

TEST REPORT

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

FOR:

Pro4Tech Ltd.

Digital camcorder remote control

Brand name: NanoPen

Model: MVC103R

This report is in conformity with ISO/ IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations 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.

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1 Applicant information

Client name: Pro4Tech Ltd.
Address: Kochav-Yokneam Bldg. 5th fl., P.O.Box 607, Yokneam 20692, Israel
Telephone: +972 4959 0081
Fax: +972 4989 0480
E-mail: yarkoni@pro4tech.com
Contact name: Mr. Eli Yarkoni

2 Equipment under test attributes

Product name: Digital camcorder remote control
Product type: Transceiver
Brand name: NanoPen
Model(s): MVC103R
Receipt date 11/29/2009

3 Manufacturer information

Manufacturer name: Pro4Tech Ltd.
Address: Kochav-Yokneam Bldg. 5th fl., P.O.Box 607, Yokneam 20692, Israel
Telephone: +972 4959 0081
Fax: +972 4989 0480
E-Mail: yarkoni@pro4tech.com
Contact name: Mr. Eli Yarkoni

4 Test details

Project ID: 20255
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 11/29/2009
Test completed: 12/07/2009
Test specification(s): 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 15.109, Radiated emission	Pass

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. S. Samokha, test engineer	December 7, 2009	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	December 23, 2009	
Approved by:	Mr. M. Nikishin, EMC and radio group manager	December 24, 2009	

6 EUT description

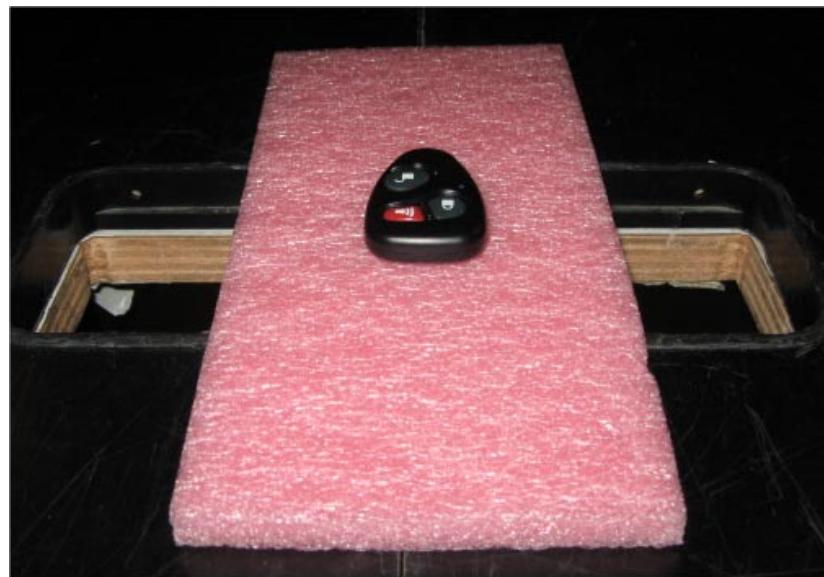
6.1 General information

The EUT, remote control, is a part of the surveillance product for the private market. The product is a self-contained covert digital camcorder concealed inside a fully functioning standard profile ballpoint pen. It consists of two units - remote control and a pen. The EUT, remote control, is a transceiver.

Photograph 6.1.1 EUT in "X-axis" orthogonal position



Photograph 6.1.2 EUT in "Y-axis" orthogonal position



Photograph 6.1.3 EUT in “Z-axis” orthogonal position



6.2 Changes made in EUT

No changes were implemented in the EUT.

6.3 Transmitter characteristics

Type of equipment				
X	Stand-alone (Equipment with or without its own control provisions)			
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)			
	Plug-in card (Equipment intended for a variety of host systems)			
Intended use	Condition of use			
fixed	Always at a distance more than 2 m from all people			
mobile	Always at a distance more than 20 cm from all people			
X portable	May operate at a distance closer than 20 cm to human body			
Operating frequency	868 MHz			
Maximum rated output power	At transmitter 50 Ω RF output connector			dBm
	Effective radiated power (for equipment with no RF connector)			-13.5 dBm
Is transmitter output power variable?	X	No		
			continuous variable	
		Yes	stepped variable with stepsize	
			dB	
			minimum RF power	
			dBm	
			maximum RF power	
Antenna connection				
unique coupling	standard connector	X	integral	with temporary RF connector
				X without temporary RF connector
Type of modulation	GFSK			
Modulating signal	ID code			
Bit rate	250 kbps			
Maximum transmitter duty cycle	100%			
Transmitter power source				
X	Battery	Nominal rated voltage	3 VDC	
	DC	Nominal rated voltage	VDC	
	AC mains	Nominal rated voltage	VAC	Frequency Hz

Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/7/2009 5:23:46 PM	Relative Humidity:	60 %
Temperature: 21 °C	Air Pressure: 1016 hPa	Power Supply:	Battery
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;
- Total duration of polling or supervision transmissions, including data, to determine system integrity in security or safety applications shall not exceed 2 seconds per hour.

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

7.1.2 Test procedure for transmitter shut down test

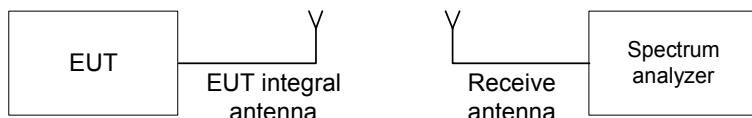
7.1.2.1 The EUT was set up as shown in Figure 7.1.1.

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

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

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

Figure 7.1.1 Setup for transmitter shut down test



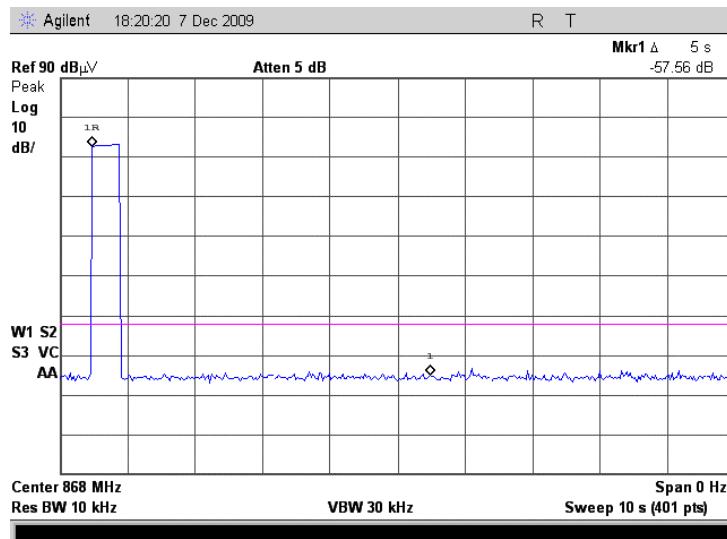


Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	12/7/2009 5:23:46 PM		
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

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	Plot 7.1.1	Comply
Transmitter activated automatically shall cease transmission within 5 seconds	NA	NA
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	NA	NA

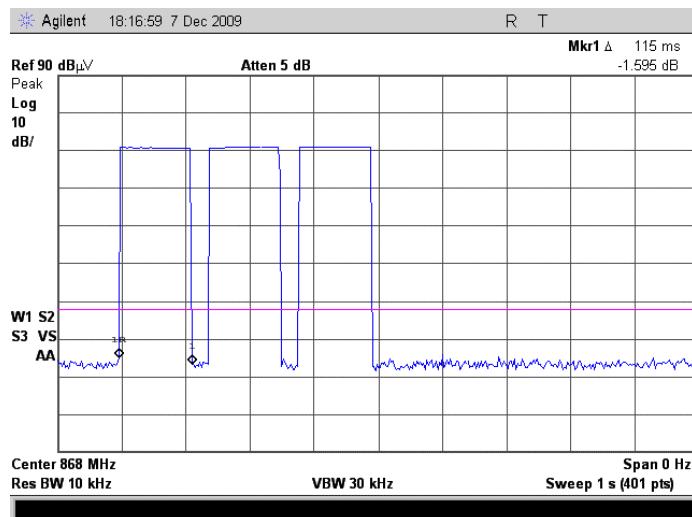
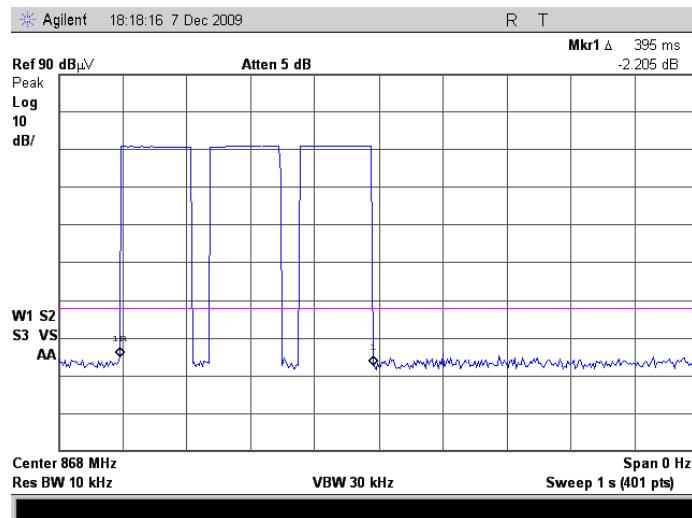
Plot 7.1.1 Transmitter shut down test result





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Test specification:	Section 15.231(a), Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:23:46 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.1.2 Transmitter shut down test result – pulse duration**Plot 7.1.3 Transmitter shut down test result – burst duration****Reference numbers of test equipment used**

HL 0337	HL 2909					
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Full description is given in Appendix A.



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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:	12/7/2009 5:41:07 PM	Relative Humidity: 60 %	Power Supply: Battery
Temperature: 21 °C	Air Pressure: 1016 hPa		
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
868.0	102.0	82.0

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		73.8 – 63.0**			
1.705 – 30.0*		69.5			
30 – 88	NA	40.0	NA		
88 – 216		43.5			
216 – 960		46.0			
960 - 1000		54.0			
Above 1000	74.0	NA	54.0		

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

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

where S₁ and S₂ – standard defined and test distance respectively in meters.

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

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

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

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

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.



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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:	12/7/2009 5:41:07 PM	Relative Humidity:	60 %
Temperature:	21 °C	Air Pressure:	1016 hPa
Remarks:			

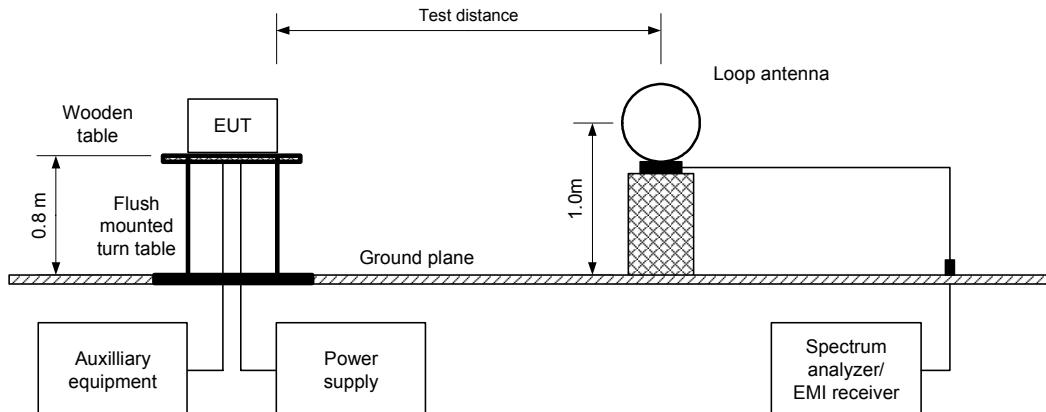
7.2.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

- 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 “Z-axis” orthogonal 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 specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.
- 7.2.3.3 The worst test results (the lowest margins) were found in the EUT “Z-axis” orthogonal position, recorded in Table 7.2.3, Table 7.2.5 and shown in the associated plots.

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

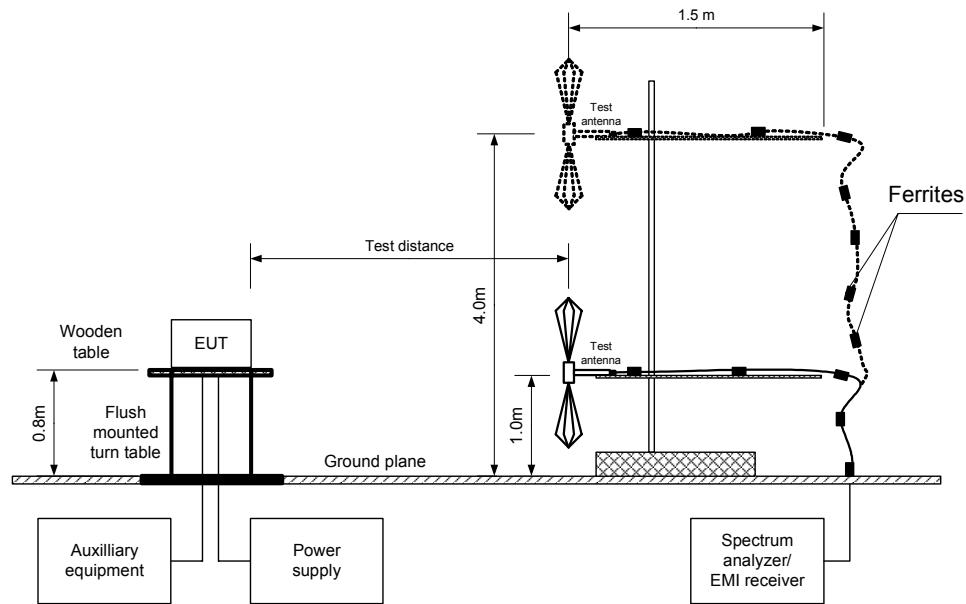




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Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/7/2009 5:41:07 PM	Relative Humidity:	60 %
Temperature: 21 °C	Air Pressure: 1016 hPa	Power Supply:	Battery
Remarks:			

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





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Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
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:	3 orthogonal (X / Y / Z)
MODULATION:	GFSK
MODULATING SIGNAL:	ID code
BIT RATE:	250 kbps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 - 9000 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	1.0 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***											
868.005	Vert	1.2	0	81.69	102.0	-20.31	0	81.69	82.0	-0.31	Pass
Spurious emissions											
1736.21	Vert	1.1	296	45.47	82.0	-36.53	0	45.47	62.0	-16.53	Pass
6942.65	Vert	1.2	0	51.70	82.0	-30.30	0	51.70	62.0	-10.30	

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

**- Margin = dB below (negative if above) specification limit.

*** Max value was obtained in Z-axis orthogonal position.

Table 7.2.4 Average factor calculation

Transmission pulse		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms		
115.0	140.0	395.0	0

*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

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

for pulse train longer than 100 ms:

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

Reference numbers of test equipment used

HL 0446	HL 0521	HL 0604	HL 1984	HL 3121	HL 3616	
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Full description is given in Appendix A.



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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:	12/7/2009 5:41:07 PM	Relative Humidity:	60 %
Temperature: 21 °C	Air Pressure: 1016 hPa	Power Supply: Battery	
Remarks:			

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

TEST DISTANCE:	3 m
EUT POSITION:	3 orthogonal (Z)
MODULATION:	GFSK
MODULATING SIGNAL:	ID code
BIT RATE:	250 kbps
TRANSMITTER OUTPUT POWER SETTINGS:	3 orthogonal (X)
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	1.0 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								

*- 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	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.29 - 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 0521	HL 0604	HL 1984	HL 2871	HL 2909	HL 3121	HL 3531	HL 3533
HL 3616							

Full description is given in Appendix A.



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Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.1 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber

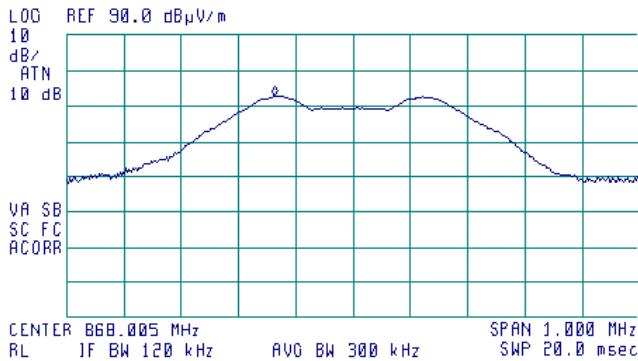
TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical

EUT POSITION: 3 orthogonal (X)



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 867.868 MHz
72.74 dB μ V/m

**Plot 7.2.2 Radiated emission measurements at the fundamental frequency**

TEST SITE: Semi anechoic chamber

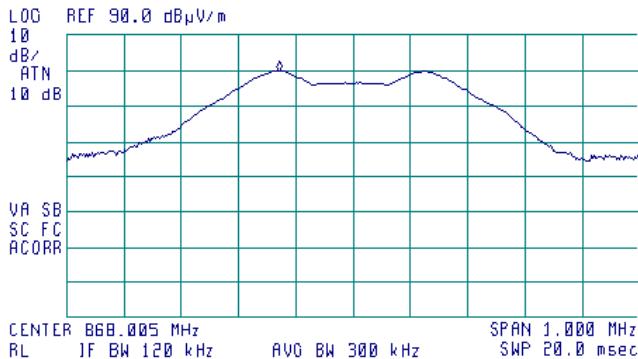
TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Horizontal

EUT POSITION: 3 orthogonal (X)



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 867.875 MHz
79.87 dB μ V/m





HERMON LABORATORIES

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:	12/7/2009 5:41:07 PM		
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.3 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber

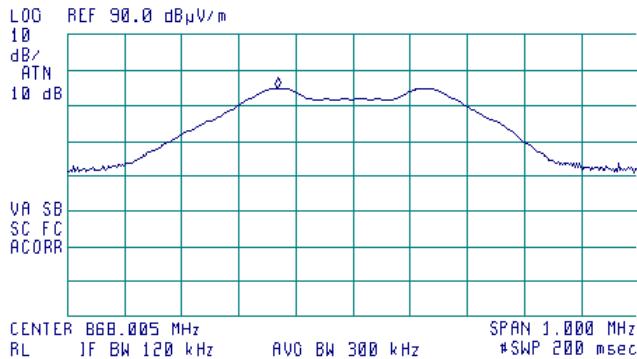
TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical

EUT POSITION: 3 orthogonal (Y)



ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 867.873 MHz
 74.92 dB μ V/m

**Plot 7.2.4 Radiated emission measurements at the fundamental frequency**

TEST SITE: Semi anechoic chamber

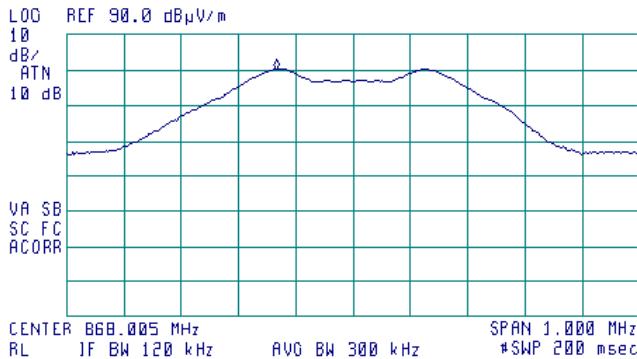
TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Horizontal

EUT POSITION: 3 orthogonal (Y)



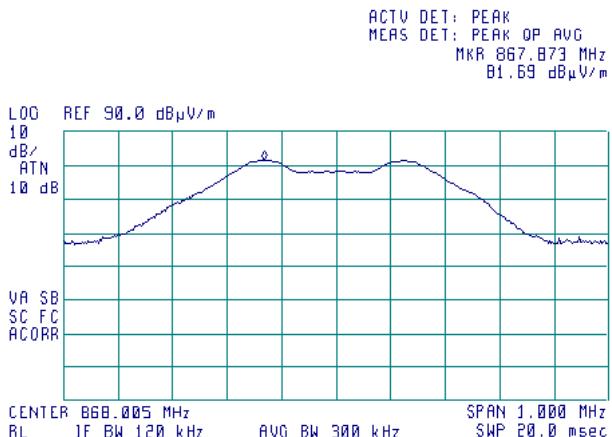
ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 867.870 MHz
 80.27 dB μ V/m



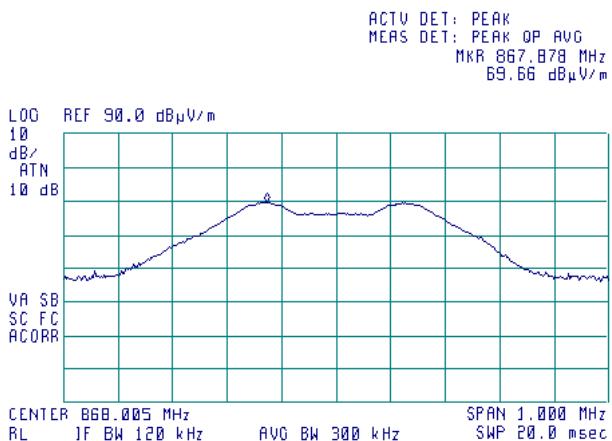
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.5 Radiated emission measurements at the fundamental frequency

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


Plot 7.2.6 Radiated emission measurements at the fundamental frequency

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





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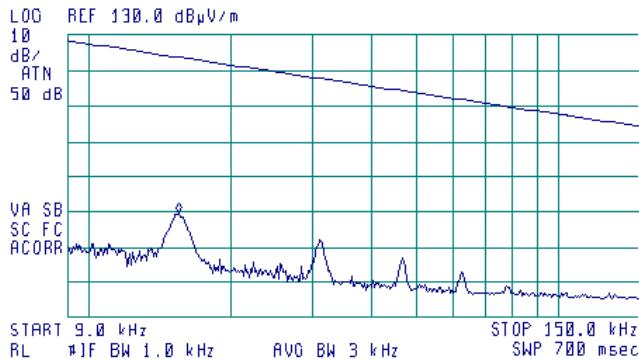
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.7 Radiated emission measurements from 9 to 150 kHz

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



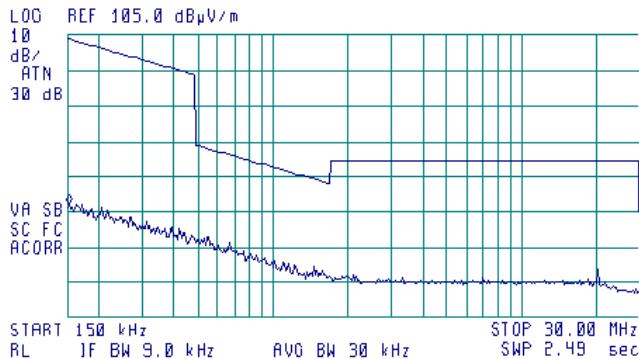
ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 15.7 kHz
 79.59 dB μ V/m

**Plot 7.2.8 Radiated emission measurements from 0.15 to 30 MHz**

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



ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 150 kHz
 57.14 dB μ V/m



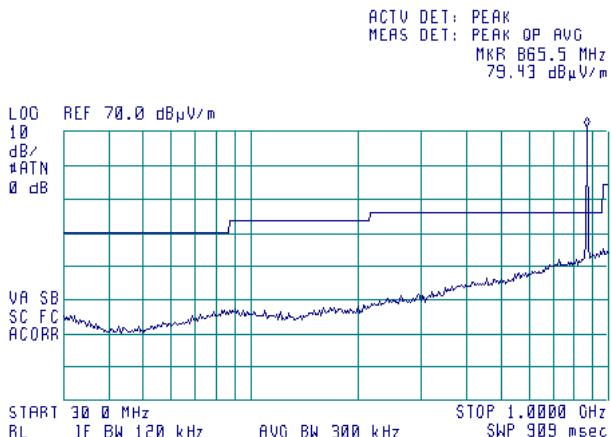


HERMON LABORATORIES

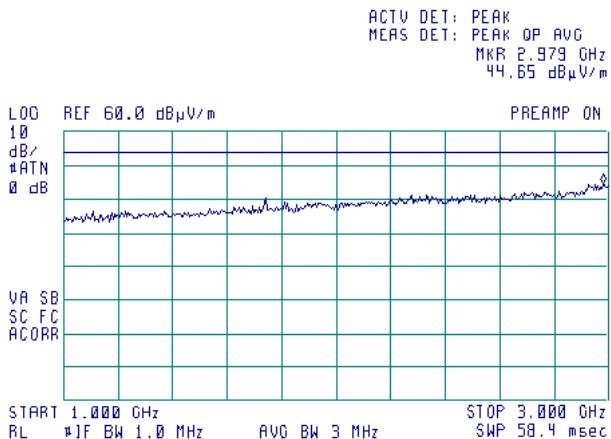
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.9 Radiated emission measurements from 30 to 1000 MHz

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

**Plot 7.2.10 Radiated emission measurements from 1000 to 3000 MHz**

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



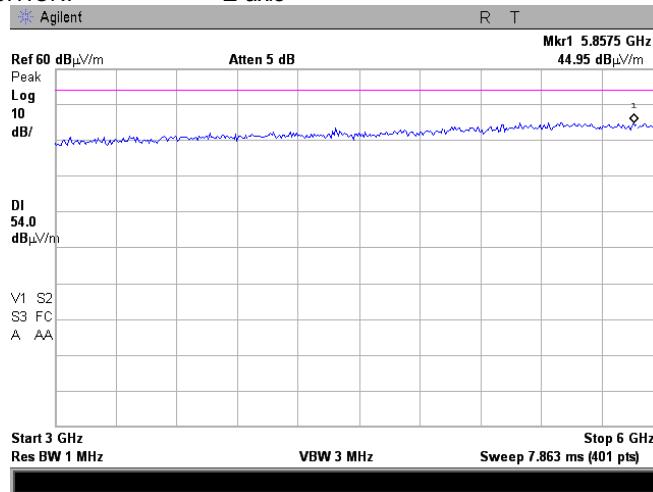


HERMON LABORATORIES

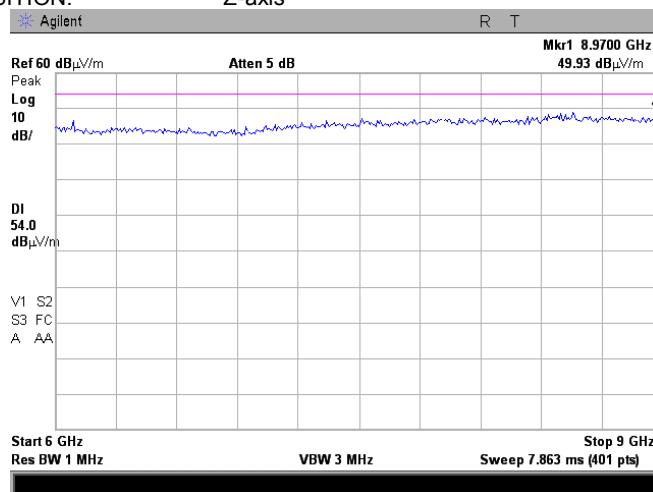
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.11 Radiated emission measurements from 3000 to 6000 MHz

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

**Plot 7.2.12 Radiated emission measurements from 6000 to 9000 MHz**

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



Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.13 Radiated emission measurements at the second harmonic frequency

TEST SITE: Semi anechoic chamber

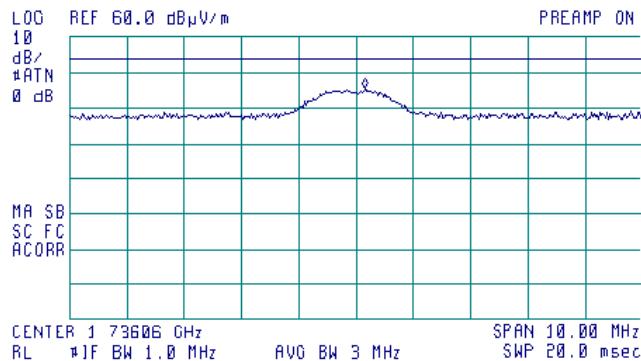
TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Vertical

EUT POSITION: Z-axis



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 1.73621 GHz
45.47 dB μ V/m



Plot 7.2.14 Radiated emission measurements at the second harmonic frequency

TEST SITE: Semi anechoic chamber

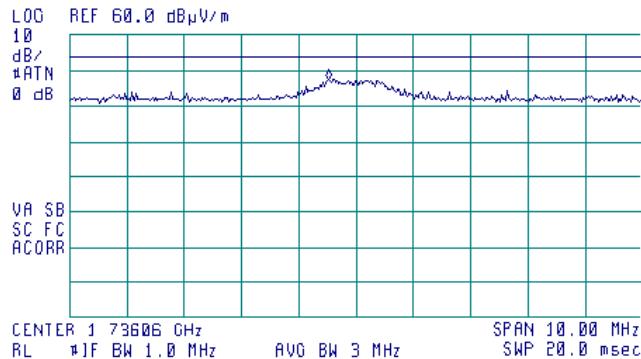
TEST DISTANCE: 3 m

ANTENNA POLARIZATION: Horizontal

EUT POSITION: Z-axis



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 1.73559 GHz
47.47 dB μ V/m



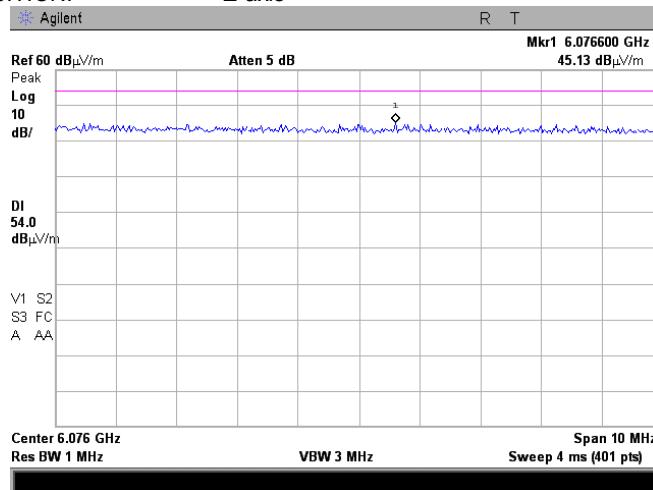


HERMON LABORATORIES

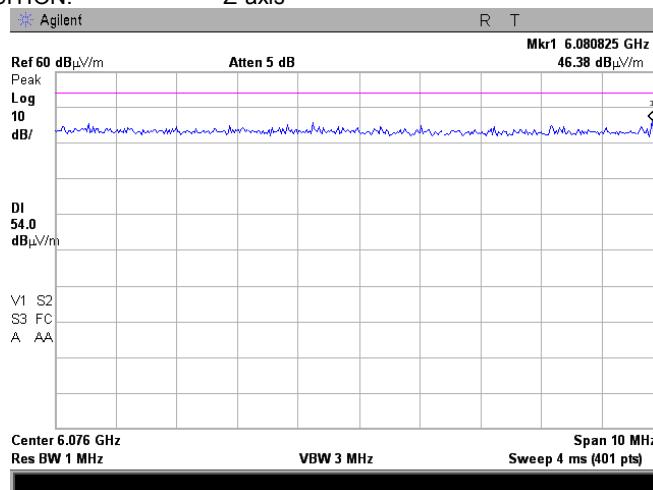
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date & Time:	12/7/2009 5:41:07 PM		
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.15 Radiated emission measurements at the seventh harmonic frequency

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

**Plot 7.2.16 Radiated emission measurements at the seventh harmonic frequency**

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



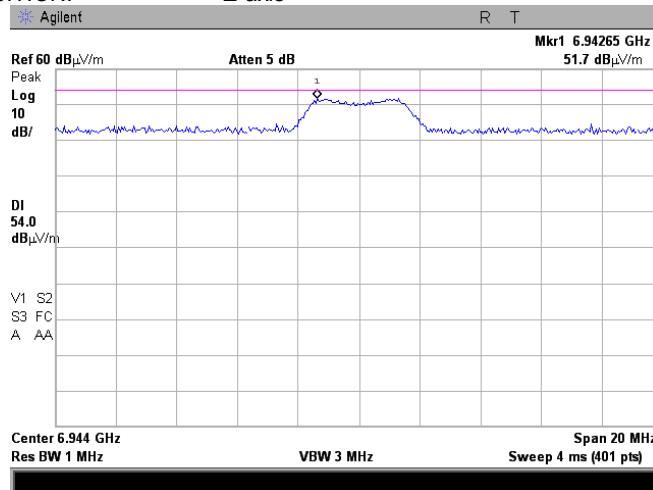


HERMON LABORATORIES

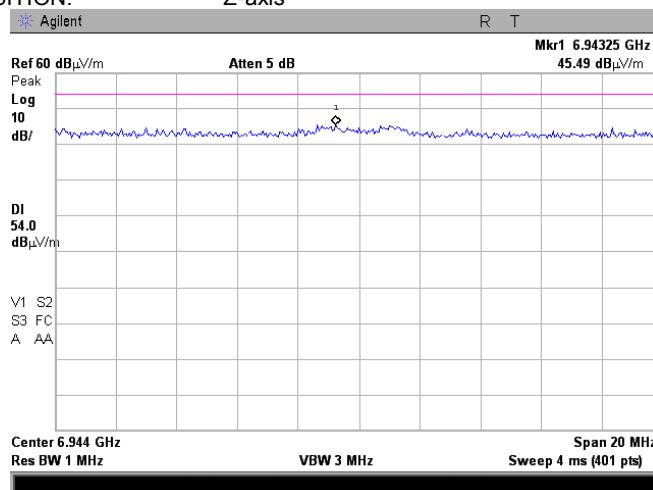
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.17 Radiated emission measurements at the eighth harmonic frequency

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

**Plot 7.2.18 Radiated emission measurements at the eighth harmonic frequency**

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



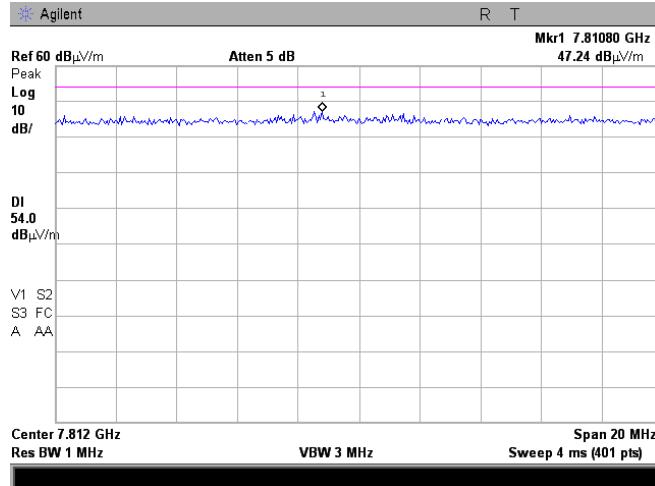


HERMON LABORATORIES

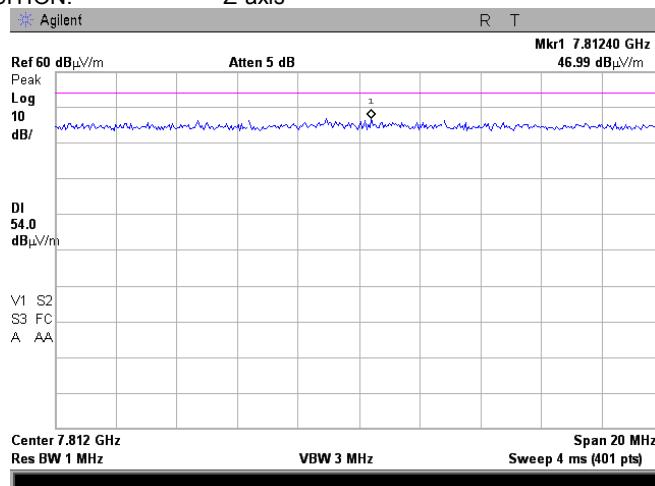
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.19 Radiated emission measurements at the ninth harmonic frequency

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

**Plot 7.2.20 Radiated emission measurements at the ninth harmonic frequency**

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



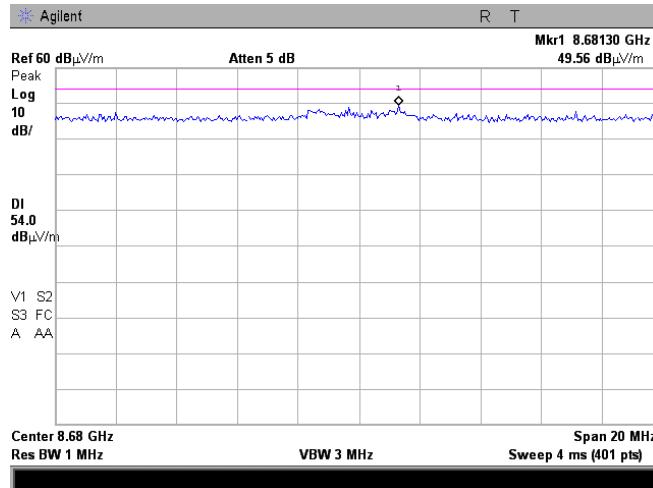


HERMON LABORATORIES

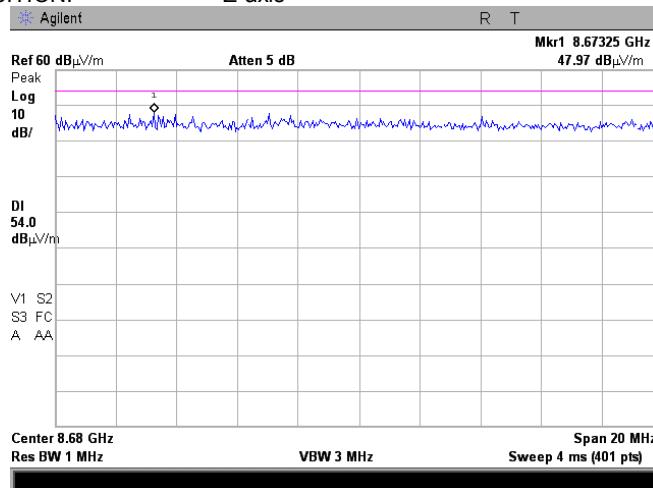
Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.21 Radiated emission measurements at the tenth harmonic frequency

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

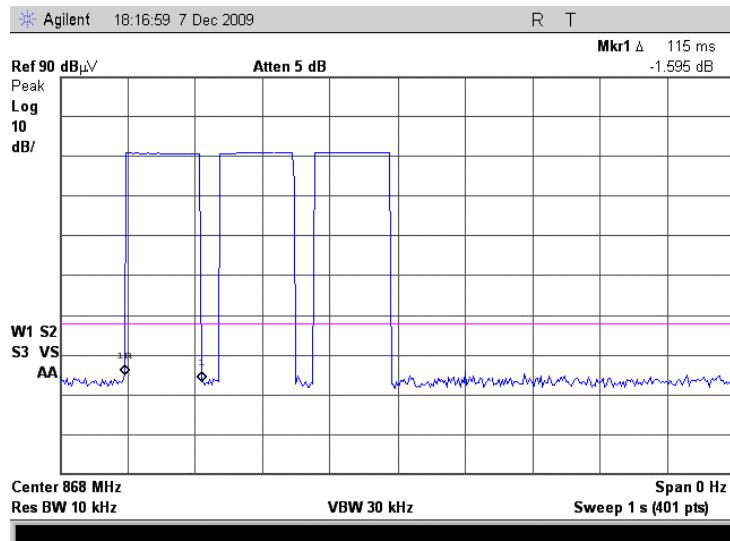
**Plot 7.2.22 Radiated emission measurements at the tenth harmonic frequency**

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

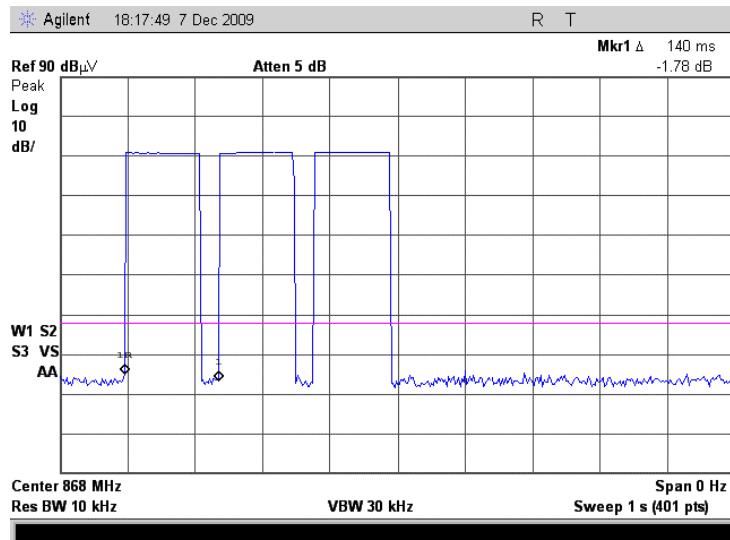


Test specification:	Section 15.231(b), Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 5:41:07 PM	PASS	
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.23 Transmission pulse duration



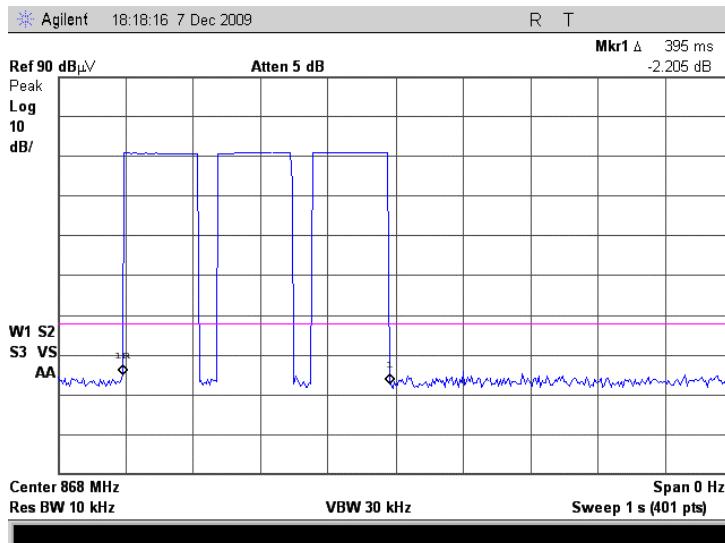
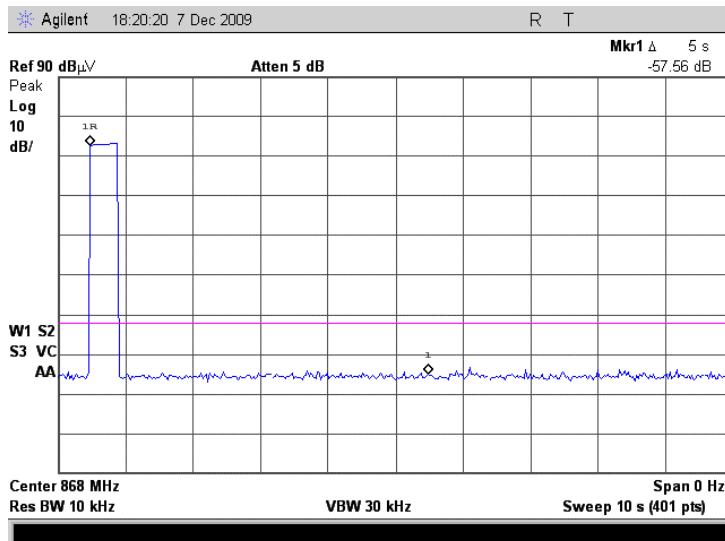
Plot 7.2.24 Transmission pulse period





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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:	12/7/2009 5:41:07 PM		
Temperature: 21 °C	Air Pressure: 1016 hPa	Relative Humidity: 60 %	Power Supply: Battery
Remarks:			

Plot 7.2.25 Transmission burst duration**Plot 7.2.26 Transmission pulse period**

Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/7/2009 5:45:59 PM	Relative Humidity:	60 %
Temperature: 21 °C	Air Pressure: 1016 hPa	Power Supply:	Battery
Remarks:			

7.3 Occupied bandwidth test

7.3.1 General

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

Table 7.3.1 Occupied bandwidth limits

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

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

7.3.2 Test procedure

- 7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.
- 7.3.2.2 The EUT was set to transmit modulated carrier.
- 7.3.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.3.2 and the associated plot.

Figure 7.3.1 Occupied bandwidth test setup





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Test specification:	Section 15.231(c), Occupied bandwidth		
Test procedure:	ANSI C63.4, Section 13.1.7		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/7/2009 5:45:59 PM	Relative Humidity:	60 %
Temperature: 21 °C	Air Pressure: 1016 hPa	Power Supply: Battery	
Remarks:			

Table 7.3.2 Occupied bandwidth test results

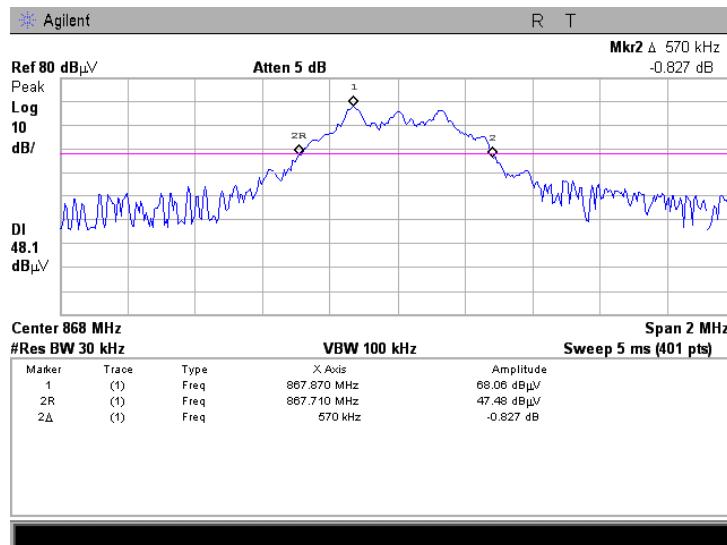
DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 30 kHz
 VIDEO BANDWIDTH: 100 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 20 dBc
 MODULATION: GFSK
 MODULATING SIGNAL: ID code
 BIT RATE: 250 kbps

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
868.0	570	0.25	2170	1600	Pass

Reference numbers of test equipment used

HL 0337	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:	12/7/2009 6:01:04 PM	Relative Humidity:	60 %
Temperature: 21 °C	Air Pressure: 1016 hPa	Power Supply:	Battery
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	

Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/7/2009 12:54:51 AM	Relative Humidity:	60%
Temperature: 21°C	Air Pressure: 1016 hPa	Power Supply:	Battery
Remarks:			

8 Unintentional emission tests

8.1 Radiated emission measurements

8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.1.1.

Table 8.1.1 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: $\text{Lim}_{S2} = \text{Lim}_{S1} + 20 \log \left(\frac{S_1}{S_2} \right)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

8.1.2 Test procedure

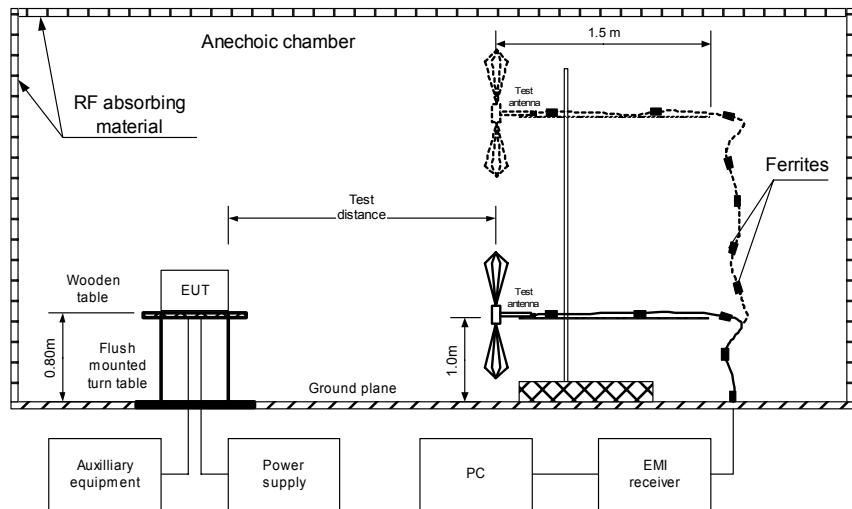
- 8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and the performance check was conducted.
- 8.1.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.
- 8.1.2.3 The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.



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Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 12:54:51 AM	PASS	
Temperature: 21°C	Air Pressure: 1016 hPa	Relative Humidity: 60%	Power Supply: Battery
Remarks:			

Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment





Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance		Verdict: PASS
Date & Time:	12/7/2009 12:54:51 AM		
Temperature: 21°C	Air Pressure: 1016 hPa	Relative Humidity: 60%	Power Supply: Battery
Remarks:			

Table 8.1.2 Radiated emission test results

EUT SET UP:

TABLE-TOP

LIMIT:

Class B

EUT OPERATING MODE:

Stand-by

TEST SITE:

SEMI ANECHOIC CHAMBER

TEST DISTANCE:

3 m

DETECTORS USED:

PEAK / QUASI-PEAK

FREQUENCY RANGE:

30 MHz – 1000 MHz

RESOLUTION BANDWIDTH:

120 kHz

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

TEST SITE:

SEMI ANECHOIC CHAMBER

TEST DISTANCE:

3 m

DETECTORS USED:

PEAK / AVERAGE

FREQUENCY RANGE:

1000 - 6000MHz

RESOLUTION BANDWIDTH:

1000 kHz

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

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

HL 0521	HL 0604	HL 1984	HL 2871	HL 2909	HL 3121	HL 3531	HL 3533
HL 3616							

Full description is given in Appendix A.



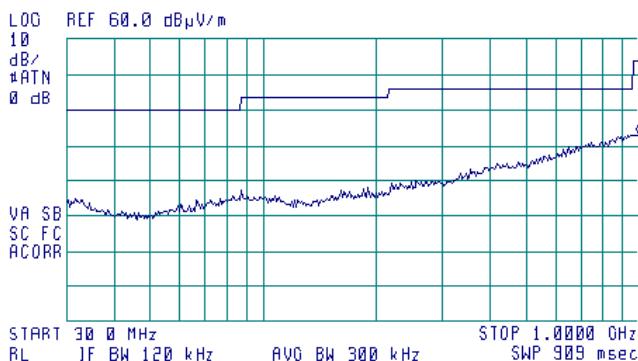
HERMON LABORATORIES

Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	12/7/2009 12:54:51 AM		
Temperature: 21°C	Air Pressure: 1016 hPa	Relative Humidity: 60%	Power Supply: Battery
Remarks:			

Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

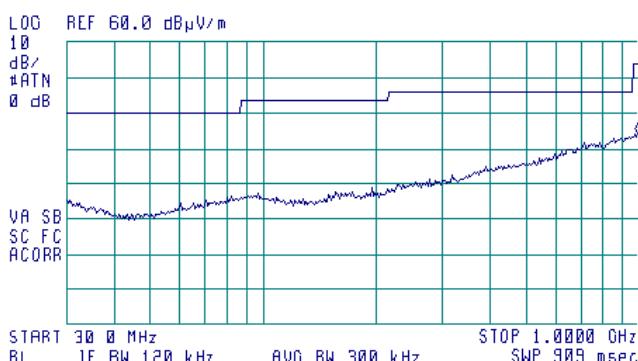
TEST SITE: Semi anechoic chamber
 LIMIT: Class B
 TEST DISTANCE: 3 m
 EUT OPERATING MODE: Stand-by

⌚ 19:49:44 DEC 06, 2009
 ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 1.0000 GHz
 33.25 dB μ V/m

**Plot 8.1.2 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization**

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

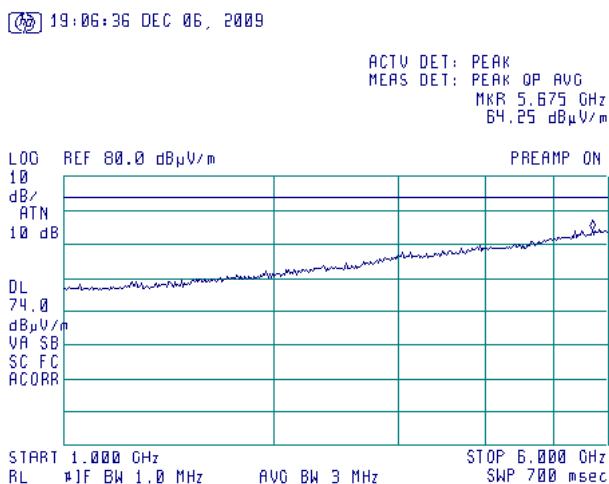
⌚ 19:59:24 DEC 06, 2009
 ACTV DET: PEAK
 MEAS DET: PEAK OP AVG
 MKR 990.5 MHz
 34.40 dB μ V/m



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 12:54:51 AM	PASS	
Temperature: 21°C	Air Pressure: 1016 hPa	Relative Humidity: 60%	Power Supply: Battery
Remarks:			

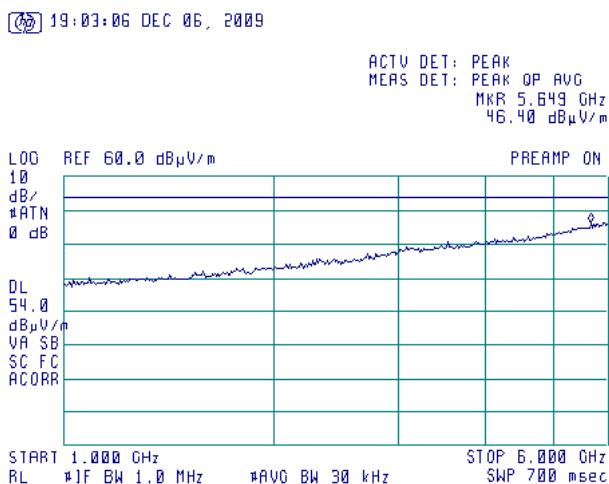
Plot 8.1.3 Radiated emission measurements from 1000 to 6000 MHz, vertical antenna polarization

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



Plot 8.1.4 Radiated emission measurements from 1000 to 6000 MHz, vertical antenna polarization

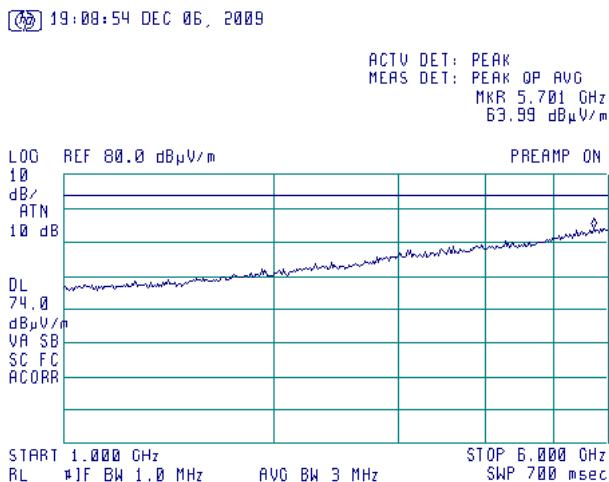
TEST SITE: Semi anechoic chamber
 LIMIT: Class B
 TEST DISTANCE: 3 m
 EUT OPERATING MODE: Stand-by
 DETECTOR Average



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	
Date & Time:	12/7/2009 12:54:51 AM	PASS	
Temperature: 21°C	Air Pressure: 1016 hPa	Relative Humidity: 60%	Power Supply: Battery
Remarks:			

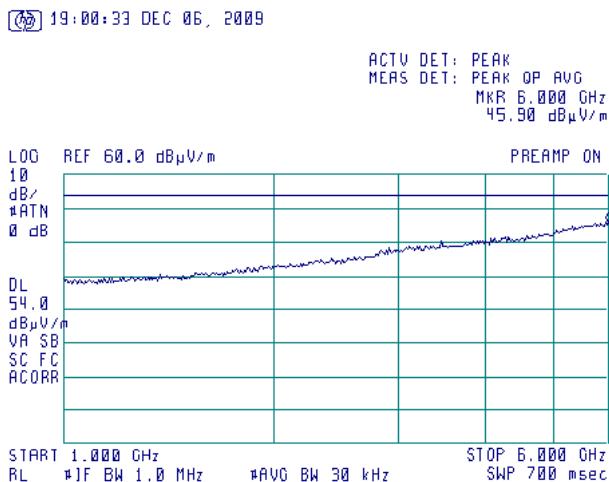
Plot 8.1.5 Radiated emission measurements from 1000 to 6000 MHz, horizontal antenna polarization

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



Plot 8.1.6 Radiated emission measurements from 1000 to 6000 MHz, horizontal antenna polarization

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



9 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	08-Jun-09	08-Jun-10
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	29-Jun-09	29-Jun-10
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	27-Aug-09	27-Aug-10
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	11-Jan-09	11-Jan-10
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	24-Aug-09	24-Aug-10
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY451024 6	05-Jul-09	05-Jul-10
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	16-Sep-09	16-Sep-10
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	07-May-09	07-May-10
3121	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-9155-00	3121	30-Dec-08	30-Dec-09
3531	Amplifier, low noise, 2 to 8 GHz	Quinstar Technology	QLJ-02084040 -J0	111590020 02	06-Dec-09	06-Dec-10
3533	Amplifier, low noise, 6 to 18 GHz	Quinstar Technology	QLJ-06184040 -J0	111590010 01	06-Dec-09	06-Dec-10
3616	Cable RF, 6.5 m, N type-N type, DC-6.5 GHz	Suhner Switzerland	Rg 214/U	NA	02-Dec-09	02-Dec-10

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Radiated emissions at 10 m measuring distance Horizontal polarization	Biconilog antenna: ± 5.0 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.1 dB Double ridged horn antenna: ± 5.3 dB
Vertical polarization	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	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB
Vertical polarization	Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Occupied bandwidth	± 8.0 %

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

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

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

11 APPENDIX C Test laboratory 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), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file numbers IC 2186A-1 for OATS and IC 2186A-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01).

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12 APPENDIX D Specification references

47CFR part 15: 2008	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.

13 APPENDIX E 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
Ser.No.1011, HL 0604

Frequency, MHz	Antenna Factor, dB(1/m)
26	7.8
28	7.8
30	7.8
40	7.2
60	7.1
70	8.5
80	9.4
90	9.8
100	9.7
110	9.3
120	8.8
130	8.7
140	9.2
150	9.8
160	10.2
170	10.4
180	10.4
190	10.3
200	10.6
220	11.6
240	12.4
260	12.8
280	13.7
300	14.7
320	15.2
340	15.4
360	16.1
380	16.4
400	16.6
420	16.7
440	17.0
460	17.7
480	18.1
500	18.5
520	19.1
540	19.5
560	19.8
580	20.6
600	21.3
620	21.5
640	21.2
660	21.4
680	21.9
700	22.2
720	22.2
740	22.1
760	22.3
780	22.6
800	22.7
820	22.9
840	23.1
860	23.4
880	23.8
900	24.1
920	24.1

Frequency, MHz	Antenna Factor, dB(1/m)
940	24.0
960	24.1
980	24.5
1000	24.9
1020	25.0
1040	25.2
1060	25.4
1080	25.6
1100	25.7
1120	26.0
1140	26.4
1160	27.0
1180	27.0
1200	26.7
1220	26.5
1240	26.5
1260	26.5
1280	26.6
1300	27.0
1320	27.8
1340	28.3
1360	28.2
1380	27.9
1400	27.9
1420	27.9
1440	27.8
1460	27.8
1480	28.0
1500	28.5
1520	28.9
1540	29.6
1560	29.8
1580	29.6
1600	29.5
1620	29.3
1640	29.2
1660	29.4
1680	29.6
1700	29.8
1720	30.3
1740	30.8
1760	31.1
1780	31.0
1800	30.9
1820	30.7
1840	30.6
1860	30.6
1880	30.6
1900	30.6
1920	30.7
1940	30.9
1960	31.2
1980	31.6
2000	32.0

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

Antenna factor
Double-ridged wave guide horn antenna
Model 3115, S/N 9911-5964, HL1984

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).

Cable loss
**Cable coaxial, Huber-Suhner, 18 GHz, 6.4 m, SMA - SMA, model 198-8155-00,
 HL 2871**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.12	5750	2.34	12000	3.55
30	0.14	6000	2.39	12250	3.61
100	0.27	6250	2.46	12500	3.67
250	0.45	6500	2.52	12750	3.74
500	0.63	6750	2.58	13000	3.79
750	0.76	7000	2.64	13250	3.82
1000	0.89	7250	2.68	13500	3.83
1250	1.01	7500	2.73	13750	3.83
1500	1.12	7750	2.78	14000	3.88
1750	1.23	8000	2.83	14250	3.93
2000	1.32	8250	2.88	14500	3.96
2250	1.41	8500	2.94	14750	4.01
2500	1.49	8750	2.97	15000	4.00
2750	1.58	9000	3.02	15250	4.01
3000	1.66	9250	3.07	15500	4.00
3250	1.73	9500	3.13	15750	4.13
3500	1.80	9750	3.18	16000	4.22
3750	1.87	10000	3.21	16250	4.29
4000	1.93	10250	3.26	16500	4.29
4250	2.01	10500	3.30	16750	4.32
4500	2.06	10750	3.36	17000	4.37
4750	2.12	11000	3.39	17250	4.45
5000	2.17	11250	3.44	17500	4.49
5250	2.24	11500	3.48	17750	4.53
5500	2.29	11750	3.52	18000	4.55



Cable loss
Microwave Cable Assembly, 18 GHz, 6.4 m, SMA – SMA, Huber-Suhner, model 198-9155-00
HL 3121

Frequency, MHz	Cable loss, dB								
10	0.08	3600	2.10	7400	3.08	11200	3.85	15100	4.58
30	0.18	3700	2.14	7500	3.11	11300	3.85	15200	4.60
50	0.26	3800	2.18	7600	3.14	11400	3.86	15300	4.63
100	0.34	3900	2.19	7700	3.16	11500	3.86	15400	4.65
200	0.47	4000	2.25	7800	3.18	11600	3.87	15500	4.71
300	0.59	4100	2.25	7900	3.20	11700	3.85	15600	4.70
400	0.66	4200	2.28	8000	3.22	11800	3.96	15700	4.69
500	0.75	4300	2.35	8100	3.26	11900	3.92	15800	4.71
600	0.83	4400	2.35	8200	3.27	12000	3.92	15900	4.74
700	0.90	4500	2.38	8300	3.29	12100	3.94	16000	4.69
800	0.96	4600	2.43	8400	3.30	12200	3.94	16100	4.72
900	1.02	4700	2.43	8500	3.31	12300	3.99	16200	4.71
1000	1.07	4800	2.45	8600	3.33	12400	4.02	16300	4.74
1100	1.12	4900	2.48	8700	3.35	12500	4.10	16400	4.74
1200	1.15	5000	2.55	8800	3.36	12600	4.09	16500	4.75
1300	1.22	5100	2.54	8900	3.38	12700	4.15	16600	4.78
1400	1.28	5200	2.56	9000	3.40	12800	4.15	16700	4.86
1500	1.29	5300	2.58	9100	3.41	12900	4.08	16800	4.84
1600	1.36	5400	2.61	9200	3.45	13000	4.21	16900	4.83
1700	1.40	5500	2.64	9300	3.48	13100	4.19	17000	4.86
1800	1.45	5600	2.69	9400	3.52	13200	4.29	17100	4.83
1900	1.51	5700	2.67	9500	3.54	13300	4.24	17200	4.90
2000	1.50	5800	2.71	9600	3.59	13400	4.26	17300	4.91
2100	1.56	5900	2.73	9700	3.59	13500	4.26	17400	4.94
2200	1.59	6000	2.75	9800	3.62	13600	4.29	17500	4.93
2300	1.63	6100	2.81	9900	3.70	13700	4.35	17600	4.93
2400	1.73	6200	2.80	10000	3.70	13800	4.31	17700	5.00
2500	1.73	6300	2.82	10100	3.72	13900	4.29	17800	5.01
2600	1.78	6400	2.85	10200	3.73	14000	4.32	17900	5.00
2700	1.84	6500	2.87	10300	3.75	14100	4.33	18000	5.00
2800	1.84	6600	2.90	10400	3.76	14200	4.34		
2900	1.91	6700	2.91	10500	3.77	14300	4.36		
3000	1.91	6800	2.94	10600	3.79	14400	4.38		
3100	1.97	6900	2.96	10700	3.80	14600	4.42		
3200	1.98	7000	2.98	10800	3.81	14700	4.42		
3300	2.04	7100	3.01	10900	3.81	14800	4.55		
3400	2.04	7200	3.02	11000	3.83	14900	4.55		
3500	2.10	7300	3.04	11100	3.84	15000	4.55		

Cable loss
Cable coaxial, RG-214/U, N type-N type, 6.5 m
Suhner Switzerland, HL 3616

Frequency, MHz	Cable loss, dB						
10	0.13	1750	2.66	3550	4.44	5350	6.08
30	0.25	1800	2.72	3600	4.46	5400	6.12
50	0.32	1850	2.78	3650	4.59	5450	6.17
100	0.48	1900	2.81	3700	4.60	5500	6.25
150	0.60	1950	2.86	3750	4.72	5550	6.31
200	0.71	2000	2.94	3800	4.72	5600	6.35
250	0.81	2050	2.97	3850	4.86	5650	6.41
300	0.91	2100	3.01	3900	4.85	5700	6.50
350	1.00	2150	3.06	3950	4.99	5750	6.52
400	1.07	2200	3.11	4000	4.90	5800	6.57
450	1.14	2250	3.16	4050	5.04	5850	6.61
500	1.23	2300	3.21	4100	5.01	5900	6.71
550	1.30	2350	3.26	4150	5.10	5950	6.70
600	1.37	2400	3.31	4200	5.08	6000	6.75
650	1.44	2450	3.35	4250	5.18	6050	6.74
700	1.50	2500	3.39	4300	5.14	6100	6.84
750	1.58	2550	3.46	4350	5.22	6150	6.87
800	1.64	2600	3.48	4400	5.21	6200	6.93
850	1.69	2650	3.55	4450	5.29	6250	6.96
900	1.77	2700	3.59	4500	5.31	6300	7.02
950	1.79	2750	3.66	4550	5.39	6350	7.04
1000	1.87	2800	3.68	4600	5.41	6400	7.10
1050	1.92	2850	3.75	4650	5.49	6450	7.11
1100	1.98	2900	3.79	4700	5.52	6500	7.19
1150	2.05	2950	3.86	4750	5.60		
1200	2.09	3000	3.89	4800	5.64		
1250	2.15	3050	3.94	4850	5.73		
1300	2.21	3100	3.98	4900	5.70		
1350	2.27	3150	4.03	4950	5.73		
1400	2.33	3200	4.06	5000	5.75		
1450	2.38	3250	4.12	5050	5.83		
1500	2.44	3300	4.14	5100	5.82		
1550	2.48	3350	4.22	5150	5.91		
1600	2.52	3400	4.24	5200	5.92		
1650	2.56	3450	4.31	5250	5.98		
1700	2.62	3500	4.35	5300	6.01		

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(µV)	decibel referred to one microvolt
dB(µV/m)	decibel referred to one microvolt per meter
dB(µA)	decibel referred to one microampere
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
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
µs	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
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
WB	wideband

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