

TEST REPORT

ACCORDING TO: FCC 47CFR part 15 subpart C § 15.209 and
RSS-210 issue 8 section 2.5.1

FOR:

Elpas Solutions Ltd.

Quad Technology Wrist Tag (WTD)

Models: 5-WTD41101-0

5-WTD40000-0

5-WTD40002-0

5-WTD40100-0

5-WTD40101-0

5-WTD41000-0

5-WTD41002-0

5-WTD41100-0

FCC ID:O4X5-WTD41101-0

IC:1467G-5WTD411010

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Table of contents

1	Applicant information	3
2	Equipment under test attributes	3
3	Manufacturer information	3
4	Test details	3
5	Tests summary	4
6	EUT description	5
6.1	General information	5
6.2	Test configuration	5
6.3	Changes made in EUT	5
6.4	EUT test positions	6
7	Transmitter tests according to 47CFR part 15 subpart C and RSS-210 requirements	7
7.1	Field strength of emissions	7
7.2	Antenna requirements	13
7.3	Occupied bandwidth test	14
8	Unintentional emissions	16
8.1	Radiated emission measurements	16
9	APPENDIX A Test equipment and ancillaries used for tests	20
10	APPENDIX B Measurement uncertainties	21
11	APPENDIX C Test laboratory description	22
12	APPENDIX D Specification references	22
13	APPENDIX E Test equipment correction factors	23
14	APPENDIX F Abbreviations and acronyms	28

1 Applicant information

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2 Equipment under test attributes

Product name: Quad Technology Wrist Tag
Product type: Transceiver operating at 125 kHz
Model(s): 5-WTD41101-0
Serial number: Prototype
Hardware version: 04
Software release: 1.36
Receipt date 2/26/2012

3 Manufacturer information

Manufacturer name: Elpas Solutions Ltd.
Address: 23 Habarzel street, Tel Aviv 69710, Israel
Telephone: +972 3768 1421
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E-Mail: MErenkrantz@tycoint.com
Contact name: Mr. Meir Erenkrantz

4 Test details

Project ID: 23051
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 2/26/2012
Test completed: <CompletedDateTime>
Test specification(s): FCC 47CFR part 15, subpart C, §15.209;
RSS-210 issue 8 section 2.5.1, RSS-Gen issue 3 Table 6

5 Tests summary

Test	Status
Transmitter characteristics	
FCC section 15.209, RSS-Gen section 7.2.5, Field strength of emissions	Pass
FCC section 15.203, RSS-Gen section 7.1.2, Antenna requirement	Pass
RSS-Gen, Section 4.6.1, Occupied bandwidth	Tested
Unintentional emissions	
RSS-Gen, Section 6.1, 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.

This test report supersedes the previously issued test report identified by Doc ID:ELPRAD_FCC.23051_15.209.

	Name and Title	Date	Signature
Tested by:	Mr. A. Troupiansky, test engineer	January 27, 2013	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	February 10, 2013	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	February 20, 2013	

6 EUT description

6.1 General information

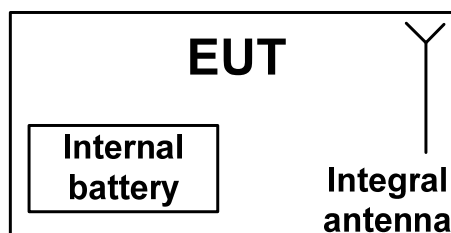
The EUT is a Quad Technology Wrist Tag (WTD) that comprises the 125 kHz transmitter and receiver radio modules and the 433 MHz transceiver. The EUT is powered from 3V internal battery.

The EUT has eight model numbers: 5-WTD41101-0, 5-WTD40000-0, 5-WTD40002-0, 5-WTD40100-0, 5-WTD40101-0, 5-WTD41000-0, 5-WTD41002-0, 5-WTD41100-0, which according to the manufacturer's declaration are electronically and electrically identical. The differences between models are given in the table below.

Part Number	Description	Differences
5-WTD41002-0	High Risk Security Bracelet, IR/RF/LF, 433 MHz, No call button, Tamper Band	Same PCB, no call button, tamper band
5-WTD41000-0	High Risk Security Bracelet, IR/RF/LF, 433 MHz, No call button, No Band	Same PCB, no call button, no band
5-WTD40002-0	High Risk Security Bracelet, RF/LF, 433 MHz, No call button, Tamper Band	Same PCB without IR, no call button, tamper band
5-WTD40000-0	High Risk Security Bracelet, RF/LF, 433 MHz, No call button, No Band	Same PCB without IR, no button, no band
5-WTD41101-0	Personal Safety Braclet, IR/RF/LF, 433MHz, call button, Standard Band	Maximum configuration tested with IR/RF/LF, with call button, with standard band
5-WTD40000-0	Personal Safety Braclet, IR/RF/LF, 433 MHz, call button, No Band	Same PCB, with call button, no band
5-WTD40000-0	Personal Safety Braclet, RF/LF, 433 MHz, call button, Standard Band	Same PCB without IR, with call button, with standard band
5-WTD40000-0	Personal Safety Braclet, RF/LF, 433 MHz, call button, No Band	Same PCB without IR, with call button, no band

The tamper band is the band with conducting wire, the standard band –the band without conducting wire. The EUT model number 5-WTD41101-0 was tested as maximum configured device.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

6.4 EUT test positions

Photograph 6.4.1 EUT in X-axis orthogonal position



Photograph 6.4.2 EUT in Y-axis orthogonal position



Photograph 6.4.3 EUT in Z-axis orthogonal position





Test specification:		Section 15.209 / RSS-210, Tables 2, 3, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		2/27/2012 - 2/28/2012	
Temperature: 22 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 3 V battery
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C and RSS-210 requirements

7.1 Field strength of emissions

7.1.1 General

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

Table 7.1.1 Radiated fundamental emission limits

Fundamental frequency, kHz	Field strength at 3 m, dB(μV/m)
	Average
125	105.7

Table 7.1.2 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)		
	Within restricted bands		
	Peak	Quasi Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**
0.090 – 0.110	NA	108.5 – 106.8**	NA
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**
0.490 – 1.705	NA	73.8 – 63.0**	NA
1.705 – 30.0*		69.5	
30 – 88		40.0	
88 – 216		43.5	
216 – 960		46.0	
960 – 1000		54.0	
1000 – 10 ^m harmonic	74.0	NA	54.0

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

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

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

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

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

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

7.1.2.2 The measurements were performed in three EUT orthogonal positions.

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

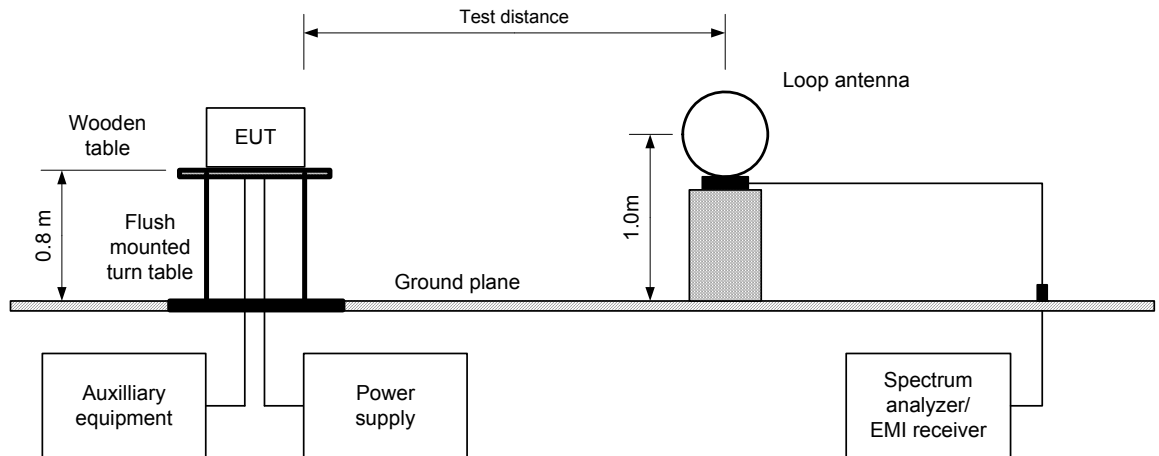
7.1.2.4 The worst test results (the lowest margins) were recorded in Table 7.1.3, Table 7.1.4 and shown in the associated plots.



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Test specification:		Section 15.209 / RSS-210, Tables 2, 3, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		2/27/2012 - 2/28/2012	
Temperature: 22 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 3 V battery
Remarks:			

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





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Test specification:	Section 15.209 / RSS-210, Tables 2, 3, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	2/27/2012 - 2/28/2012		
Temperature: 22 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 3 V battery
Remarks:			

Table 7.1.3 Field strength of fundamental emission

TEST DISTANCE: 1 m
 TEST SITE: Anechoic chamber
 EUT POSITION: X, Y, Z
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 – 30 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)

F, kHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength			Verdict
	Pol.	Height, m		Measured @1m, dB(μV/m)	Limit @3m, dB(μV/m)	Margin, dB**	Measured @1m, dB(μV/m)	Limit @3m, dB(μV/m)	Margin, dB**	
124.387	H	1.0	33	63.5	125.7	-62.2	63.5	105.7	-42.2	Pass

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

**- Margin (dB) = measured result - specification limit.

Reference numbers of test equipment used

HL 0446	HL 2780	HL 2883	HL 3390				
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Full description is given in Appendix A.



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Test specification:		Section 15.209 / RSS-210, Tables 2, 3, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		2/27/2012 - 2/28/2012	
Temperature: 22 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 3 V battery
Remarks:			

Table 7.1.4 Field strength of spurious emissions

TEST DISTANCE: 3 m
 TEST SITE: Anechoic chamber
 EUT POSITION: X, Y, Z
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 – 30 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)

F, MHz	Antenna		Azimuth, degrees*	Peak field strength			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**	
No emissions were found										Pass

*- Margin = Measured emission - specification limit.

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

Table 7.1.5 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 0446	HL 2780	HL 2883	HL 3389				
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Full description is given in Appendix A.



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Test specification:	Section 15.209 / RSS-210, Tables 2, 3, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	2/27/2012 - 2/28/2012		
Temperature: 22 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 3 V battery
Remarks:			

Plot 7.1.1 Radiated emission measurements at the fundamental frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 1 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X, Y, Z



Plot 7.1.2 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 1 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: X, Y, Z



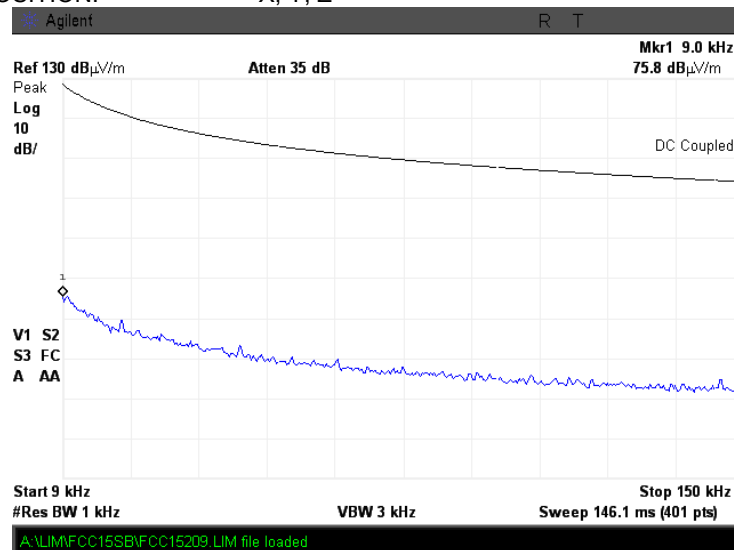


HERMON LABORATORIES

Test specification:		Section 15.209 / RSS-210, Tables 2, 3, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		2/27/2012 - 2/28/2012	
Temperature: 22 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 3 V battery
Remarks:			

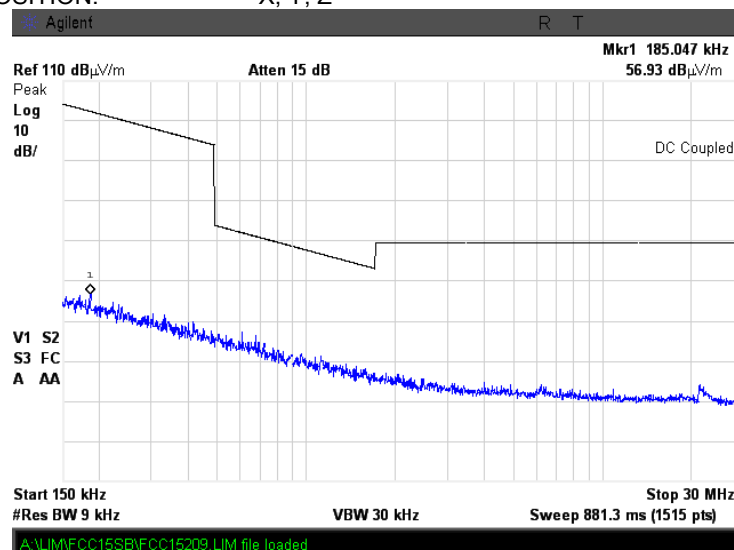
Plot 7.1.3 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X, Y, Z



Plot 7.1.4 Radiated emission measurements from 0.15 to 30 MHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: X, Y, Z



Test specification:		Section 15.203, RSS-Gen section 7.1.2, Antenna requirement	
Test procedure:		Visual inspection / supplier declaration	
Test mode:	Compliance	Verdict:	PASS
Date:	3/27/2012		
Temperature: 21 °C	Air Pressure: 1012 hPa	Relative Humidity: 51 %	Power Supply: 6 V battery
Remarks:			

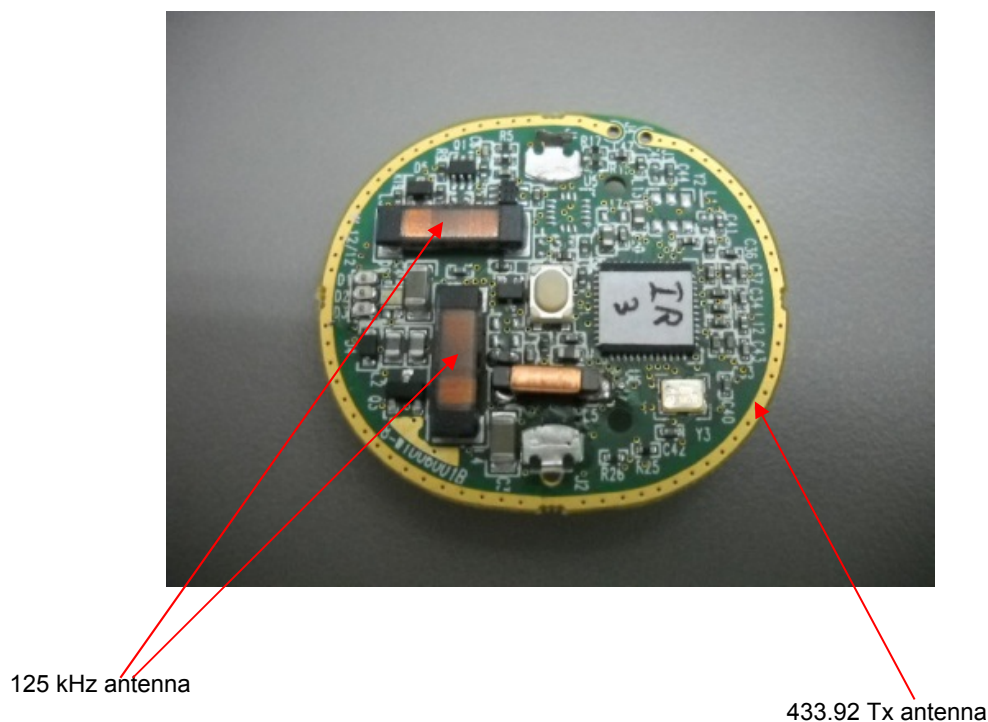
7.2 Antenna requirements

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 7.2.1.

Table 7.2.1 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 7.2.1 Antenna assembly



Test specification:		RSS-Gen, Section 4.6.1, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date:		3/27/2012	
Temperature: 21 °C	Air Pressure: 1012 hPa	Relative Humidity: 51 %	Power Supply: 3 V battery
Remarks:			

7.3 Occupied bandwidth test

7.3.1 General

This test was performed to measure transmitter occupied bandwidth not specified by the standard.

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 at maximum data rate.

7.3.2.3 The transmitter bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.3.1 and the associated plot.

Figure 7.3.1 Occupied bandwidth test setup



Test specification:		RSS-Gen, Section 4.6.1, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:	Compliance	Verdict: PASS	
Date:	3/27/2012		
Temperature: 21 °C	Air Pressure: 1012 hPa	Relative Humidity: 51 %	Power Supply: 3 V battery
Remarks:			

Table 7.3.1 Occupied bandwidth test results

DETECTOR USED: Peak
SWEEP TIME: Auto
RESOLUTION BANDWIDTH: $\geq 1\%$ of the 20 dB bandwidth
VIDEO BANDWIDTH: $\geq$ RBW
SIGNAL: MODULATED
MODULATION ENVELOPE REFERENCE POINTS: 99% power

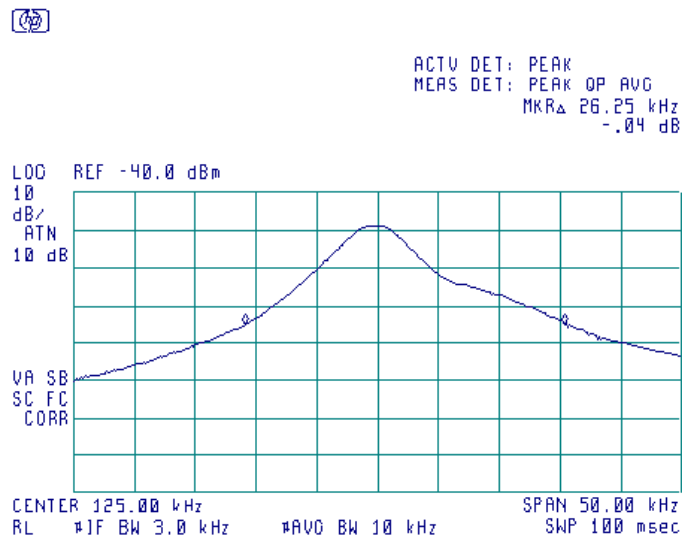
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
125	26.25 kHz	NA	NA	Pass

Reference numbers of test equipment used

HL 0446	HL 2780	HL 2883	HL 3389					
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Full description is given in Appendix A.

Plot 7.3.1 Occupied bandwidth test result





Test specification:		RSS-Gen, Section 6.1, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		2/28/2012	
Temperature: 22 °C	Air Pressure: 1014 hPa	Relative Humidity: 46 %	Power Supply: 3 V battery
Remarks:			

8 Unintentional emissions

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 limits according to RSS-Gen Section 6.1

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

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

8.1.2 Test procedure for measurements in semi-anechoic chamber

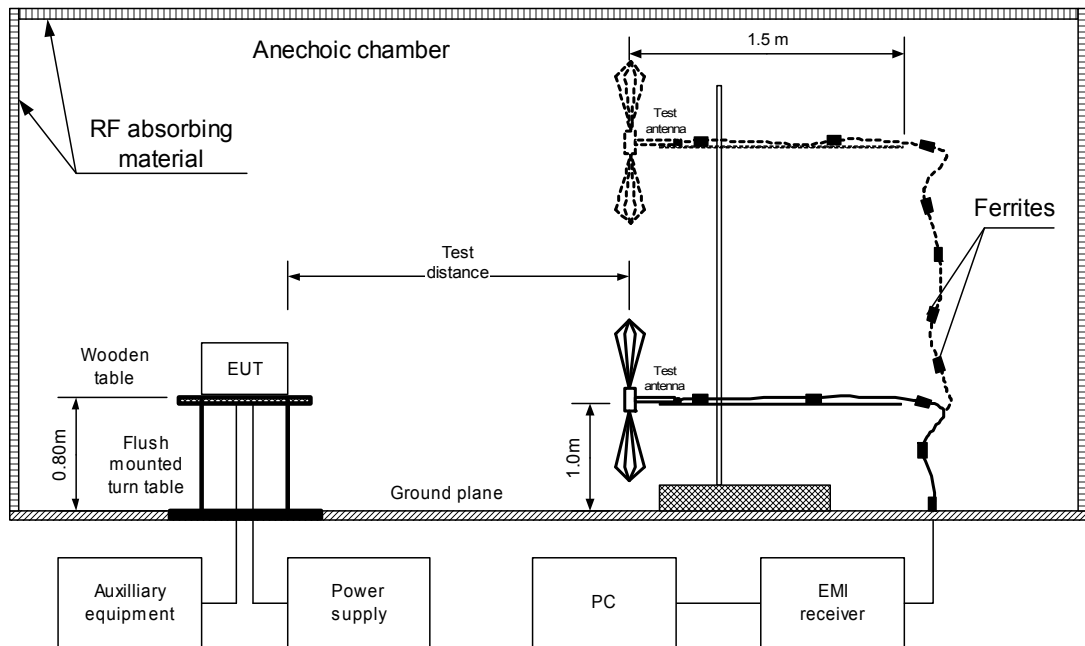
8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and the performance check was conducted.

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 provided in the associated tables and plots.

Test specification: RSS-Gen, Section 6.1, Radiated emission			
Test procedure: ANSI C63.4, Sections 11.6 and 12.1.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 2/28/2012			
Temperature: 22 °C	Air Pressure: 1014 hPa	Relative Humidity: 46 %	Power Supply: 3 V battery
Remarks:			

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





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Test specification:		RSS-Gen, Section 6.1, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		2/28/2012	
Temperature: 22 °C	Air Pressure: 1014 hPa	Relative Humidity: 46 %	Power Supply: 3 V battery
Remarks:			

Table 8.1.2 Radiated emission test results

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

DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

Frequency, MHz		Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
Peak emission, dB(μV/m)	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 2697	HL 2780	HL 2883	HL 3389				
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Full description is given in Appendix A.

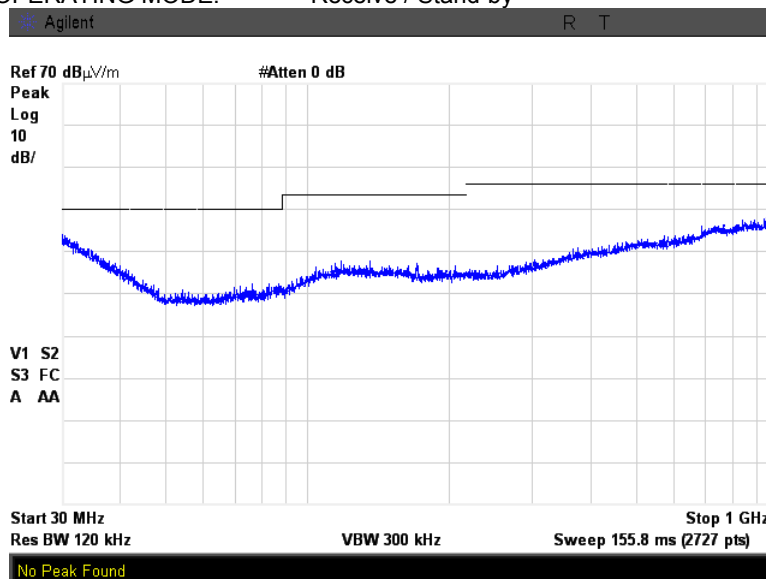


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Test specification:		RSS-Gen, Section 6.1, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		2/28/2012	
Temperature: 22 °C	Air Pressure: 1014 hPa	Relative Humidity: 46 %	Power Supply: 3 V battery
Remarks:			

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

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



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	03-Jul-12	03-Jul-13
2697	Antenna, 30 MHz - 3.0 GHz	Sunol Sciences. Corp. Pleasanton, California USA	JB3	A022805	20-May-12	20-May-14
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY451024 62	09-Jul-12	09-Jul-13
2883	Cable, 18 GHz N-type, M-F, 3 m	Bird Electronic Corp.	TC-MNFN-3.0	211539 003	04-Dec-12	04-Dec-13
3389	Microwave Cable Assembly, 26.5 GHz, 1.0 m, N type/N type	Suhner Sucoflex	104EA	3389	06-Feb-13	06-Feb-14
3390	Microwave Cable Assembly, 26.5 GHz, 1.0 m, N type/N type	Suhner Sucoflex	104EA	3390	06-Feb-13	06-Feb-14
4160	Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out.	Agilent Technologies	87405C	MY470105 94	08-Aug-12	08-Aug-13

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Radiated emissions at 3 m measuring distance	
Horizontal polarization	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

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, IC 2186A-2 for anechoic chamber, IC 2186A-3 for full-anechoic chamber for RE measurements above 1 GHz), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), 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). The FCC Designation Number is US1003.

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12 APPENDIX D Specification references

FCC 47CFR part 15: 2011	Radio Frequency Devices
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications
ANSI C63.4: 2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
RSS-210 Issue 8: 2010	Low Power Licence- Exempt Radiocommunication Devices
RSS-Gen Issue 3: 2010	General Requirements and Information for the Certification of Radiocommunication Equipment

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 calibration
Sunol Sciences Inc., model JB3, serial number A022805, HL 2697

Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain
30	22.2	-22.5	0.01	620	19.7	6.3	4.27	1215	24.9	7.0	5.05	1810	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	1815	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	1820	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	25.2	6.8	4.82	1825	28.7	6.8	4.75	2420	31.0	6.8	4.82
45	11.3	-8.1	0.16	640	19.9	6.4	4.40	1235	25.1	7.0	4.96	1830	28.7	6.8	4.76	2425	31.1	6.8	4.81
50	8.9	-4.7	0.34	645	19.9	6.5	4.45	1240	25.0	7.1	5.09	1835	28.7	6.7	4.72	2430	31.0	6.9	4.87
55	7.9	-2.8	0.52	650	19.9	6.5	4.51	1245	25.0	7.1	5.12	1840	28.8	6.7	4.69	2435	31.0	6.9	4.86
60	7.5	-2.1	0.62	655	19.9	6.6	4.60	1250	25.0	7.1	5.15	1845	28.6	6.9	4.90	2440	31.2	6.8	4.74
65	8.5	-2.0	0.63	660	19.9	6.7	4.69	1255	25.0	7.2	5.25	1850	28.4	7.1	5.12	2445	31.1	6.9	4.91
70	9.0	-1.9	0.64	665	19.9	6.7	4.70	1260	24.9	7.3	5.36	1855	28.5	7.0	5.07	2450	31.0	7.0	4.96
75	8.8	-1.1	0.78	670	20.0	6.7	4.71	1265	25.0	7.3	5.31	1860	28.6	7.0	5.01	2455	31.0	7.0	5.01
80	8.4	-0.2	0.97	675	20.1	6.7	4.71	1270	25.1	7.2	5.26	1865	28.5	7.1	5.17	2460	30.9	7.2	5.19
85	8.0	0.6	1.20	680	20.1	6.7	4.71	1275	25.3	7.0	5.05	1870	28.4	7.3	5.33	2465	31.1	6.9	4.95
90	8.2	1.1	1.29	685	20.1	6.8	4.79	1280	25.5	6.8	4.94	1875	28.4	7.2	5.28	2470	31.3	6.8	4.76
95	9.2	0.5	1.13	690	20.1	6.9	4.88	1285	25.4	7.0	4.97	1880	28.5	7.2	5.22	2475	31.4	6.7	4.69
100	10.6	-0.4	0.92	695	20.2	6.8	4.82	1290	25.3	7.1	5.10	1885	28.5	7.2	5.22	2480	31.3	6.8	4.79
110	12.6	-1.6	0.70	705	20.4	6.8	4.75	1300	25.2	7.3	5.33	1895	28.6	7.2	5.24	2490	31.1	7.0	4.99
120	13.9	-2.1	0.62	715	20.5	6.8	4.80	1310	25.5	7.1	5.09	1905	28.5	7.3	5.36	2500	30.9	7.2	5.27
125	14.2	-2.0	0.63	720	20.5	6.9	4.85	1315	25.4	7.2	5.23	1910	28.5	7.4	5.45	2505	31.1	7.1	5.15
130	14.2	-1.7	0.68	725	20.6	6.8	4.81	1320	25.3	7.3	5.36	1915	28.5	7.3	5.38	2510	31.0	7.2	5.22
140	13.4	0.3	0.94	735	20.9	6.7	4.55	1330	25.6	7.0	5.06	1925	28.6	7.3	5.39	2520	31.2	7.0	5.05
150	12.9	0.8	1.21	745	21.0	6.6	4.59	1340	25.7	7.1	5.09	1935	28.5	7.4	5.54	2530	31.0	7.3	5.37
160	12.7	1.6	1.44	755	21.0	6.8	4.74	1350	25.7	7.1	5.17	1945	28.5	7.5	5.59	2540	31.2	7.1	5.09
165	12.5	2.0	1.59	760	21.0	6.8	4.83	1355	25.8	7.0	5.06	1950	28.6	7.4	5.48	2545	31.0	7.3	5.43
170	12.2	2.6	1.83	765	21.1	6.8	4.73	1360	25.9	6.9	4.95	1955	28.6	7.5	5.57	2550	31.0	7.3	5.39
175	11.8	3.3	2.13	770	21.3	6.7	4.64	1365	26.0	6.9	4.95	1960	28.6	7.5	5.65	2555	31.1	7.2	5.30
180	11.6	3.7	2.36	775	21.3	6.7	4.68	1370	26.0	7.0	4.98	1965	28.7	7.4	5.47	2560	31.0	7.4	5.47
185	11.5	4.0	2.54	780	21.3	6.7	4.72	1375	26.0	7.0	5.01	1970	28.5	7.2	5.29	2565	30.8	7.6	5.70
190	11.6	4.2	2.61	785	21.3	6.8	4.77	1380	26.0	7.0	5.06	1975	28.9	7.2	5.22	2570	31.1	7.3	5.37
200	13.1	3.2	2.07	795	21.4	6.8	4.79	1390	26.1	6.9	4.92	1985	29.1	7.1	5.11	2580	31.6	6.9	4.87
205	12.0	4.4	2.76	800	21.5	6.8	4.77	1395	26.2	6.9	4.94	1990	29.1	7.0	5.06	2585	31.6	6.8	4.79
210	11.0	5.6	3.66	805	21.6	6.7	4.71	1400	26.2	7.0	4.96	1995	29.1	7.1	5.09	2590	31.6	6.9	4.88
215	11.3	5.6	3.59	810	21.7	6.7	4.65	1405	26.1	7.0	5.02	2000	29.1	7.1	5.11	2595	31.5	7.0	4.97
220	11.6	5.5	3.52	815	21.7	6.7	4.72	1410	26.1	7.1	5.09	2005	29.1	7.1	5.16	2600	31.6	6.9	4.86
225	11.7	5.5	3.45	820	21.7	6.8	4.80	1415	26.2	7.0	5.02	2010	29.1	7.1	5.15	2605	31.3	7.2	5.30
230	11.9	5.5	3.57	825	21.7	6.8	4.82	1420	26.3	7.0	5.06	2015	29.2	7.1	5.13	2610	31.4	7.1	5.15
235	12.1	5.5	3.56	830	21.7	6.9	4.85	1425	26.2	7.1	5.10	2020	29.2	7.1	5.18	2615	31.7	6.9	4.88
240	12.3	5.5	3.54	835	21.8	6.8	4.82	1430	26.1	7.2	5.25	2025	29.3	7.1	5.08	2620	31.6	7.0	4.97
245	12.3	5.7	3.71	840	21.9	6.8	4.80	1435	26.1	7.2	5.24	2030	29.3	7.0	5.05	2625	31.4	7.1	5.17
250	12.3	5.9	3.88	845	21.9	6.8	4.83	1440	26.2	7.2	5.24	2035	29.3	7.1	5.07	2630	31.6	7.0	5.00
255	12.5	5.9	3.85	850	21.9	6.9	4.86	1445	26.3	1	5.11	2040	29.3	7.1	5.13	2635	31.8	6.8	4.82
260	12.7	5.8	3.83	855	22.0	6.8	4.80	1450	26.5	7.0	4.98	2045	29.2	7.2	5.23	2640	31.7	7.0	4.98
265	13.2	5.5	3.54	860	22.1	6.8	4.74	1455	26.4	7.1	5.07	2050	29.2	7.2	5.27	2645	31.7	6.9	4.93
270	13.7	5.2	3.27	865	22.1	6.9	4.82	1460	26.4	7.1	5.17	2055	29.3	7.2	5.21	2650	31.8	6.9	4.85
275	13.7	5.3	3.39	870	21.9	7.1	5.11	1465	26.4	7.2	5.19	2060	29.5	7.0	5.02	2655	31.8	6.9	4.85
280	13.7	5.4	3.50	875	22.0	7.1	5.08	1470	26.4	7.2	5.22	2065	29.4	7.1	5.08	2660	31.7	7.0	5.02
285	13.7	5.6	3.61	880	22.1	7.0	5.05	1475	26.4	7.1	5.17	2070	29.4	7.1	5.01	2665	32.0	6.7	4.71
290	13.7	5.7	3.72	885	22.1	7.0	5.06	1480	26.5	7.1	5.12	2075	29.5	7.0	5.01	2670	32.0	6.7	4.67
295	13.8	5.8	3.77	890	22.1	7.0	5.06	1485	26.5	7.1	5.14	2080	29.8	6.8	4.76	2675	31.9	6.8	4.81
300	13.9	5.8	3.81	895	22.2	7.1	5.09	1490	26.5	7.1	5.17	2085	29.7	6.9	4.89	2680	31.7	7.0	5.04
305	14.0	5.9	3.85	900	22.2	7.1	5.12	1495	26.5	7.2	5.24	2090	29.7	6.9	4.86	2685	31.9	6.8	4.83
310	14.1	5.9	3.88	905	22.3	7.1	5.09	1500	26.5	7.2	5.31	2095	29.8	6.8	4.78	2690	32.1	6.7	4.72
315	14.3	5.8	3.88	910	22.3	7.0	5.05	1505	26.5	7.2	5.27	2100	29.8	6.8	4.75	2695	32.1	6.7	4.71
320	14.4	5.9	3.90	915	22.4	7.0	4.99	1510	26.6	7.2	5.30	2105	29.8	6.8	4.81	2700	32.0	6.8	4.81
325	14.5	5.9	3.92	920	22.6	6.9	4.92	1515	26.6	7.2	5.37	2110	29.9	6.8	4.78	2705	32.0	6.8	4.80
330	14.6	5.9	3.93	925	22.7	6.9	4.85	1520	26.5	7.3	5.38	2115	29.9	6.8	4.76	2710	32.1	6.8	4.79
335	14.7	6.0	4.02	930	22.8	6.8	4.77	1525	26.6	7.3	5.37	2120	29.9	6.8	4.84	2715	32.1	6.7	4.71
340	14.7	6.2	4.12	935	22.8	6.8	4.83	1530	26.6	7.3	5.36	2125	29.9	6.9	4.89	2720	32.4	6.5	4.47
345	14.9	6.1	4.06	940	22.8	6.9	4.89	1535	26.6	7.4	5.44	2130	29.9	6.9	4.90	2725	32.2	6.7	4.63
350	15.1	6.0	3.99	945	22.8	6.9	4.87	1540	26.5	7.4	5.53	2135	29.8	6.9	4.94	2730	31.9	7.0	5.05
355	15.3	5.9	3.88	950	22.9	6.9	4.85	1545	26.5	7.5	5.58	2140	29.8	7.1	5.08	2735	31.6	7.4	5.44
360	15.8	5.8	3.78	955	23.0	6.8	4.81	1550	26.6	7.5	5.63	2145	29.8	6.9	4.92	2740	31.6	7.1	5.40
365	15.5	5.9	3.89	960	23.1	6.8	4.77	1555	26.7	7.3	5.59	2150	29.9	7.0	4.98	2745	31.9	7.0	5.06
370	15.5	6.0	4.01	965	23.1	6.7	4.73	1560	26.9	7.1	5.18	2155	29.8	7.1	5.10	2750	32.0	6.9	4.94
375	15.6	6.1	4.03	970	23.2	6.7	4.69	1565	26.9	7.2	5.23	2160	29.8	7.1	5.09	2755	32.0	7.0	5.08
380	15.7	6.1	4.05	975	23.3	6.6	4.62	1570	26.9	7.2	5.30	2165	29.9	7.0	5.00	2760	32.0	7.0	4.96
385	15.7	6.2	4.15	980	23.5	6.6	4.54	1575	27.0	7.2	5.23	2170	29.9	7.1	5.07	2765	32.2	6.8	4.80
390	15.7	6.3	4.25	985	23.5	6.6	4.52	1580	27.0	7.1	5.17	2175	29.8	7.2	5.20	2770	32.3	6.8	

Cable loss
Cable coaxial, Bird, 18 GHz, N-type, M-F, model TC-MNFN-3.0, S/N 211539 003
HL 2883

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.06	5750	1.70	12000	2.46
30	0.12	6000	1.75	12250	2.48
100	0.21	6250	1.80	12500	2.52
250	0.34	6500	1.81	12750	2.50
500	0.47	6750	1.86	13000	2.54
750	0.59	7000	1.86	13250	2.48
1000	0.67	7250	1.92	13500	2.63
1250	0.76	7500	1.96	13750	2.65
1500	0.84	7750	1.98	14000	2.72
1750	0.92	8000	2.02	14250	2.67
2000	0.98	8250	2.03	14500	2.70
2250	1.05	8500	2.05	14750	2.72
2500	1.12	8750	2.11	15000	2.79
2750	1.17	9000	2.17	15250	2.80
3000	1.22	9250	2.17	15500	2.83
3250	1.27	9500	2.20	15750	2.75
3500	1.33	9750	2.19	16000	2.82
3750	1.38	10000	2.22	16250	2.85
4000	1.42	10250	2.25	16500	2.90
4250	1.46	10500	2.30	16750	2.89
4500	1.51	10750	2.28	17000	2.88
4750	1.54	11000	2.32	17250	2.85
5000	1.59	11250	2.34	17500	2.96
5250	1.62	11500	2.39	17750	3.04
5500	1.65	11750	2.42	18000	3.04

Cable loss
Cable coaxial, Microwave Cable Assembly, 104EA, 18 GHz, 1.0 m
Suhner Sucoflex, HL 3389

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	-0.16	4000	0.67	9000	1.03	14000	1.35
15	-0.02	4100	0.68	9100	1.03	14100	1.36
20	0.01	4200	0.70	9200	1.03	14200	1.35
30	0.04	4300	0.71	9300	1.03	14300	1.36
40	0.05	4400	0.71	9400	1.03	14400	1.34
50	0.06	4500	0.72	9500	1.02	14500	1.34
60	0.07	4600	0.73	9600	1.03	14600	1.35
70	0.08	4700	0.73	9700	1.03	14700	1.35
80	0.09	4800	0.73	9800	1.02	14800	1.32
90	0.10	4900	0.74	9900	1.00	14900	1.30
100	0.10	5000	0.73	10000	0.99	15000	1.31
150	0.13	5100	0.72	10100	0.99	15100	1.30
200	0.15	5200	0.73	10200	0.98	15200	1.30
300	0.18	5300	0.73	10300	0.98	15300	1.31
400	0.21	5400	0.75	10400	0.96	15400	1.31
500	0.23	5500	0.77	10500	0.95	15500	1.31
600	0.25	5600	0.80	10600	0.93	15600	1.31
700	0.27	5700	0.79	10700	0.91	15700	1.32
800	0.29	5800	0.79	10800	0.92	15800	1.33
900	0.30	5900	0.79	10900	0.95	15900	1.34
1000	0.32	6000	0.79	11000	0.97	16000	1.34
1100	0.33	6100	0.79	11100	0.99	16100	1.34
1200	0.35	6200	0.82	11200	0.98	16200	1.33
1300	0.37	6300	0.82	11300	0.98	16300	1.33
1400	0.38	6400	0.85	11400	0.97	16400	1.33
1500	0.40	6500	0.84	11500	0.96	16500	1.31
1600	0.40	6600	0.84	11600	0.95	16600	1.29
1700	0.41	6700	0.85	11700	0.95	16700	1.27
1800	0.42	6800	0.85	11800	0.97	16800	1.28
1900	0.44	6900	0.84	11900	0.99	16900	1.29
2000	0.48	7000	0.85	12000	0.99	17000	1.32
2100	0.49	7100	0.87	12100	1.01	17100	1.35
2200	0.50	7200	0.89	12200	1.04	17200	1.36
2300	0.51	7300	0.91	12300	1.06	17300	1.40
2400	0.52	7400	0.95	12400	1.07	17400	1.42
2500	0.53	7500	0.97	12500	1.08	17500	1.40
2600	0.54	7600	0.98	12600	1.11	17600	1.39
2700	0.55	7700	1.01	12700	1.13	17700	1.36
2800	0.57	7800	1.00	12800	1.13	17800	1.35
2900	0.58	7900	1.01	12900	1.15	17900	1.35
3000	0.59	8000	1.02	13000	1.16	18000	1.35
3100	0.59	8100	1.04	13100	1.18		
3200	0.60	8200	1.05	13200	1.21		
3300	0.61	8300	1.05	13300	1.23		
3400	0.61	8400	1.05	13400	1.26		
3500	0.62	8500	1.05	13500	1.26		
3600	0.62	8600	1.05	13600	1.30		
3700	0.62	8700	1.04	13700	1.29		
3800	0.63	8800	1.03	13800	1.31		
3900	0.65	8900	1.03	13900	1.33		

Cable loss
Cable coaxial, Microwave Cable Assembly, 104EA, 18 GHz, 1.0 m
Suhner Sucoflex, HL 3390

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.03	4800	0.55	9800	0.89	14900	1.07
30	0.04	4900	0.56	9900	0.89	15000	1.07
50	0.05	5000	0.57	10000	0.86	15100	1.08
100	0.07	5100	0.58	10100	0.86	15200	1.07
200	0.10	5200	0.58	10200	0.88	15300	1.09
300	0.12	5300	0.59	10300	0.92	15400	1.10
400	0.14	5400	0.59	10400	0.94	15500	1.10
500	0.16	5500	0.60	10500	0.96	15600	1.12
600	0.17	5600	0.61	10600	0.93	15700	1.15
700	0.18	5700	0.61	10700	0.89	15800	1.15
800	0.20	5800	0.63	10800	0.89	15900	1.17
900	0.21	5900	0.63	10900	0.88	16000	1.14
1000	0.23	6000	0.64	11000	0.92	16100	1.14
1100	0.24	6100	0.64	11100	0.91	16200	1.15
1200	0.25	6200	0.64	11200	0.89	16300	1.14
1300	0.27	6300	0.65	11300	0.88	16400	1.13
1400	0.28	6400	0.65	11400	0.88	16500	1.13
1500	0.28	6500	0.66	11500	0.90	16600	1.13
1600	0.30	6600	0.67	11600	0.94	16700	1.14
1700	0.31	6700	0.67	11700	0.96	16800	1.14
1800	0.32	6800	0.67	11800	0.92	16900	1.14
1900	0.33	6900	0.68	11900	0.92	17000	1.14
2000	0.34	7000	0.67	12000	0.91	17100	1.15
2100	0.35	7100	0.68	12100	0.92	17200	1.14
2200	0.35	7200	0.69	12200	0.95	17300	1.15
2300	0.36	7300	0.69	12300	0.98	17400	1.15
2400	0.37	7400	0.68	12400	0.96	17500	1.16
2500	0.39	7500	0.69	12500	0.99	17600	1.16
2600	0.40	7600	0.70	12600	0.96	17700	1.16
2700	0.41	7700	0.71	12700	0.93	17800	1.19
2800	0.42	7800	0.72	12800	0.94	17900	1.21
2900	0.42	7900	0.72	12900	0.98	18000	1.25
3000	0.43	8000	0.72	13000	0.99		
3100	0.44	8100	0.73	13100	0.99		
3200	0.45	8200	0.74	13200	0.99		
3300	0.46	8300	0.75	13300	0.99		
3400	0.46	8400	0.74	13400	1.00		
3500	0.47	8500	0.73	13500	1.02		
3600	0.47	8600	0.73	13600	1.05		
3700	0.47	8700	0.75	13700	1.03		
3800	0.49	8800	0.77	13800	1.02		
3900	0.49	8900	0.77	13900	1.03		
4000	0.50	9000	0.77	14000	1.03		
4100	0.51	9100	0.77	14100	1.05		
4200	0.52	9200	0.78	14200	1.05		
4300	0.52	9300	0.80	14300	1.04		
4400	0.53	9400	0.82	14400	1.03		
4500	0.53	9500	0.82	14600	1.06		
4600	0.54	9600	0.83	14700	1.07		
4700	0.56	9700	0.89	14800	1.08		

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AVRG	average (detector)
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
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
μ s	microsecond
NA	not applicable
OATS	open area test site
Ω	Ohm
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

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