	7.3	5.39	2525	30.8	7.4	5.54
150	-12.8	0.8	1.21	745	21.0	6.6	4.58	1340	25.7	7.1	5.07	1935	28.6	7.3	5.39	2530	31.7	7.0	5.37
160	-12.7	1.6	1.44	755	21.0	6.8	4.74	1350	25.7	7.1	5.17	1945	28.5	7.5	5.59	2540	31.2	7.1	5.59
165	-12.5	2.0	1.59	760	21.0	6.8	4.83	1355	25.8	7.0	5.06	1950	28.6	7.4	5.48	2545	31.0	7.3	5.43
170	-12.2	2.6	1.83	765	21.1	6.8	4.73	1360	25.9	6.9	4.95	1955	28.6	7.5	5.57	2550	31.0	7.3	5.39
175	-11.8	3.3	2.13	770	21.3	6.7	4.64	1365	26.0	6.9	4.95	1960	28.6	7.5	5.65	2555	31.1	7.2	5.30
180	-11.6	3.7	2.36	775	21.3	6.7	4.68	1370	26.0	6.9	4.96	1965	28.6	7.5	5.65	2560	31.1	7.2	5.30
190	-11.6	4.2	2.61	785	21.3	6.8	4.77	1380	26.0	7.0	5.06	1975	28.9	7.2	5.22	2570	31.1	7.3	5.37
200	-13.1	3.2	2.07	795	21.4	6.8	4.79	1390	26.1	6.9	4.92	1985	29.1	7.1	5.11	2580	31.6	6.9	4.87
205	-12.0	4.4	2.76	800	21.5	6.8	4.77	1395	26.2	6.9	4.94	1990	29.1	7.0	5.06	2585	31.6	6.8	4.79
210	-11.0	5.6	3.66	805	21.6	6.7	4.71	1400	26.2	7.0	4.96	1995	29.1	7.1	5.09	2590	31.6	6.8	4.88
215	-11.6	5.6	3.66	810	21.7	6.7	4.65	1405	26.1	7.0	5.02	2000	29.1	7.1	5.11	2595	31.5	7.0	4.97
220	-11.6	5.5	3.52	815	21.7	6.7	4.72	1410	26.1	7.1	5.09	2005	29.1	7.2	5.10	2600	31.6	6.9	4.85
225	-11.7	5.5	3.55	820	21.7	6.8	4.80	1415	26.2	7.0	5.02	2010	29.1	7.1	5.15	2605	31.3	7.2	5.30
230	-11.9	5.5	3.57	825	21.7	6.8	4.82	1420	26.3	7.0	4.96	2015	29.2	7.1	5.13	2610	31.4	7.1	5.15
235	-12.1	5.5	3.56	830	21.7	6.9	4.85	1425	26.2	7.1	5.10	2020	29.2	7.1	5.18	2615	31.7	6.9	4.88
240	-12.3	5.5	3.54	835	21.8	6.8	4.82	1430	26.1	7.2	5.25	2025	29.3	7.1	5.08	2620	31.6	7.0	4.97
245	-12.3	5.7	3.71	840	21.9	6.8	4.80	1435	26.1	7.2	5.24	2030	29.3	7.0	5.05	2625	31.4	7.1	5.17
250	-12.4	5.9	3.89	845	21.9	6.8	4.85	1440	26.2	7.2	5.24	2035	29.4	7.1	5.07	2630	31.7	7.0	5.00
255	-12.5	5.9	3.85	850	21.9	6.9	4.86	1445	26.3	7.1	5.11	2040	29.3	7.1	5.13	2635	31.8	6.8	4.82
260	-12.7	5.8	3.83	855	22.0	6.8	4.80	1450	26.5	7.0	4.98	2045	29.2	7.2	5.23	2640	31.7	7.0	4.98
265	-13.2	5.5	3.54	860	22.1	6.8	4.74	1455	26.4	7.1	5.07	2050	29.2	7.2	5.27	2645	31.7	6.9	4.93
270	-13.7	5.2	3.27	865	22.0	6.9	4.92	1460	26.4	7.1	5.17	2055	29.3	7.2	5.21	2650	31.8	6.9	4.85
275	-13.7	5.3	3.39	870	21.9	7.1	5.11	1465	26.4	7.2	5.19	2060	29.5	7.0	5.02	2655	31.8	6.9	4.85
280	-13.4	5.4	3.51	875	21.9	7.1	5.08	1470	26.4	7.2	5.22	2065	29.4	7.1	5.12	2660	31.7	7.0	5.02
285	-13.7	5.6	3.61	880	22.1	7.0	5.05	1475	26.4	7.1	5.17	2070	29.4	7.1	5.10	2665	32.0	6.7	4.71
290	-13.7	5.7	3.72	885	22.1	7.0	5.06	1480	26.5	7.1	5.12	2075	29.5	7.0	5.01	2670	32.0	6.7	4.67
295	-13.8	5.8	3.77	890	22.1	7.0	5.06	1485	26.5	7.1	5.14	2080	29.8	6.8	4.76	2675	31.9	6.8	4.81
300	-13.9	5.8	3.81	895	22.2	7.1	5.09	1490	26.5	7.1	5.17	2085	29.7	6.9	4.89	2680	31.7	7.0	5.04
305	-14.0	5.9	3.85	900	22.2	7.1	5.12	1495	26.5	7.2	5.24	2090	29.7	6.9	4.86	2685	31.9	6.8	4.83
310	-14.1	5.9	3.88	905	22.3	7.1	5.09	1500	26.5	7.2	5.24	2095	29.8	6.8	4.78	2690	32.1	6.7	4.72
315	-14.3	5.9	3.89	910	22.3	7.0	5.05	1505	26.5	7.2	5.27	2100	29.9	6.8	4.75	2695	32.1	6.7	4.71
320	-14.4	5.9	3.90	915	22.4	7.0	4.99	1510	26.6	7.2	5.23	2105	29.8	6.8	4.81	2700	32.0	6.8	4.81
325	-14.5	5.9	3.92	920	22.6	6.9	4.92	1515	26.6	7.2	5.30	2110	29.9	6.8	4.78	2705	32.0	6.8	4.80
330	-14.6	5.9	3.93	925	22.7	6.9	4.85	1520	26.6	7.3	5.38	2115	29.9	6.8	4.76	2710	32.1	6.8	4.79
335	-14.7	6.0	4.02	930	22.8	6.8	4.77	1525	26.5	7.3	5.37	2120	29.9	6.8	4.84	2715	32.1	6.7	4.71
340	-14.7	6.0	4.02	935	22.8	6.8	4.83	1530	26.6	7.3	5.36	2125	29.8	6.9	4.89	2720	32.4	6.5	4.47
345	-14.9	6.1	4.06	940	22.8	6.9	4.89	1535	26.6	7.4	5.44	2130	29.9	6.9	4.90	2725	32.2	6.7	4.63
350	-15.1	6.0	3.99	945	22.8	6.9	4.87	1540	26.5	7.4	5.53	2135	29.8	6.9	4.94	2730	31.9	7.0	5.05
360	-15.6	5.8	3.78	955	23.0	6.8	4.81	1550	26.5	7.5	5.63	2145	29.9	6.9	4.92	2740	31.6	7.1	5.46
365	-15.5	5.9	3.89	960	23.1	6.8	4.77	1555	26.7	7.3	5.39	2150	29.9	7.0	4.98	2745	31.9	7.0	5.06
370	-15.5	6.0	4.01	965	23.1	6.7	4.73	1560	26.9	7.1	5.16	2155	29.8	7.1	5.10	2750	32.0	6.9	4.94
375	-15.6	6.1	4.04	970	23.2	6.7	4.69	1565	26.9	7.2	5.20	2160	29.8	7.1	5.09	2755	32.0	7.0	4.98
380	-15.7	6.1	4.05	975	23.3	6.6	4.62	1570	26.9	7.2	5.20	2165	29.7	7.0	5.07	2760	32.3	7.0	5.06
385	-15.7	6.2	4.15	980	23.5	6.6	4.54	1575	27.0	7.2	5.23	2170	29.9	7.1					

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

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

Cable loss
Cable RF, 2m, model: Sucoflex 104PE, S/N 13094/4PE, HL 1566

No.	Frequency, MHz	Cable loss, dB	Tolerance, dB	Measurement uncertainty, dB
1	30	0.10	≤ 5.0	±0.12
2	50	0.13		
3	100	0.20		
4	300	0.33		
5	500	0.45		
6	800	0.60		
7	1000	0.65		
8	1500	0.91		
9	2000	1.08		
10	2500	1.19		
11	3000	1.28		
12	3500	1.49		
13	4000	1.63	≤ 5.0	±0.17
14	4500	1.63		
15	5000	1.66		
16	5500	1.88		
17	6000	1.96		
18	6500	1.93		
19	7000	2.07		
20	7500	2.37		
21	8000	2.34		
22	8500	2.64		
23	9000	2.68		
24	9500	2.64		
25	10000	2.70		
26	10500	2.84		
27	11000	2.88		
28	11500	3.19		
29	12000	3.15		
30	12500	3.20	≤ 5.0	±0.26
31	13000	3.22		
32	13500	3.47		
33	14000	3.41		
34	14500	3.59		
35	15000	3.79		
36	15500	4.24		
37	16000	4.12		
38	16500	4.46		
39	17000	4.50		
40	17500	4.49		
41	18000	4.45		

Cable loss

Cable coaxial, GORE A2P01POL118, 2.3 m, model GORE-3, serial number 176, HL 0589
+ Cable coaxial, ANDREW PSWJ4, 6 m, model: ANDREW-6, serial number 163, 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		±0.17
18	3300	3.47		
19	3600	3.62		
20	3900	3.84		
21	4200	3.92		
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 18 GHz, 6.5 m, blue, model NPS-1803A-6500-NPS, serial number T4974, HL 1947
Calibration data

Frequency, GHz	Insertion 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	Insertion 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, serial number C-56, 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		