

TEST REPORT

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

FOR:

Visonic Technologies Ltd.

**ELPAS Local Positioning
Systems**

Baby Tag IR/RF/LF Tech

Model: 5-BTC00433-A

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1 Applicant information

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Telephone: +972 3768 1408
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E-mail: ZachiH@visonic.com
Contact name: Mr. Zachi Holzman

2 Equipment under test attributes

Product name: Baby Tag IR/RF/LF Tech
Product family: ELPAS Local Positioning Systems
Model: 5-BTC00433-A
Serial number: 12401590
Receipt date: 8/17/2005

3 Manufacturer information

Manufacturer name: Visonic Technologies Ltd.
Address: Habarzel street 30, Tel Aviv, 69710, Israel
Telephone: +972 3768 1408
Fax: +972 3768 1415
E-mail: ZachiH@visonic.com
Contact name: Mr. Zachi Holzman

4 Test details

Project ID: 16642
Location: Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel
Test started: 8/17/2005
Test completed: 11/11/2007
Test specifications: FCC Part 15, subpart C, §15.231(a), 15.231(e); subpart B, §15.109

5 Tests summary

Test	Status
Transmitter characteristics	
Section 15.231(a), 15.231(e), 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	Pass
Section 15.111, Conducted emission at receiver antenna port	Not required

Testing was completed against the 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.

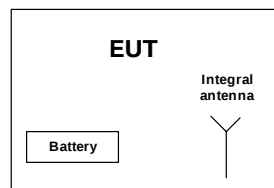
	Name and Title	Date	Signature
Tested by:	Mr. A. Lane, test engineer	November 11, 2007	
	Mr. M. Nikishin, EMC and radio group leader		
Reviewed by:	Ms. N. Averin, certification engineer	November 13, 2007	
Approved by:	Mr. M. Nikishin, EMC and radio group leader	November 13, 2007	

6 EUT description

6.1 General information

The Baby Tag is a transmitter attached to a baby's ankle, used for a real-time infant location monitoring. The EUT is a triple technology tag offering a combination of IR, RF (433.92 MHz) and LF technologies. Transmission using RF and IR technologies broadcasts the tag's condition (moving/at rest, battery state, tamper wire) and pinpoints the location (identifying the exact room, hallway or nearby exit). The LF reader sensor capability detects when the infant approaches a protected exit. The EUT has an LF receiver operating at 125 kHz, which receives signals from LF transmitter (reader) at 125 kHz. The EUT is equipped with an integral antenna and is powered from 3 VDC rechargeable Lithium battery.

6.2 Test configuration



6.3 EUT general view



Test specification:	Sections 15.231(a), 15.231 (e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/4/2006 5:29:35 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
Remarks:			

7 Transmitter tests according to FCC 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;
- Duration of each transmission shall not be greater than 1 second;
- Silent period between transmissions shall be at least 30 times the duration of the transmission;
- Silent period between transmissions shall be in no case less than 10 seconds.
- A transmitter activated automatically shall cease transmissions within 5 seconds after activation.

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 measurements of transmission duration

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 transmission time was captured and shown in the associated plots. The test results were recorded in Table 7.1.2, Table 7.1.3.

Figure 7.1.1 Setup for transmitter shut down test



Test specification:	Sections 15.231(a), 15.231 (e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/4/2006 5:29:35 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 permitted	Supplier declaration	Comply
Duration of each transmission shall not be greater than 1 second	Plot 7.1.3	Comply
Silent period between transmissions shall be at least 30 times the duration of the transmission	Plot 7.1.4	Comply
Silent period between transmissions shall be in no case less than 10 seconds	Plot 7.1.4	Comply
A transmitter activated automatically shall cease transmissions within 5 seconds after activation	Plots 7.1.5, 7.1.6	Comply

Table 7.1.2 Total duration of supervision transmissions, FCC Part 15, subpart C, 15.231(e)

Pulse duration, ms	Pulse period, ms	Total burst duration, ms	Silent period between transmissions, s	Silent period between transmissions limit, s	Verdict
0.240	0.277	2.125	15.38	10	Comply

Table 7.1.3 Total duration of alarm/tamper transmissions, FCC Part 15, subpart C, §15.231(a)

Pulse duration, ms	Pulse period, ms	Total burst duration, ms	Train of four bursts duration, s	Interval between bursts, ms	Total transmission limit, s	Verdict
0.240	0.277	2.125	1.412	462	5	Comply

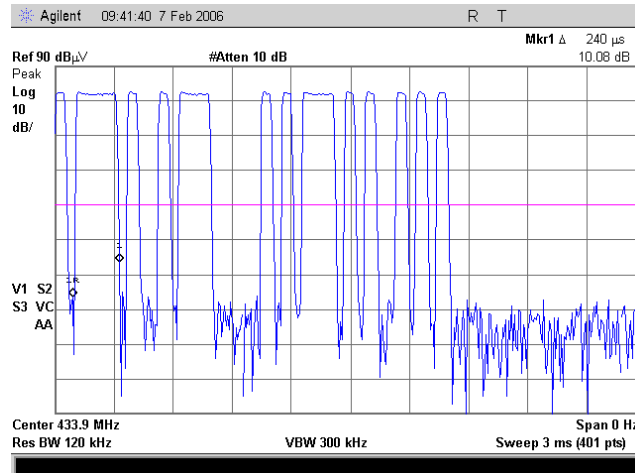
Reference numbers of test equipment used

HL 0337	HL 2780					
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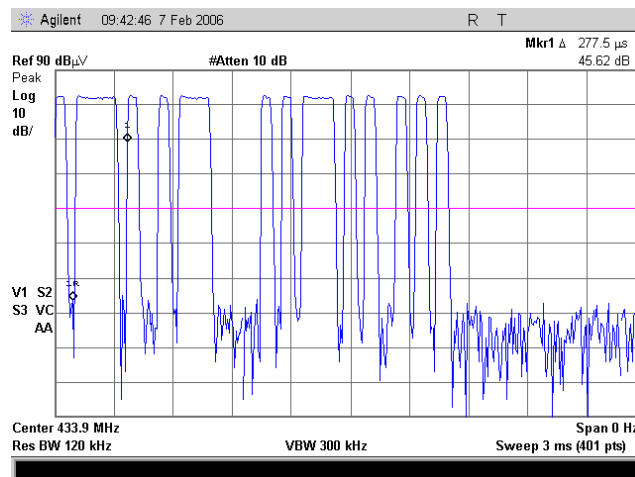
Full description is given in Appendix A.

Test specification:	Sections 15.231(a), 15.231 (e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/4/2006 5:29:35 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
Remarks:			

Plot 7.1.1 Pulse duration of alarm/tamper/supervision transmission

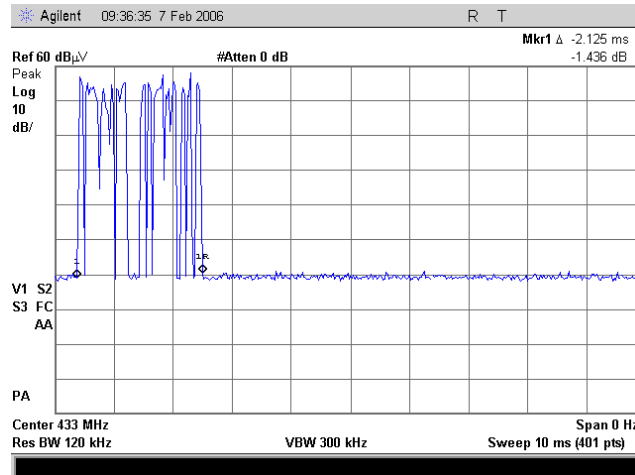


Plot 7.1.2 Pulse period of alarm/tamper/supervision transmission

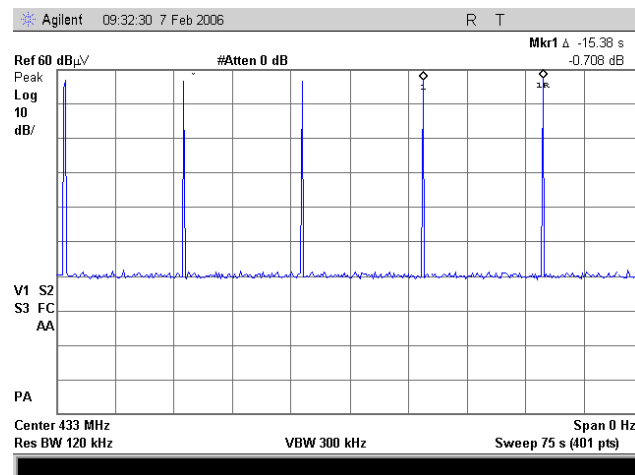


Test specification:	Sections 15.231(a), 15.231 (e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/4/2006 5:29:35 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
Remarks:			

Plot 7.1.3 Transmission burst duration of alarm/tamper/supervision transmission

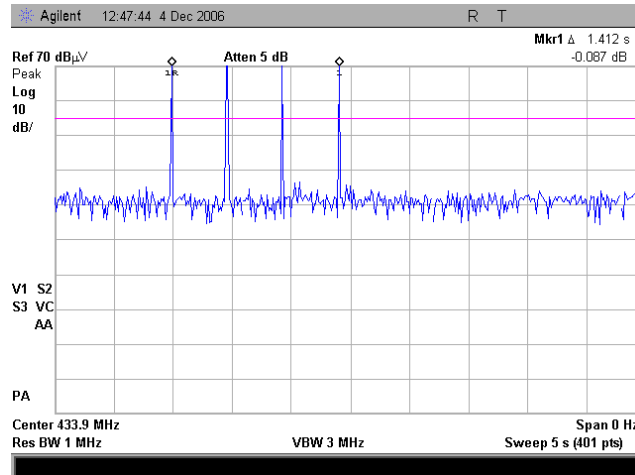


Plot 7.1.4 Silent period between two adjacent supervision transmissions

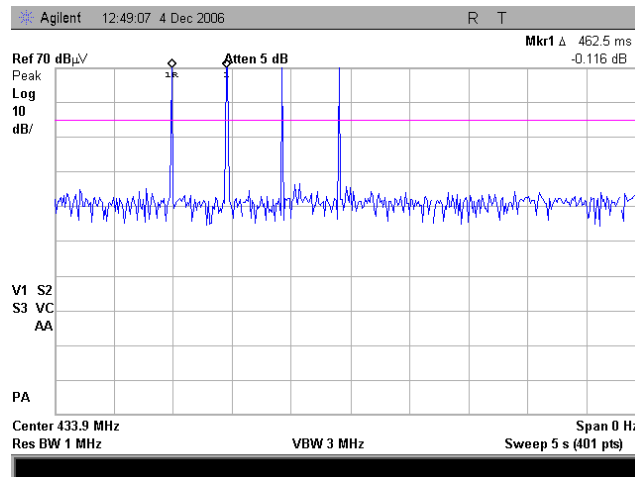


Test specification:	Sections 15.231(a), 15.231 (e), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/4/2006 5:29:35 PM		
Temperature: 24 °C	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 3 VDC
Remarks:			

Plot 7.1.5 Alarm/tamper transmission train duration



Plot 7.1.6 Alarm/tamper transmission, interval between bursts



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:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	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
433.92	92.87	72.87

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**	72.87	52.87
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 measurements were performed in three EUT orthogonal positions.

7.2.2.3 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.

7.2.2.4 The worst test results (the lowest margins) were found in the EUT horizontal (X) position, 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 measurements were performed in three EUT orthogonal positions.

7.2.3.3 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.

7.2.3.4 The worst test results (the lowest margins) were found in the EUT horizontal (X) position, 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:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

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

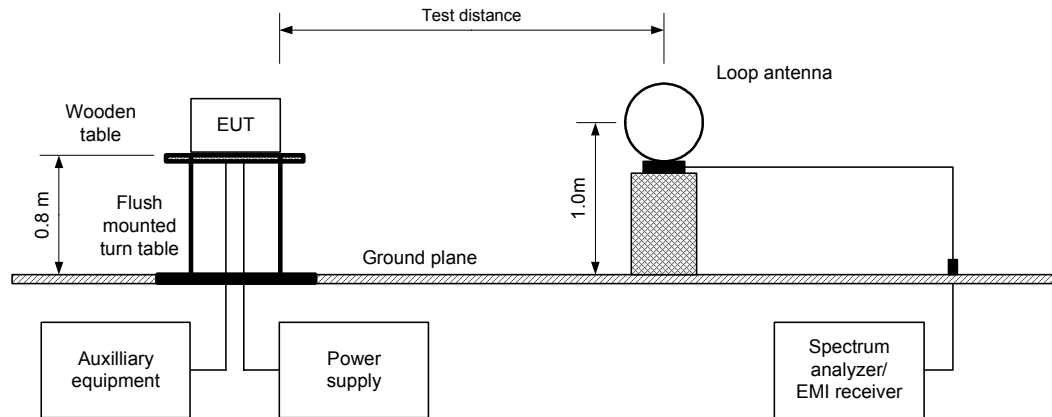
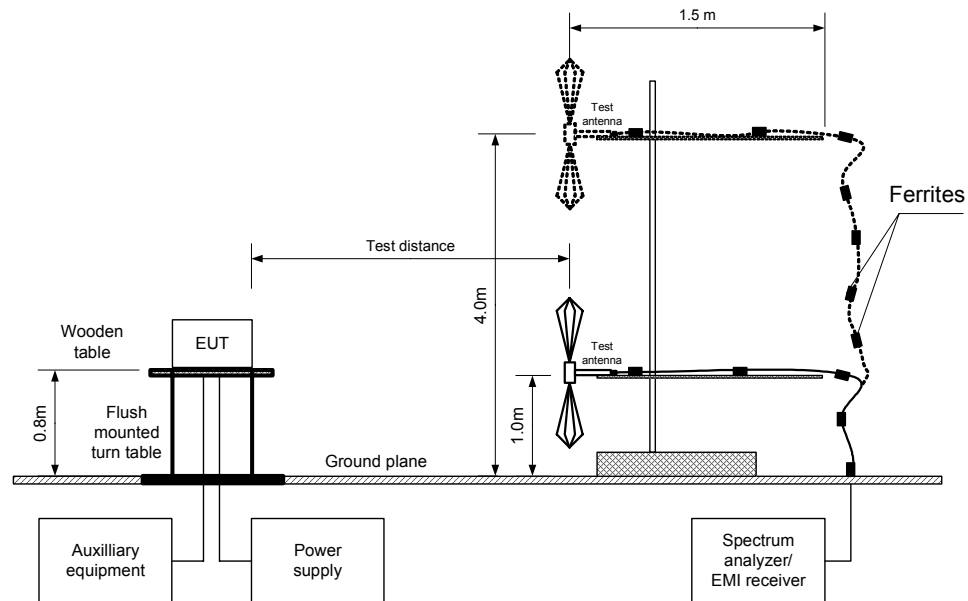


Figure 7.2.2 Setup for spurious emission field strength measurements above 30 MHz



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:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	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: X-axis
MODULATION: ASK
MODULATING SIGNAL: ID code
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
TRANSMITTER OUTPUT POWER: 0.005 mW
INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1 kHz (9 kHz – 150 kHz)
9.0 kHz (150 kHz – 30 MHz)
120 kHz (30 MHz – 1000 MHz)
1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

F, MHz	Antenna		Azimuth, degrees*	Peak field strength			Avr factor, dB	Average field strength			Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission											
433.93	V	1.70	60	69.93	92.87	-22.94	-34.7	35.23	72.87	-37.64	Pass
Spurious emissions											
0.009-0.15	No emissions were found.						-34.7	No emissions were found.			Pass
0.15-30	No emissions were found.						-34.7	No emissions were found.			
867.838	V	1.0	86	58.72	72.87	-14.15	-34.7	24.02	52.87	-28.85	Pass
1301.74	H	1.0	121	50.45	74.00	-23.55	-34.7	15.75	54.00	-38.25	
1735.81	H	1.2	60	53.84	72.87	-19.03	-34.7	19.14	52.87	-33.73	
2169.60	H	2.1	304	55.82	72.87	-17.05	-34.7	21.12	52.87	-31.75	
2603.52	H	2.0	330	53.68	72.87	-19.19	-34.7	18.98	52.87	-33.89	
3037.44	H	1.0	270	53.33	72.87	-19.54	-34.7	18.63	52.87	-34.24	
3471.36	H	1.2	240	54.83	72.87	-18.04	-34.7	20.13	52.87	-32.74	
4339.20	H	1.0	270	49.83	74.00	-24.17	-34.7	15.13	54.00	-38.87	

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

Table 7.2.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
0.240	0.277	2.125	100	Continuous	-34.7

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

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:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	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: X-axis
 MODULATION: ASK
 MODULATING SIGNAL: ID code
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 TRANSMITTER OUTPUT POWER: 0.005 mW
 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 spurious 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 0589	HL 0593	HL 0594	HL 0604	HL 1004
HL 1424	HL 1941	HL 2009	HL 2432				

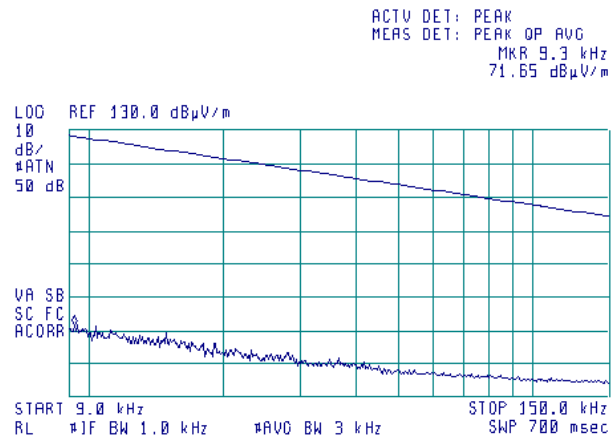
Full description is given in Appendix A.

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:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.1 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical & Horizontal
EUT POSITION: X-axis

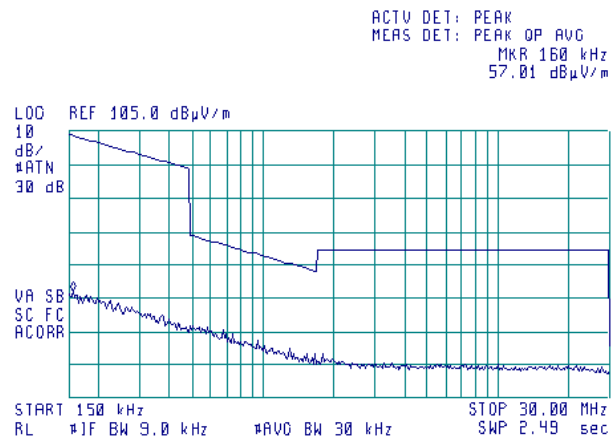
18:27:32 DEC 05, 2005



Plot 7.2.2 Radiated emission measurements from 0.15 to 30 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical & Horizontal
EUT POSITION: X-axis

18:32:40 DEC 05, 2005

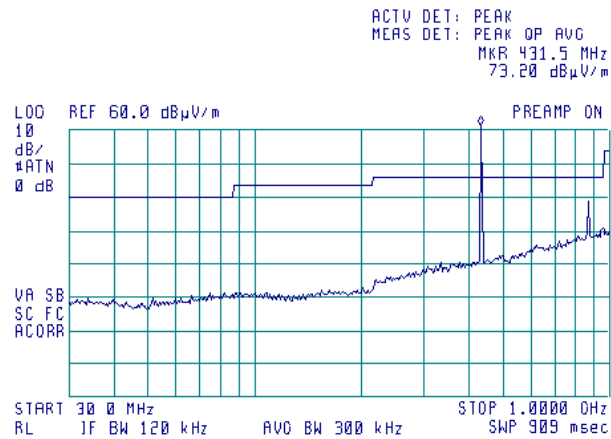


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.3 Radiated emission measurements from 30 to 1000 MHz

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

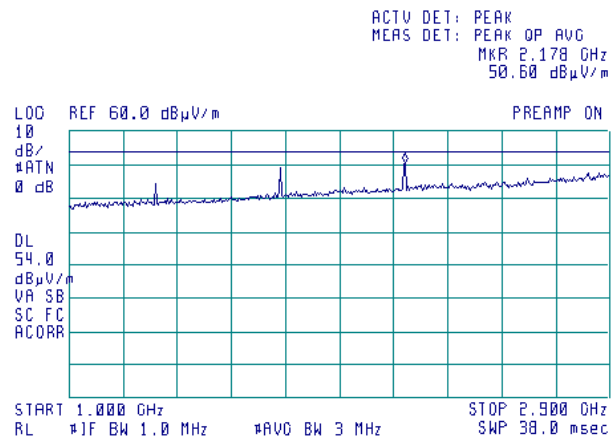
10:07:03 OCT 02, 2005



Plot 7.2.4 Radiated emission measurements from 1000 to 2900 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSZITION: X-axis

18:42:35 DEC 05, 2005



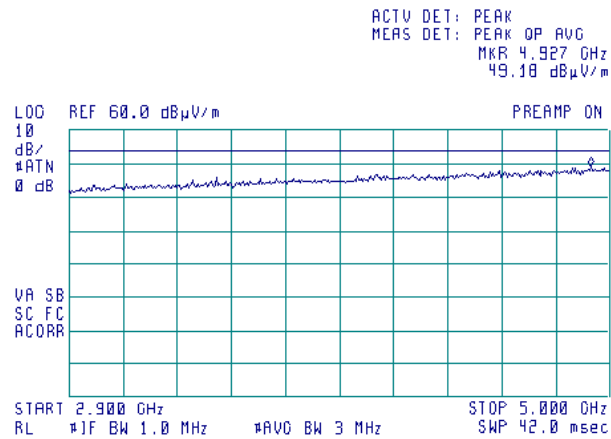


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.5 Radiated emission measurements from 2900 to 5000 MHz

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

11:21:42 OCT 02, 2005



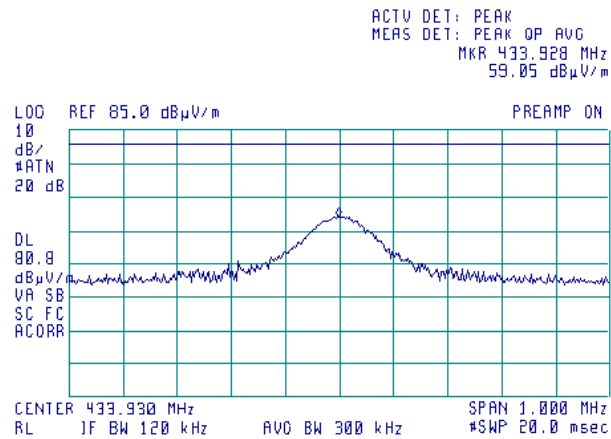


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.6 Radiated emission measurements at the fundamental frequency

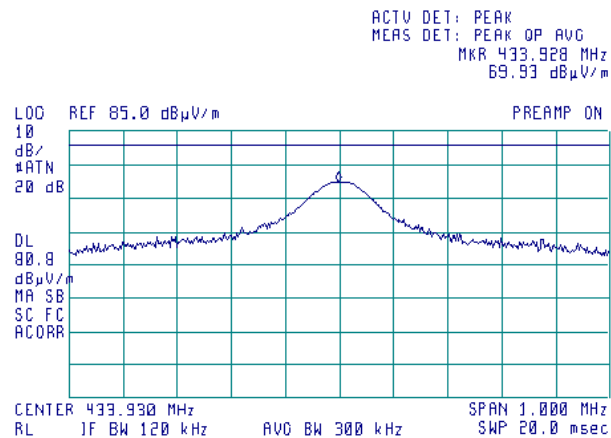
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis

10:52:34 AUG 25, 2005

**Plot 7.2.7 Radiated emission measurements at the fundamental frequency**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis

10:46:51 AUG 25, 2005



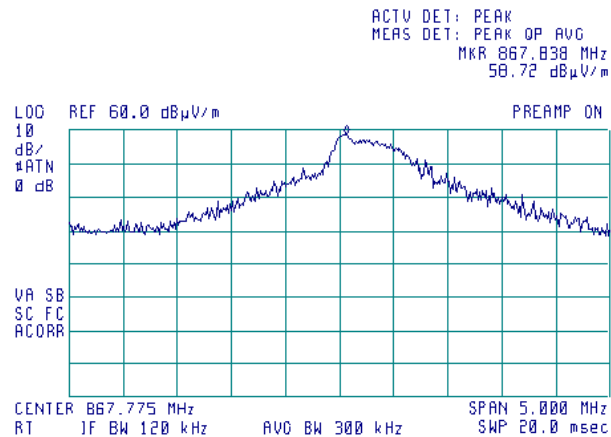


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.8 Radiated emission measurements at the second harmonic frequency

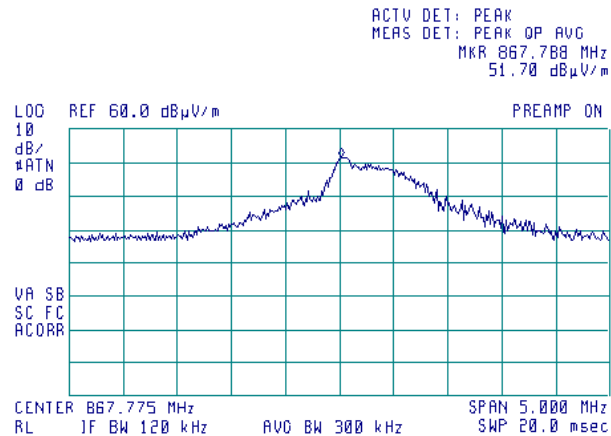
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis

10:24:55 OCT 02, 2005

**Plot 7.2.9 Radiated emission measurements at the second harmonic frequency**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis

10:18:41 OCT 02, 2005

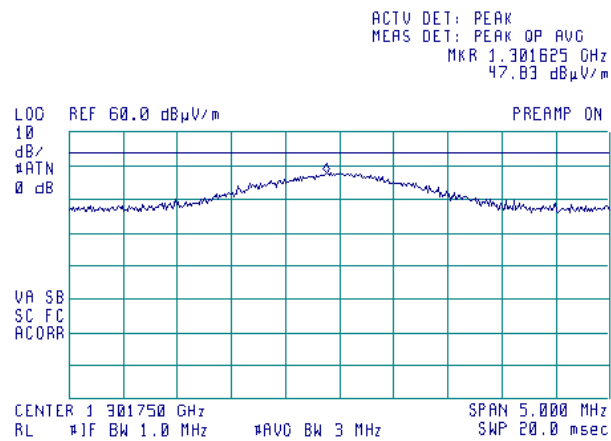


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.10 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis

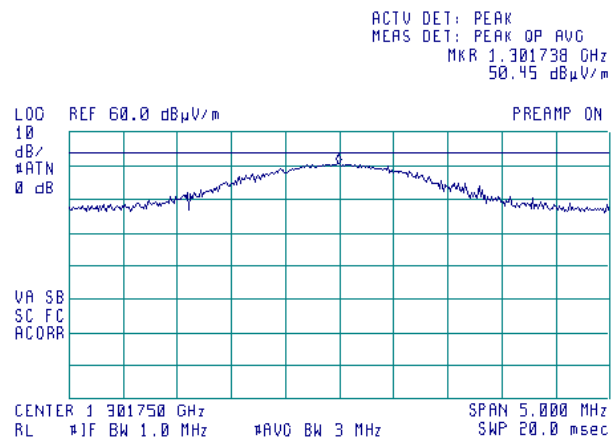
11:05:56 OCT 02, 2005



Plot 7.2.11 Radiated emission measurements at the third harmonic frequency

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

11:10:20 OCT 02, 2005



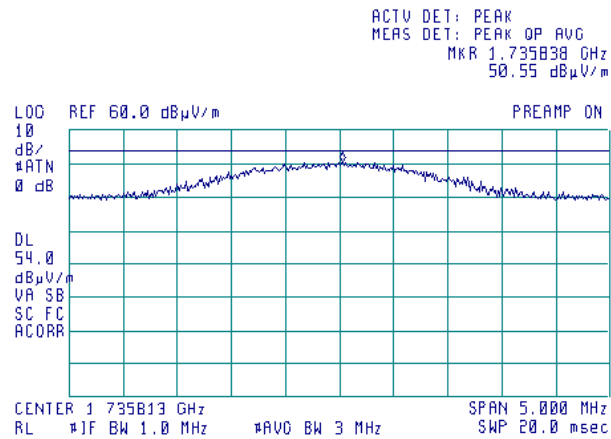


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.12 Radiated emission measurements at the forth harmonic frequency

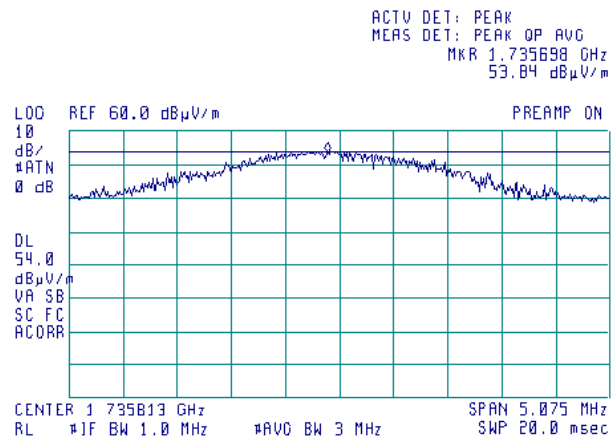
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis

17:46:43 DEC 05, 2005

**Plot 7.2.13 Radiated emission measurements at the forth harmonic frequency**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis

17:41:32 DEC 05, 2005



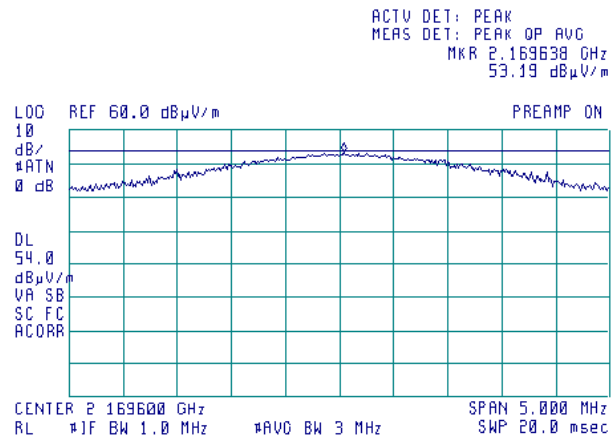


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.14 Radiated emission measurements at the fifth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis

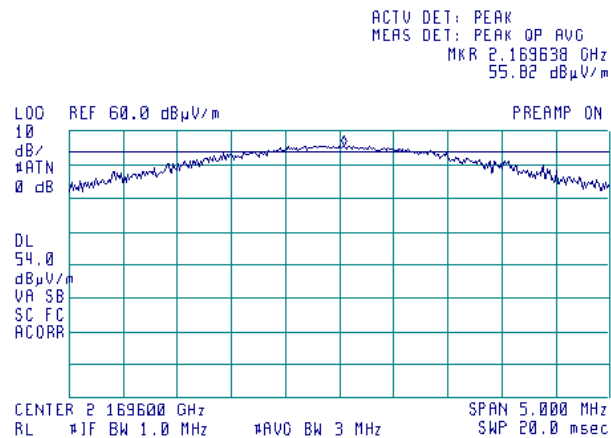
17:51:21 DEC 05, 2005



Plot 7.2.15 Radiated emission measurements at the fifth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis

17:56:40 DEC 05, 2005



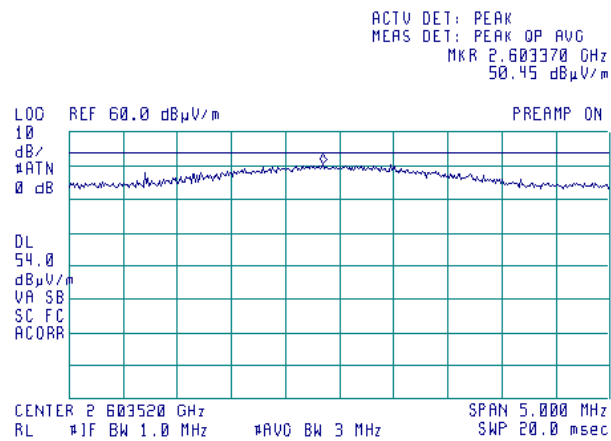


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.16 Radiated emission measurements at the sixth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis

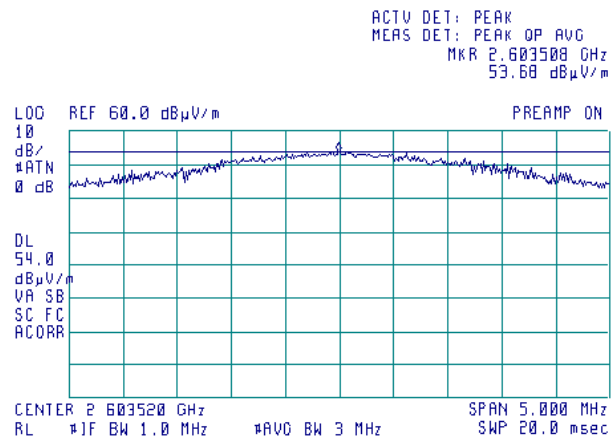
18:05:08 DEC 05, 2005



Plot 7.2.17 Radiated emission measurements at the sixth harmonic frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis

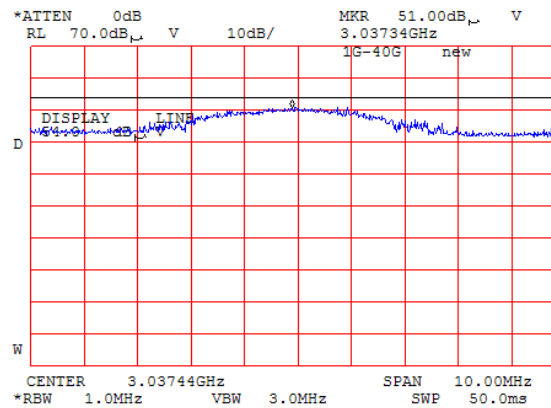
18:01:09 DEC 05, 2005



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:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

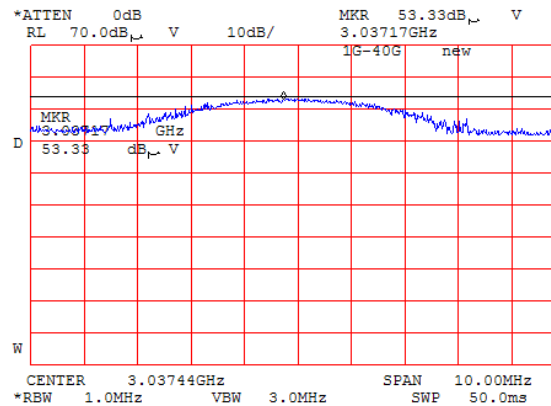
Plot 7.2.18 Radiated emission measurements at the seventh harmonic frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis



Plot 7.2.19 Radiated emission measurements at the seventh harmonic frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis

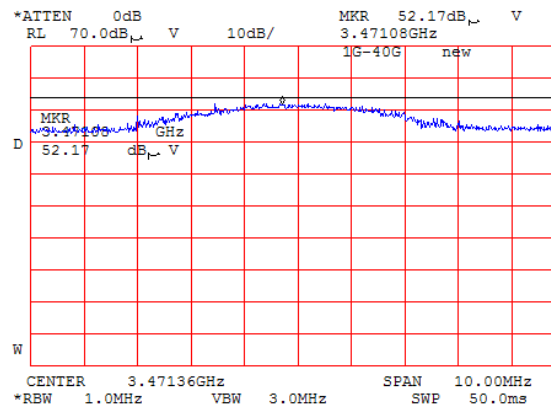




Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

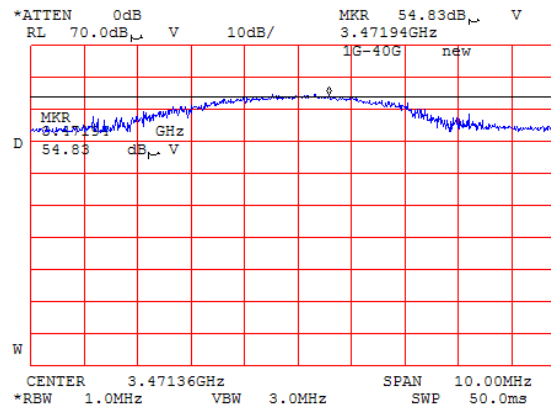
Plot 7.2.20 Radiated emission measurements at the eighth harmonic frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis



Plot 7.2.21 Radiated emission measurements at the eighth harmonic frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis

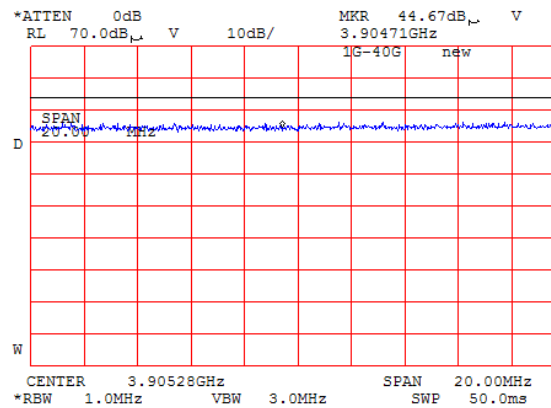




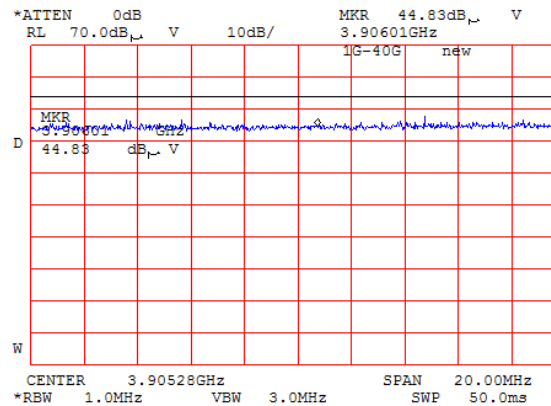
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.22 Radiated emission measurements at the ninth harmonic frequency

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X-axis

**Plot 7.2.23 Radiated emission measurements at the ninth harmonic frequency**

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X-axis

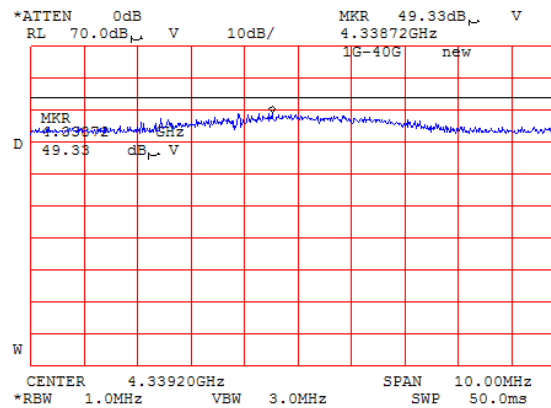




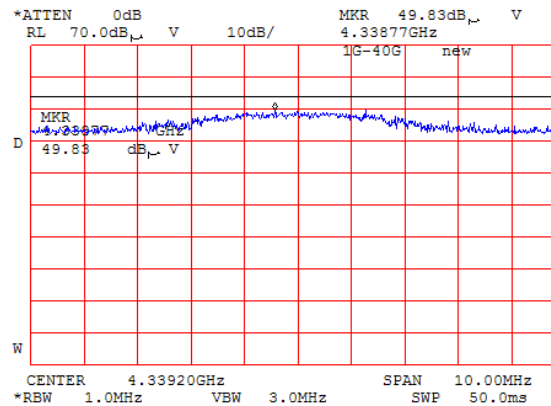
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.24 Radiated emission measurements at the tenth harmonic frequency

TEST SITE: OATS
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Vertical
 EUT POSITION: X-axis

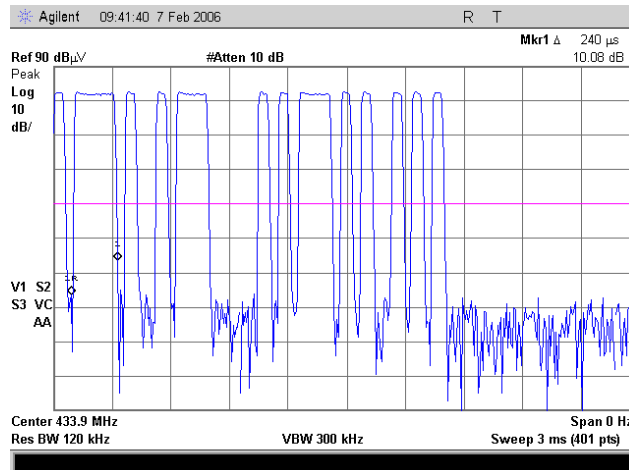
**Plot 7.2.25 Radiated emission measurements at the tenth harmonic frequency**

TEST SITE: OATS
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Horizontal
 EUT POSITION: X-axis

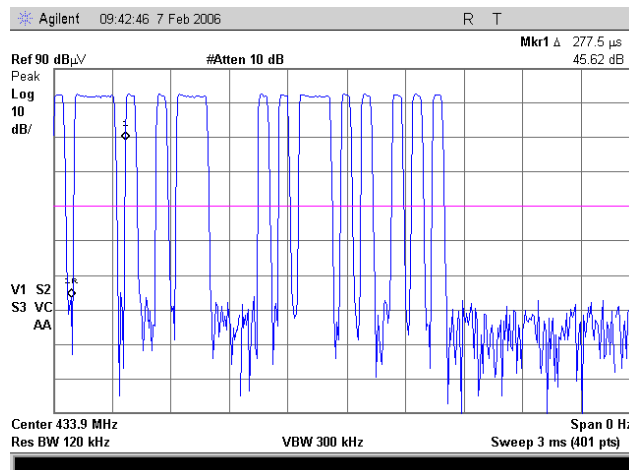


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.26 Transmission pulse duration



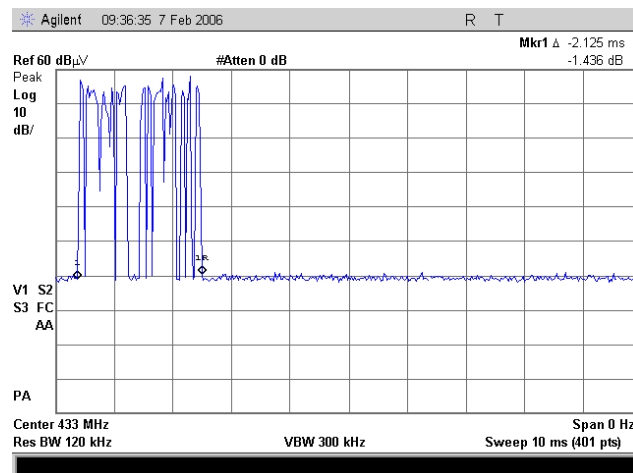
Plot 7.2.27 Transmission pulse period





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:	2/7/2006 8:49:39 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	Power Supply: 3 VDC
Remarks:			

Plot 7.2.28 Transmission burst duration



Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/24/2005 5:26:52 PM		
Temperature: 22 °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 plot.

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

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

7.3.2 Test procedure

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

7.3.2.2 The EUT was set to transmit modulated carrier.

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

Figure 7.3.1 Occupied bandwidth test setup



Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/24/2005 5:26:52 PM		
Temperature: 22 °C	Air Pressure: 1010 hPa	Relative Humidity: 40 %	Power Supply: 3 VDC
Remarks:			

Table 7.3.2 Occupied bandwidth test results

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

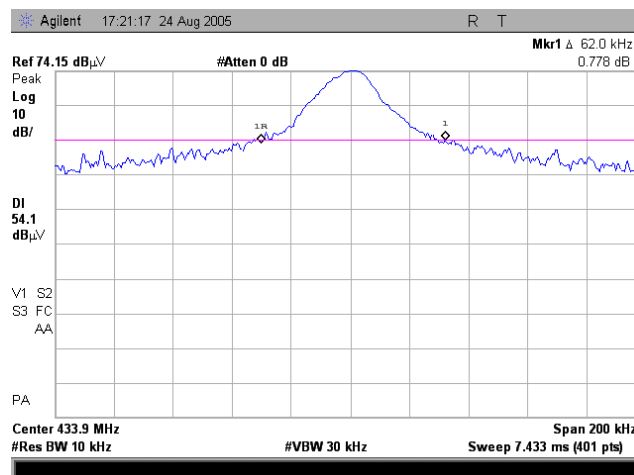
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
433.9	62.0	0.25	1082.5	-1020.5	Pass

Reference numbers of test equipment used

HL 1525	HL 2780							
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Full description is given in Appendix A.

Plot 7.3.1 Occupied bandwidth test result



Test specification:	Section 15.203, Antenna requirement		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	2/7/2006 2:46:07 PM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 39 %	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, Radiated emission, Class B		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/25/2005 8:42:07 AM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	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: $\text{Lim}_{S_2} = \text{Lim}_{S_1} + 20 \log(S_1/S_2)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

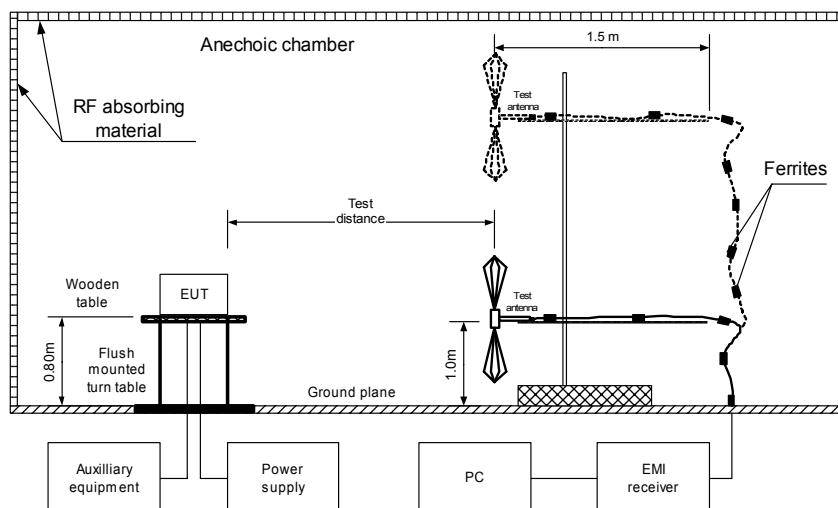
7.5.2 Test procedure

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 the antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was swept 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 worst test results (the lowest margins) 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





Test specification:	Section 15.109, Radiated emission, Class B		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/25/2005 8:42:07 AM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 3 VDC
Remarks:			

Table 7.5.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Receive / Standby
TEST SITE: ANECHOIC CHAMBER
TEST DISTANCE: 3 m
FREQUENCY RANGE: 30 MHz – 1000 MHz
DETECTOR USED: PEAK
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*				
No emissions were found.								Pass

FREQUENCY RANGE: 1000 MHz – 4.5 GHz
DETECTOR USED: PEAK
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 1849	HL 1850	HL 1941	HL 2109	HL 2432
HL 2697							

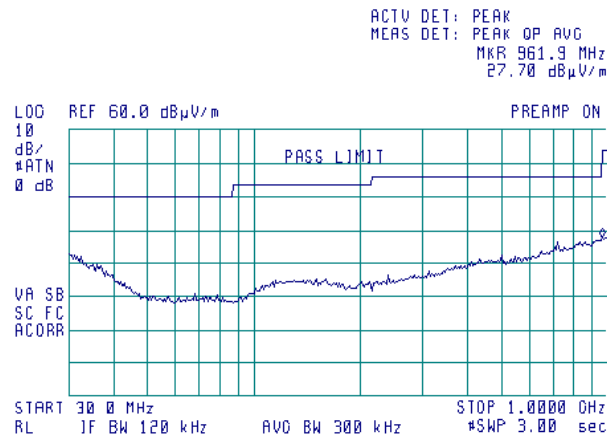
Full description is given in Appendix A.

Test specification:	Section 15.109, Radiated emission, Class B		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/25/2005 8:42:07 AM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 3 VDC
Remarks:			

Plot 7.5.1 Radiated emission measurements in 30- 1000 MHz range, vertical & horizontal antenna polarization

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

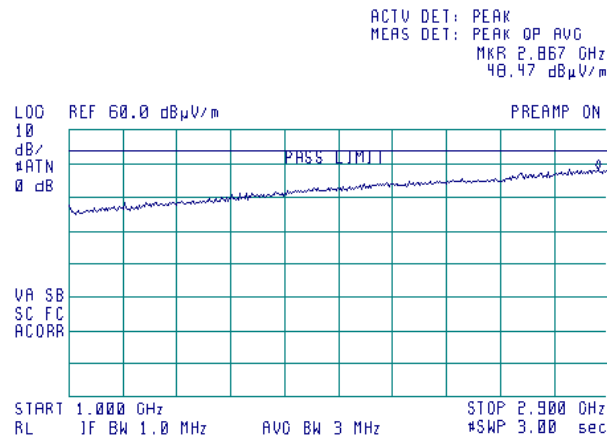
09:19:54 AUG 23, 2005



Plot 7.5.2 Radiated emission measurements in 1000- 2900 MHz range, vertical & horizontal antenna polarization

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

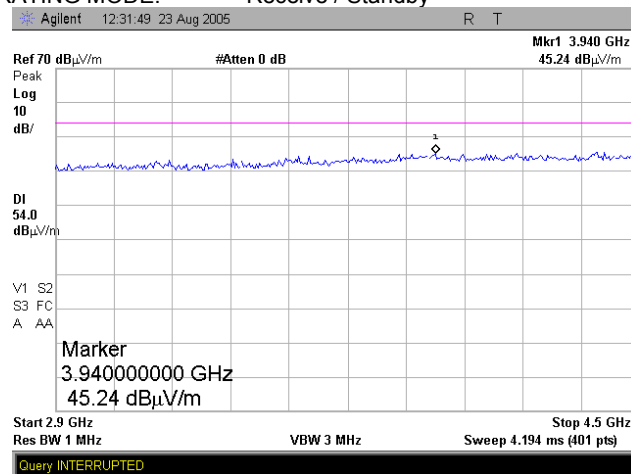
09:24:21 AUG 23, 2005



Test specification:	Section 15.109, Radiated emission, Class B		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/25/2005 8:42:07 AM		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 3 VDC
Remarks:			

Plot 7.5.3 Radiated emission measurements in 2900- 4500 MHz range, vertical & horizontal antenna polarization

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



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-07	12-Jun-08
0446	Antenna, Loop active, 10kHz-30MHz	EMCO	6502	2857	28-Jun-07	28-Jun-08
0465	Anechoic Chamber 9(L) x 6.5(W) x 5.5(H) m	HL	AC - 1	023	10-Oct-07	10-Oct-08
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A0025 3	10-Oct-07	10-Oct-08
0589	Cable Coaxial, GORE A2P01POL118, 2.3 m	HL	GORE-3	176	10-Oct-07	10-Oct-08
0593	Antenna Mast, 1-4 m Pneumatic	Madgesh	AM-F1	101	03-Feb-07	03-Feb-08
0594	Turn Table for anechoic chamber flush mount d=1.2 m Pneumatic	HL	TT-WDC1	102	27-Jan-07	27-Jan-08
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE 26 - 2000 MHz	EMCO	3141	9611-1011	27-Jan-07	27-Jan-08
1004	Cable Coaxial , ANDREW PSWJ4 , 6m	HL	ANDREW-6	163	27-Jan-07	27-Jan-08
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies (HP)	8564EC	3946A0021 9	12-Jun-07	12-Jun-08
1425	EMI Receiver, 9 kHz - 2.9 GHz	Agilent Technologies (HP)	8542E	3710A0022 2, 3705A0020 4	12-Jun-07	12-Jun-08
1525	Cable RF, 2 m	Telequis	MIL-C-17F-RG 058 CU	1525	11-Sep-07	11-Sep-08
1553	Cable RF, 3.5 m	Alpha Wire	RG-214	1553	12-Jun-07	12-Jun-08
1566	Cable RF, 2 m	Huber-Suhner	Sucoflex 104PE	13094/4PE	12-Jun-07	12-Jun-08
1849	Antenna mast with polarity control (Small Anechoic chamber)	Sh. I. Machines	AM-F4	1849	06-Feb-07	06-Feb-08
1850	Turntable	Sh. I. Machines	TT-M-3	1850	06-Feb-07	06-Feb-08
1941	Cable 18GHz, 4 m, green	Rhophase Microwave Limited	SPS-1803A-4000-NPS	T4657	18-Jan-07	18-Jan-08
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	18-Jan-07	18-Jan-08
2109	Anechoic Chamber 6(L) x 5.5(W) x 2.95(H) m	HL	AC-2	2109	12-Dec-06	12-Dec-07
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	22-Mar-07	22-Mar-08
2697	Antenna, 30 MHz - 3.0 GHz	Sunol Sciences. Corp. Pleasanton, California USA	JB3	A022805	10-Mar-07	10-Mar-08
2780	EMS analyzer, 100 Hz to 26.5 GHz	Agilent Technologies (HP)	E7405A	MY451024 6	11-Jun-07	11-Jun-08

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).

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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, HL 0446

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

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

Antenna factor

Biconilog antenna EMCO, model 3141, serial number 1011

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

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(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, dB	Num gain	Frequency, MHz	ACF, dB	Gain, dB	Num gain	Frequency, MHz	ACF, dB	Gain, dB	Num gain	Frequency, MHz	ACF, dB	Gain, dB	Num gain	Frequency, MHz	ACF, dB	Gain, dB	Num gain
30	22.2	-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	650	19.9	6.6	4.60	1245	25.0	7.1	5.12	1940	28.8	6.7	4.69	2435	31.0	6.9	4.88
65	8.5	-2.0	0.63	655	19.9	6.7	4.69	1250	25.0	7.1	5.15	1945	28.8	6.9	4.90	2440	31.2	6.8	4.74
70	9.0	-1.9	0.64	660	19.9	6.7	4.70	1255	24.9	7.3	5.36	1950	28.5	7.0	5.07	2445	31.1	6.9	4.91
75	9.8	-1.1	0.78	665	19.9	6.7	4.71	1260	25.0	7.3	5.31	1955	28.5	7.0	5.07	2450	31.0	7.0	4.96
80	8.4	-0.2	0.97	670	20.1	6.7	4.71	1265	25.1	7.2	5.26	1960	28.5	7.1	5.17	2455	31.0	7.0	5.01
85	8.0	0.8	1.20	675	20.1	6.7	4.71	1270	25.3	7.0	5.05	1965	28.4	7.3	5.33	2460	31.1	6.9	4.95
90	8.2	1.1	1.29	680	20.1	6.8	4.79	1275	25.6	6.8	4.84	1970	28.4	7.2	5.28	2465	31.3	6.8	4.76
95	9.2	0.5	1.13	685	20.1	6.9	4.88	1280	25.4	7.0	4.97	1975	28.5	7.2	5.22	2470	31.4	6.7	4.69
100	10.6	-0.4	0.92	690	20.2	6.8	4.82	1285	25.3	7.1	5.10	1980	28.5	7.2	5.22	2475	31.3	6.8	4.79
105	11.7	-1.1	0.78	695	20.3	6.8	4.76	1290	25.3	7.2	5.22	1985	28.6	7.2	5.21	2480	31.1	7.0	5.00
110	12.6	-1.6	0.70	700	20.4	6.8	4.75	1295	26.2	7.3	5.33	1990	28.6	7.2	5.24	2485	31.1	7.0	4.99
115	13.3	-1.9	0.65	705	20.5	6.8	4.75	1300	26.3	7.2	5.21	1995	28.6	7.2	5.27	2490	31.2	7.0	4.99
120	13.9	-2.1	0.62	710	20.5	6.8	4.80	1305	25.5	7.1	5.09	2000	28.5	7.3	5.38	2495	30.9	7.2	5.27
125	14.2	-2.0	0.63	715	20.5	6.9	4.85	1310	25.4	7.2	5.24	2005	28.5	7.4	5.45	2500	31.1	7.1	5.15
130	14.2	-1.7	0.68	720	20.6	6.8	4.81	1315	25.3	7.3	5.36	2010	28.5	7.3	5.38	2505	31.1	7.1	5.15
135	13.8	-1.0	0.79	725	20.6	6.8	4.81	1320	25.3	7.3	5.36	2015	28.5	7.3	5.38	2510	31.0	7.2	5.22
140	13.4	-0.3	0.94	730	20.7	6.8	4.77	1325	25.6	7.2	5.21	2020	28.6	7.3	5.31	2515	31.0	7.2	5.26
145	13.1	0.3	1.08	735	20.9	6.7	4.65	1330	25.6	7.0	5.06	2025	28.6	7.3	5.36	2520	31.2	7.0	5.05
150	12.9	0.1	1.21	740	21.0	6.6	4.53	1335	25.7	7.1	5.07	2030	28.6	7.3	5.39	2525	30.8	7.4	5.54
155	12.9	0.1	1.21	745	21.0	6.6	4.53	1340	25.7	7.1	5.07	2035	28.6	7.3	5.39	2530	31.6	7.0	5.37
160	12.7	1.6	1.44	750	21.0	6.8	4.74	1345	25.7	7.1	5.17	2040	28.5	7.5	5.59	2535	31.2	7.1	5.59
165	12.5	2.0	1.59	755	21.0	6.8	4.83	1350	25.8	7.0	5.06	2045	28.6	7.4	5.48	2540	31.0	7.3	5.43
170	12.2	2.6	1.83	760	21.1	6.8	4.73	1355	25.9	6.9	4.95	2050	28.6	7.5	5.57	2545	31.0	7.3	5.39
175	11.8	3.3	2.13	765	21.3	6.7	4.64	1360	26.0	6.9	4.95	2055	28.6	7.5	5.65	2550	31.1	7.2	5.30
180	11.6	3.7	2.36	770	21.3	6.7	4.64	1365	26.0	6.9	4.95	2060	28.6	7.5	5.65	2555	31.1	7.2	5.30
185	11.6	4.2	2.61	775	21.3	6.8	4.77	1370	26.0	7.0	5.06	2065	28.6	7.5	5.65	2560	31.0	7.4	5.47
190	11.6	4.2	2.61	780	21.3	6.8	4.77	1375	26.0	7.0	5.06	2070	28.9	7.2	5.22	2565	31.1	7.3	5.37
195	11.6	4.2	2.61	785	21.3	6.8	4.77	1380	26.0	7.0	5.06	2075	28.9	7.2	5.22	2570	31.1	7.3	5.37
200	13.1	3.2	2.07	790	21.4	6.8	4.79	1385	26.1	6.9	4.92	2080	29.1	7.1	5.11	2575	31.6	6.9	4.87
205	12.0	4.4	2.76	795	21.5	6.8	4.77	1390	26.2	6.9	4.94	2085	29.1	7.0	5.06	2580	31.6	6.8	4.79
210	11.0	5.6	3.66	800	21.6	6.7	4.71	1395	26.2	7.0	4.96	2090	29.1	7.1	5.09	2585	31.6	6.9	4.88
215	11.3	5.9	3.88	805	21.6	6.7	4.71	1400	26.2	7.0	4.96	2095	29.1	7.1	5.09	2590	31.6	6.9	4.88
220	11.6	5.5	3.52	810	21.7	6.7	4.72	1405	26.1	7.0	5.02	2100	29.1	7.1	5.11	2595	31.6	6.9	4.88
225	11.7	5.5	3.55	815	21.7	6.8	4.80	1410	26.2	7.0	5.02	2105	29.1	7.1	5.11	2600	31.6	6.9	4.88
230	11.9	5.5	3.57	820	21.7	6.8	4.82	1415	26.2	7.0	5.02	2110	29.2	7.1	5.13	2605	31.3	7.2	5.30
235	12.1	5.5	3.56	825	21.7	6.8	4.82	1420	26.3	7.0	4.96	2115	29.2	7.1	5.13	2610	31.4	7.1	5.15
240	12.3	5.5	3.54	830	21.7	6.9	4.85	1425	26.2	7.1	5.10	2120	29.2	7.1	5.18	2615	31.7	6.9	4.88
245	12.3	5.7	3.71	835	21.8	6.8	4.82	1430	26.1	7.2	5.25	2125	29.3	7.1	5.18	2620	31.6	7.0	4.97
250	12.3	5.7	3.71	840	21.9	6.8	4.80	1435	26.1	7.2	5.24	2130	29.3	7.0	5.05	2625	31.4	7.1	5.17
255	12.3	5.9	3.88	845	21.9	6.8	4.80	1440	26.2	7.2	5.24	2135	29.3	7.0	5.05	2630	31.6	7.0	5.00
260	12.5	5.9	3.85	850	21.9	6.9	4.86	1445	26.3	7.1	5.11	2140	29.3	7.1	5.13	2635	31.8	6.8	4.82
265	12.7	5.8	3.83	855	22.0	6.8	4.80	1450	26.5	7.0	4.98	2145	29.2	7.2	5.23	2640	31.7	7.0	4.98
270	13.2	5.5	3.54	860	22.1	6.8	4.74	1455	26.4	7.1	5.07	2150	29.2	7.2	5.27	2645	31.7	6.9	4.93
275	13.7	5.2	3.27	865	22.0	6.9	4.92	1460	26.4	7.1	5.17	2155	29.3	7.2	5.21	2650	31.8	6.9	4.85
280	13.7	5.3	3.39	870	21.9	7.1	5.11	1465	26.4	7.2	5.19	2160	29.5	7.0	5.02	2655	31.8	6.9	4.85
285	13.7	5.4	3.44	875	21.9	7.1	5.11	1470	26.4	7.2	5.19	2165	29.5	7.0	5.02	2660	31.7	7.0	5.02
290	13.7	5.6	3.61	880	22.1	7.0	5.05	1475	26.4	7.1	5.17	2170	29.4	7.1	5.10	2665	32.0	6.7	4.71
295	13.7	5.7	3.72	885	22.1	7.0	5.06	1480	26.5	7.1	5.12	2175	29.5	7.0	5.01	2670	32.0	6.7	4.67
300	13.8	5.8	3.77	890	22.1	7.0	5.06	1485	26.5	7.1	5.14	2180	29.8	6.8	4.76	2675	31.9	6.8	4.81
305	13.9	5.8	3.81	895	22.2	7.1	5.09	1490	26.5	7.1	5.17	2185	29.7	6.9	4.89	2680	31.7	7.0	5.04
310	14.0	5.9	3.85	900	22.2	7.1	5.12	1495	26.5	7.2	5.24	2190	29.7	6.9	4.86	2685	31.9	6.8	4.83
315	14.1	5.9	3.88	905	22.3	7.1	5.09	1500	26.5	7.2	5.24	2195	29.8	6.8	4.78	2690	32.1	6.7	4.72
320	14.3	5.9	3.89	910	22.3	7.0	5.05	1505	26.5	7.2	5.27	2200	29.9	6.8	4.75	2695	32.1	6.7	4.71
325	14.4	5.9	3.90	915	22.4	7.0	4.99	1510	26.6	7.2	5.23	2205	29.8	6.8	4.81	2700	32.0	6.8	4.81
330	14.5	5.9	3.92	920	22.6	6.9	4.92	1515	26.6	7.2	5.30	2210	29.9	6.8	4.78	2705	32.0	6.8	4.80
335	14.6	5.9	3.93	925	22.7	6.9	4.85	1520	26.6	7.3	5.38	2215	29.9	6.8	4.76	2710	32.1	6.8	4.79
340	14.7	6.0	4.02	930	22.8	6.8	4.77	1525	26.6	7.3	5.37	2220	29.9	6.8	4.84	2715	32.1	6.7	4.71
345	14.7	6.0	4.02	935	22.8	6.8	4.77	1530	26.6	7.3	5.38	2225	29.9	6.8	4.84	2720	32.4	6.5	4.47
350	14.9	6.1	4.06	940	22.8	6.9	4.89	1535	26.6	7.4	5.44	2230	29.9	6.9	4.90	2725	32.2	6.7	4.63
355	15.1	6.0	3.99	945	22.8	6.9	4.87	1540	26.5	7.4	5.53	2235	29.8	6.9	4.94	2730	31.9	7.0	5.05
360	15.6	5.8	3.78	950	23.0	6.8	4.81	1545	26.5	7.5	5.63	2240	29.9	6.9	4.92	2735	31.6	7.1	5.46
365	15.5	5.9	3.89	955	23.1	6.8	4.77	1550											

Antenna factor
Double-ridged waveguide horn antenna
EMC Test Systems, model 3115, serial number: 00027177

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

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

Cable Coaxial, GORE A2P01POL118, 2.3 m, model:GORE-3, s/n 176 (HL 0589)
+ Cable Coaxial, ANDREW PSWJ4, 6m, model: ANDREW-6, s/n 163 (HL 1004)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation, dB	Tolerance (Specification), dB	Meas. Uncert., dB	Notes
1	Insertion Loss	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	Insertion Loss	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 RF, 8 m, model:RG-214, s/n C-56 (HL 2009)
Calibration data

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

Cable loss
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		
14	4500	1.63	≤ 5.0	±0.17
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 18 GHz, 4 m, green, model: SPS-1803A-4000-NPS, S/N T4657, HL 1941

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

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