

TEST REPORT

ACCORDING TO: FCC CFR 47 Part 15 subpart C, section 15.231(e) and subpart B
RSS-210 issue 8 Annex 1, ICES-003 Issue 5:2012

FOR:

**Elpas Solutions Ltd.
Lone Worker Active RFID Tag
Models:**

5-LW241037-0

5-LW240057-0

5-LW241020-0

5-LW240020-0

FCC ID:O4X5-LW2410370

IC:1467G-5LW2410370

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1 Applicant information

Client name: Elpas Solutions Ltd.
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Telephone: +972 3768 1400
Fax: +972 3768 1415
E-mail: aelshtein@tycoint.com
Contact name: Mr. Arick Elshtein

2 Equipment under test attributes

Product name: Lone Worker Active RFID Tag
Product type: Transceiver operating at 433 MHz (Tx) and 125 kHz (Rx)
Model(s): 5-LW241037-0
Hardware version: 1.0
Software release: 1.0
Receipt date 23-Dec-14

3 Manufacturer information

Manufacturer name: Elpas Solutions Ltd.
Address: 23 Habarzel street, Tel Aviv 69710, Israel
Telephone: +972 3768 1400
Fax: +972 3768 1415
E-Mail: aelshtein@tycoint.com
Contact name: Mr. Arick Elshtein

4 Test details

Project ID: 26351
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 23-Dec-14
Test completed: 11-Feb-15
Test specification(s): FCC 47CFR part 15, subpart C, §15.231(e) subpart B;
RSS-210 issue 8 Annex 1, RSS-Gen issue 4, ICES-003 issue 5:2012

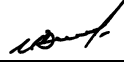


5 Tests summary

Test	Status
Transmitter characteristics	
FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements	Pass
FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	Pass
FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	Pass
FCC Part 15, Section 207 / RSS-Gen, Section 8.8, Conducted emission	Not required
FCC Part 15, Section 203 / RSS-Gen, Section 8.3, Antenna requirements	Pass
Unintentional emissions	
FCC Part 15, Section 107 / ICES-003, Section 6.1 class B, Conducted emission at AC power port	Not required
FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2/ ICES-003, Section 6.2 class B, 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:	Mrs. E. Pitt, test engineer	February 3, 2015	
	Mr. V. Einem, test engineer		
	Mr. I. Zilberstein, test engineer		
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	February 22, 2015	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	March 16, 2015	



6 EUT description

6.1 General information

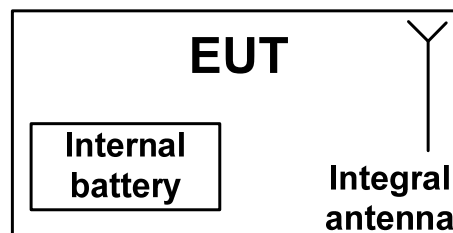
The EUT is a Lone Worker active RFID tag that comprises the 433.92 MHz transmitter and the 125 kHz receiver radio modules. The EUT is powered from 3V internal battery.

According to manufacturer's declaration of similarity provided in Appendix G of the test report, all EUT models have the same housing/enclosure, PCB, RF (ASK) transmitter (433.92 MHz), LF receiver (125 kHz) and three pushbuttons, and they vary in the following:

- the EUT model 5-LW241037-0 has also a fall detector and an IR transmitter;
- the EUT model 5-LW240057-0 has also a fall detector but has not an IR transmitter;
- the EUT model 5-LW241020-0 has also an IR transmitter but has not a fall detector;
- the EUT model 5-LW240020-0 has not a fall detector nor an IR transmitter.

That is why only the EUT model 5-LW241037-0 was tested as the most populated version covering all other variants.

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





6.5 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)				
Operating frequencies		433.92 MHz			
Maximum rated output power		At transmitter 50 Ω RF output connector		dBm	
		Field strength at 3 m distance		89.52 dB(μ V/m) -peak 59.62 dB(μ V/m)-average	
Is transmitter output power variable?		X	No		
		Yes		continuous variable	
				stepped variable with stepsize	dB
			minimum RF power		dBm
		maximum RF power		dBm	
Antenna connection					
unique coupling	standard connector	X	integral	X	with temporary RF connector without temporary RF connector
Antenna/s technical characteristics					
Type	Manufacturer		Model number		
Internal	Elpas		Printed antenna		
Type of modulation		ASK			
Transmitter aggregate data rate/s		19.2 kbps			
Transmitter power source					
X	Battery	Nominal rated voltage	3.0 VDC	Battery type	Lithium
	DC	Nominal rated voltage	VDC		
	AC mains	Nominal rated voltage	VAC	Frequency	
Common power source for transmitter and receiver				X	yes no

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V 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;
- Duration of each transmission shall not be greater than 1 second;
- Silent period between transmissions shall be at least 30 times the duration of the transmission;
- Silent period between transmissions shall be in no case less than 10 seconds.

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 the associated plots. The test results were recorded in Table 7.1.2.

Figure 7.1.1 Setup for transmitter shut down test

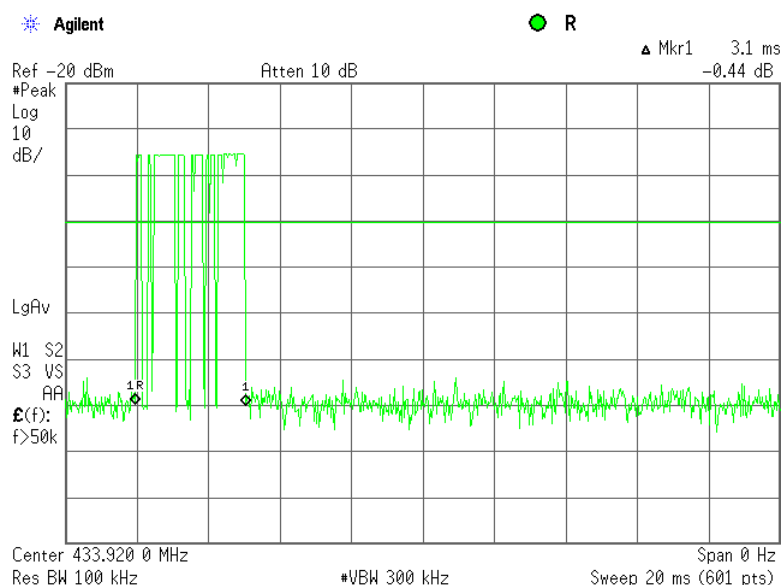


Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery
Remarks:			

Table 7.1.1 Periodic operation requirements

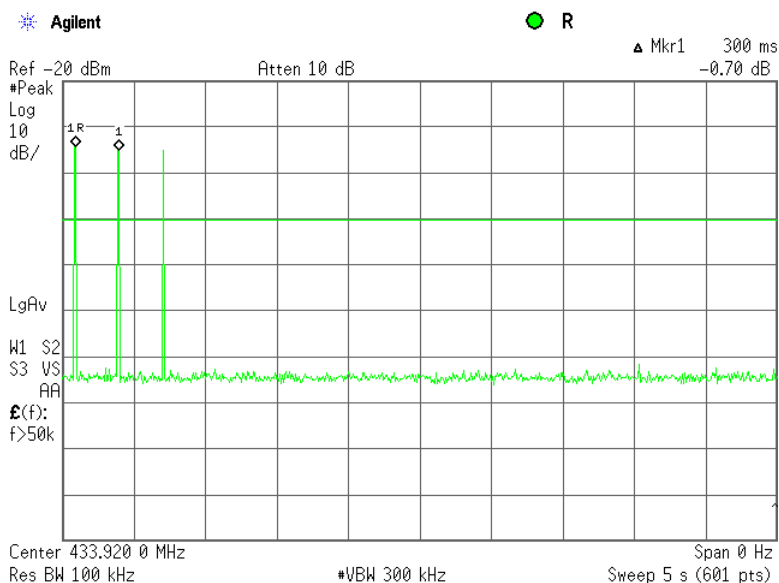
Requirement	Rationale	Verdict
Continuous transmissions are not permitted	Supplier declaration	Comply
Duration of each transmission shall not be greater than 1 second	Plot 7.1.1	Comply
Silent period between transmissions shall be at least 30 times the duration of the transmission	Plot 7.1.4	Comply
Silent period between transmissions shall be in no case less than 10 seconds	Plot 7.1.4	Comply

Plot 7.1.1 Transmitter pulse duration



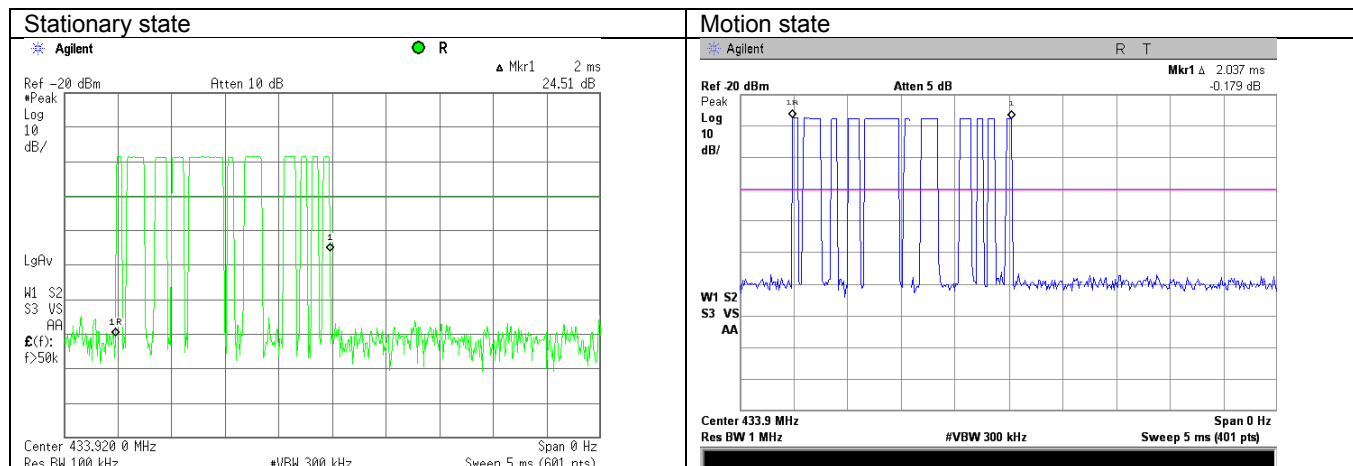
Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery
Remarks:			

Plot 7.1.2 Transmission pulse period

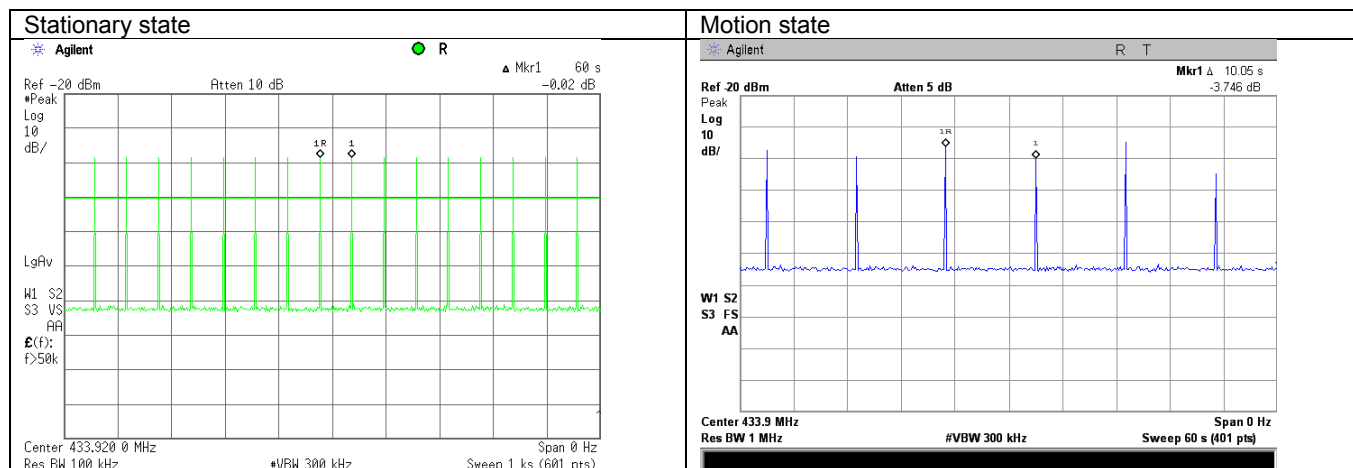


Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery
Remarks:			

Plot 7.1.3 Supervision Transmission duration



Plot 7.1.4 Supervision Transmission period.





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Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements			
Test procedure:	Supplier declaration			
Test mode:	Compliance	Verdict: PASS		
Date(s):	03-Feb-15			
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery	
Remarks:				

Table 7.1.2 Total duration of transmissions

Pulse duration*, ms		Pulse period, ms		Total transmission duration, ms	Silent period between transmissions, s	Silent period between transmissions limit, s	Margin, s	Verdict
Preamble	Data	Preamble	Data					
NA	3.1	NA	300	3.1	10.05	10	-0.05	Pass

Reference numbers of test equipment used

HL 2909	HL 3818						
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Full description is given in Appendix A.



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

7.2 Field strength of emissions

7.2.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.2.1 and Table 7.2.2.

Table 7.2.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
433.9	92.9	72.9

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**	74***	54***
0.090 – 0.110	NA	108.5 – 106.8**	NA		
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**		
0.490 – 1.705	NA	73.8 – 63.0**	NA		
1.705 – 30.0*		69.5			
30 – 88		40.0			
88 – 216		43.5			
216 – 960		46.0			
960 - 1000		54.0			
Above 1000	74.0	NA	54.0		

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

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

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

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

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.

*** - according to standard section 15.205(c)

Note 2: The above field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.



Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Dec-14	
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
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 recorded in Table 7.3.3, Table 7.3.5 and shown in the associated plots.

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

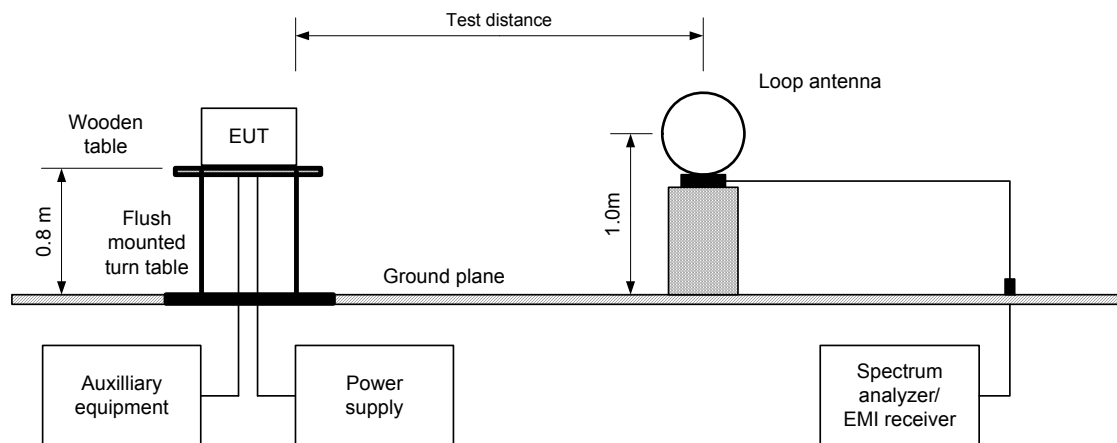
7.2.3.1 The EUT was set up as shown in Figure 7.2.2, energized and the performance check was conducted.

7.2.3.2 The measurements were performed in three EUT orthogonal positions.

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

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

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

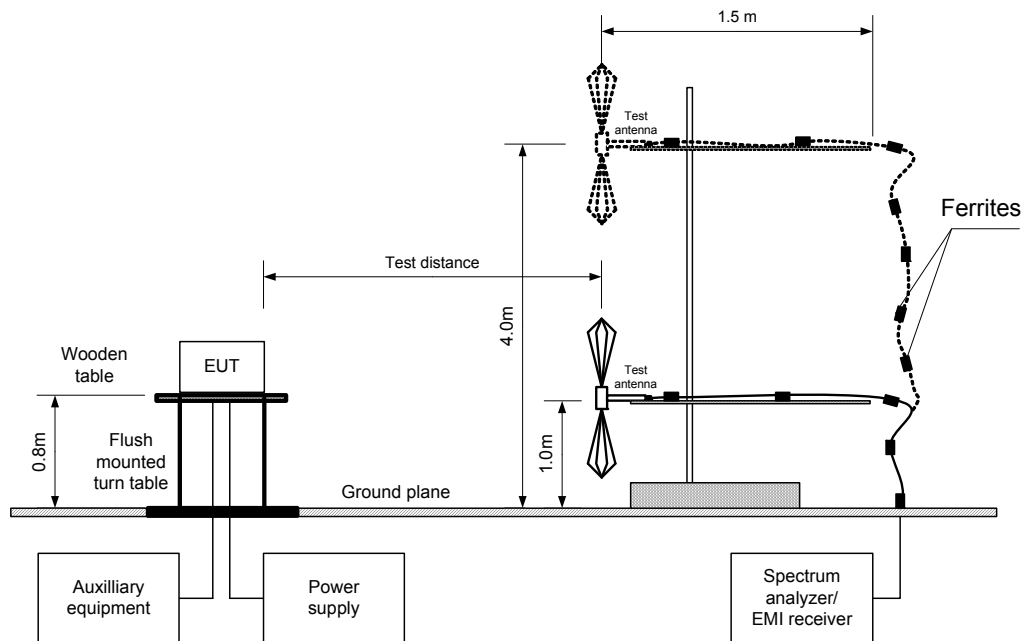




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Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:		ANSI C63.4, Section 13.1.4		
Test mode:		Compliance	Verdict: PASS	
Date(s):		23-Dec-14		
Temperature: 23.6 °C		Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:				

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





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Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions				
Test procedure:	ANSI C63.4, Section 13.1.4				
Test mode:	Compliance	Verdict: PASS			
Date(s):	23-Dec-14				
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V 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: ASK
BIT RATE: 19.2 kbps
INVESTIGATED FREQUENCY RANGE: 0.009 - 4500 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
9.0 kHz (150 kHz – 30 MHz)
120 kHz (30 MHz – 1000 MHz)
1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

F, MHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength				Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission***											
433.920	V	1.0	0	89.52	92.9	-3.38	89.52	59.62	72.9	-13.28	Pass
Spurious emissions											
867.832	V	1.2	20	34.55	74.0	-39.45	34.55	4.35	54.0	-49.65	Pass
1301.690	V	1.0	253	49.38	74.0	-24.62	49.38	19.18	54.0	-34.82	

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

** - Margin, dB = Measured (calculated) value, dB(μV/m) - Limit, dB(μV/m)

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

Table 7.2.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
3.1	300	NA	NA	NA	-30.2

*- 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 1915	HL 4295	HL 4535	HL 4541	HL 4542	HL 4543	HL 4549	HL 4551
HL 4575	HL 4603	HL 4604					

Full description is given in Appendix A.



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Report ID: ELPRAD_FCC.26351.docx

Date of Issue: 22-Feb-15

Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Dec-14	
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

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

TEST DISTANCE: 3 m
 EUT POSITION: 3 orthogonal (X / Y / Z)
 MODULATION: ASK
 BIT RATE: 19.2 kbps
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 120 kHz (30 MHz – 1000 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconical (30 MHz – 200 MHz)
 Log periodic (200 MHz – 1000 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 signals 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 1915	HL 4295	HL 4535	HL 4541	HL 4542	HL 4543	HL 4549	HL 4551
HL 4575	HL 4603	HL 4604					

Full description is given in Appendix A.



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

Table 7.2.6 Restricted bands according to FCC 15, Section 205

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	12.290 - 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	16.420 - 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	

Table 7.2.7 Restricted bands according to RSS-Gen, Table 3

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.291 - 8.294	16.80425 - 16.80475	399.9 - 410	3260 - 3267	10.6 - 12.7
2.1735 - 2.190	8.362 - 8.366	25.5 - 25.67	608 - 614	3332 - 3339	13.25 - 13.4
3.020 - 3.026	8.37625 - 8.38675	37.5 - 38.25	960 - 1427	3345.8 - 3358	14.47 - 14.5
4.125 - 4.128	8.41425 - 8.41475	73 - 74.6	1435 - 1626.5	3500 - 4400	15.35 - 16.2
4.17725 - 4.17775	12.290 - 12.293	74.8 - 75.2	1645.5 - 1646.5	4500 - 5150	17.7 - 21.4
4.20725 - 4.20775	12.51975 - 12.52025	108 - 138	1660 - 1710	5350 - 5460	22.01 - 23.12
5.677 - 5.683	12.57675 - 12.57725	156.52475 - 156.52525	1718.8 - 1722.2	7250 - 7750	23.6 - 24.0
6.215 - 6.218	13.36 - 13.41	156.7 - 156.9	2200 - 2300	8025 - 8500	31.2 - 31.8
6.26775 - 6.26825	16.42 - 16.423	240 - 285	2310 - 2390	9000 - 9200	36.43 - 36.5
6.31175 - 6.31225	16.69475 - 16.69525	322 - 335.4	2655 - 2900	9300 - 9500	Above 38.6

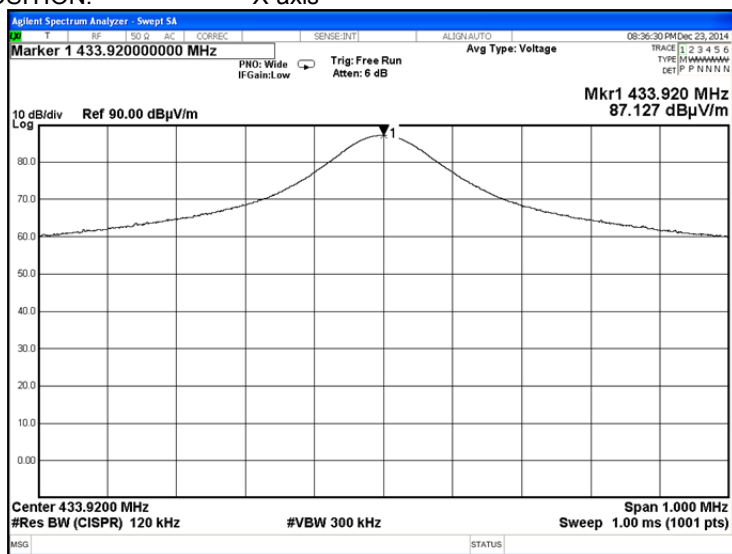


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Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

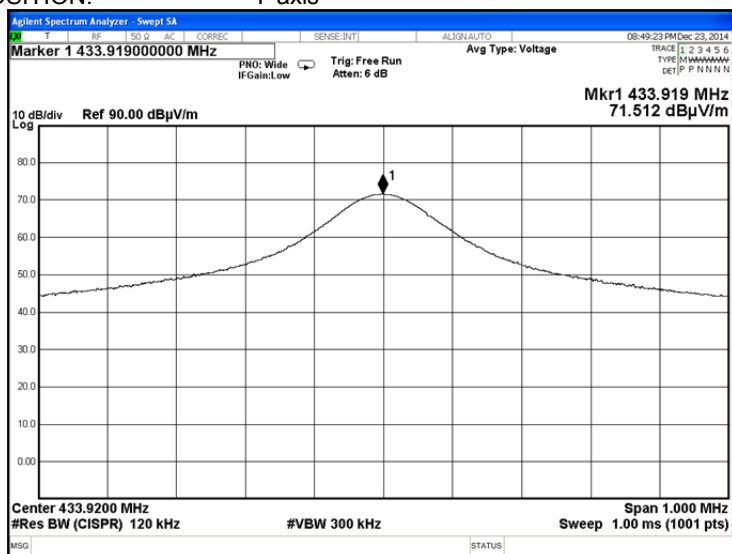
Plot 7.2.1 Radiated emission measurements at the fundamental frequency

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



Plot 7.2.2 Radiated emission measurements at the fundamental frequency

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



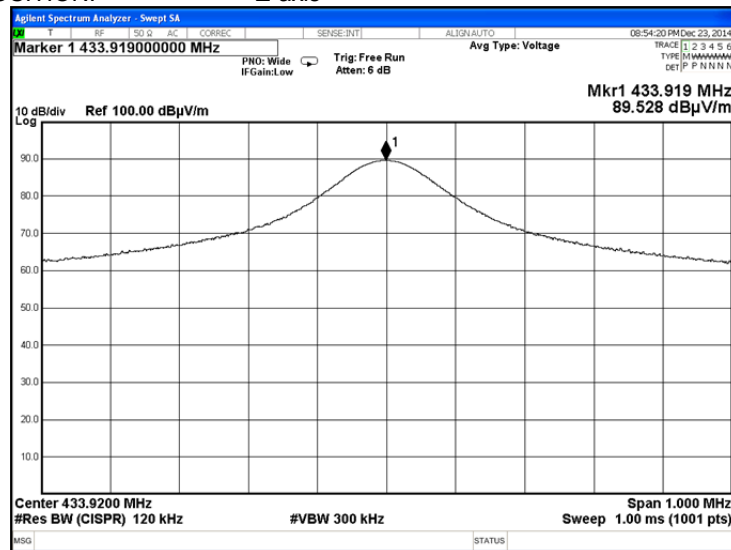


HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

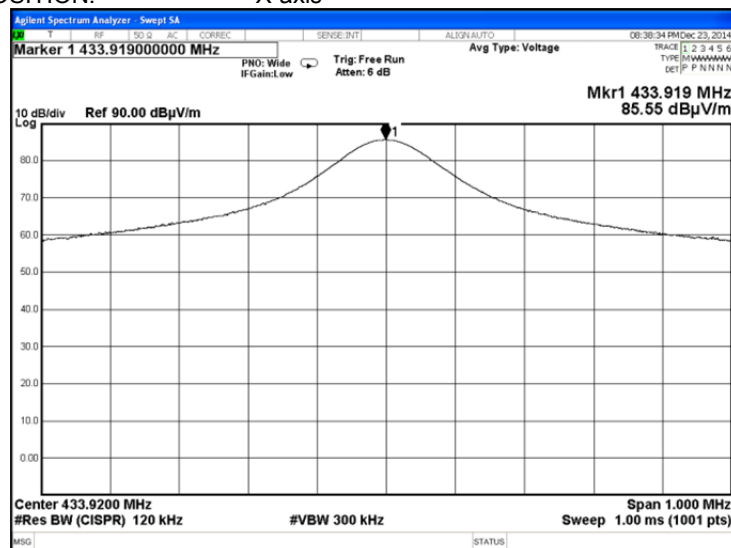
Plot 7.2.3 Radiated emission measurements at the fundamental frequency

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



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: X-axis



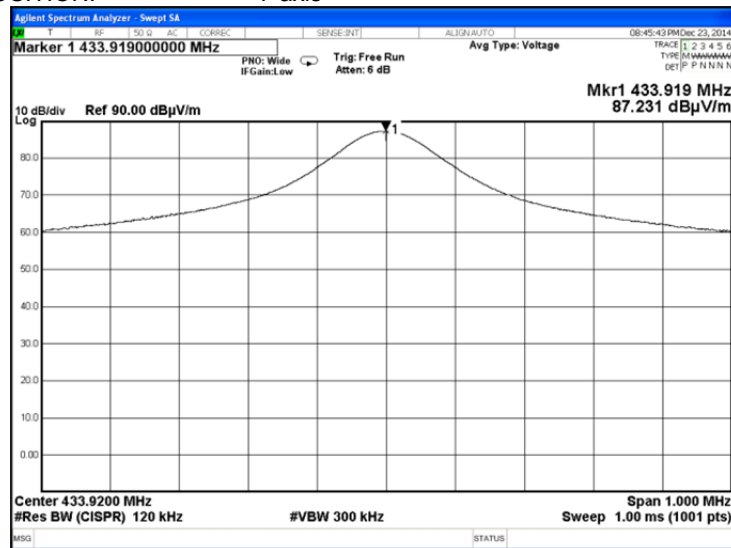


HERMON LABORATORIES

Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Dec-14	
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

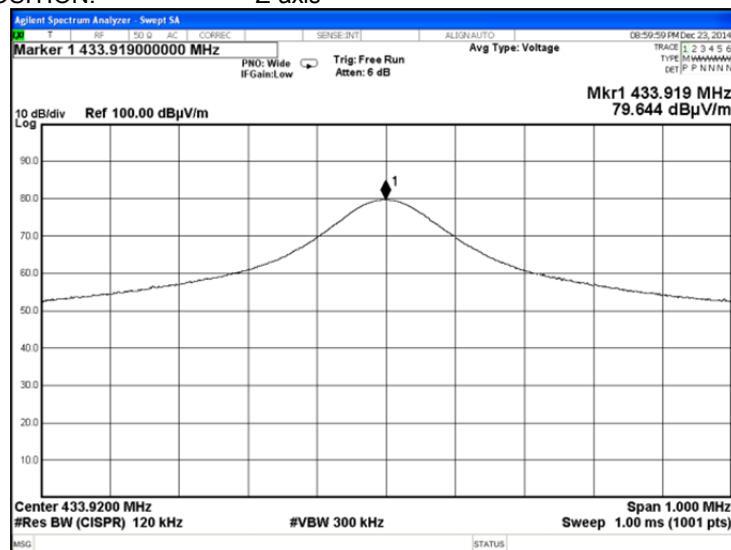
Plot 7.2.5 Radiated emission measurements at the fundamental frequency

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



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: Z-axis



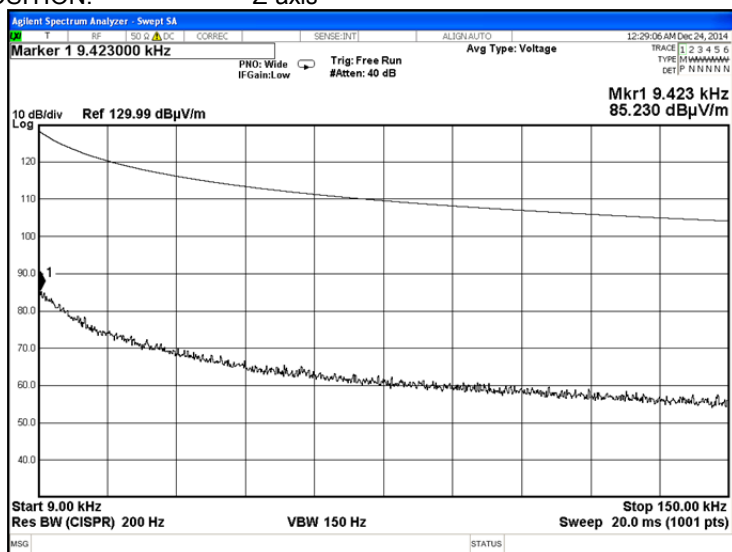


HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

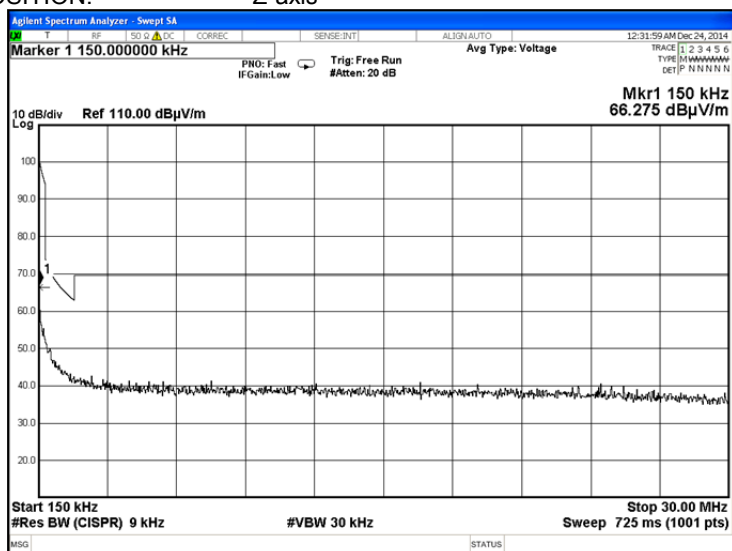
Plot 7.2.7 Radiated emission measurements from 9 to 150 kHz

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



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



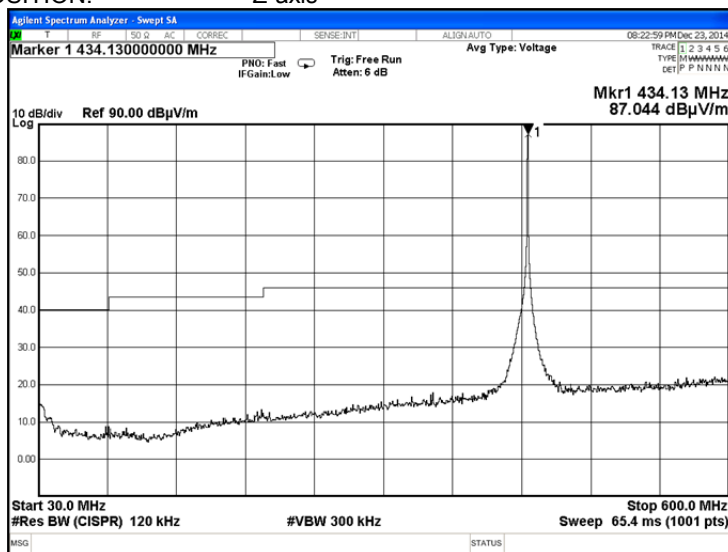


HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

Plot 7.2.9 Radiated emission measurements from 30 to 600 MHz

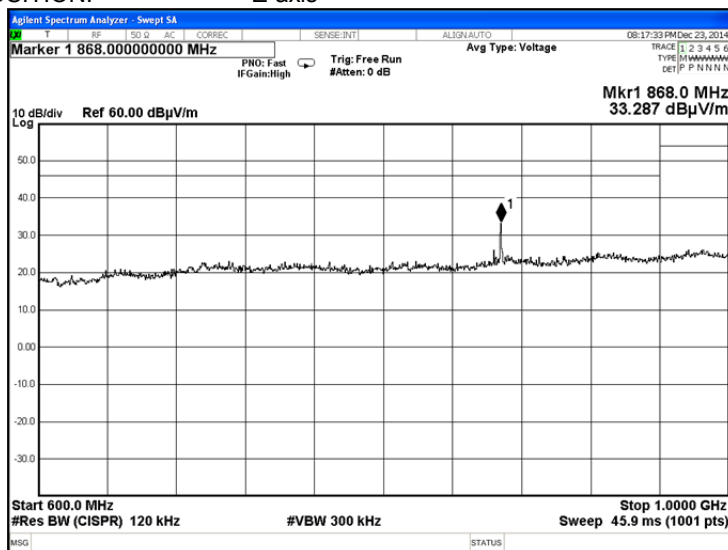
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Z-axis



Note: 434 MHz is the fundamental frequency

Plot 7.2.10 Radiated emission measurements from 600 to 1000 MHz

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





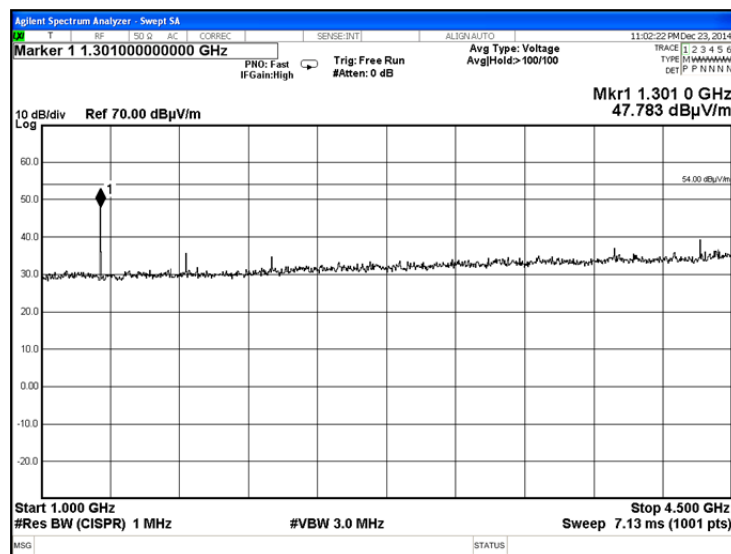
HERMON LABORATORIES

Report ID: ELPRAD_FCC.26351.docx
Date of Issue: 22-Feb-15

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

Plot 7.2.11 Radiated emission measurements from 1000 to 4500 MHz

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



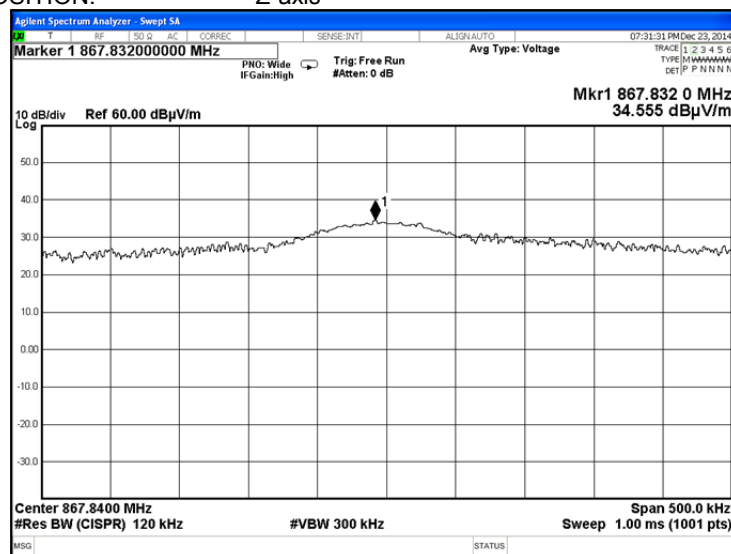


HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

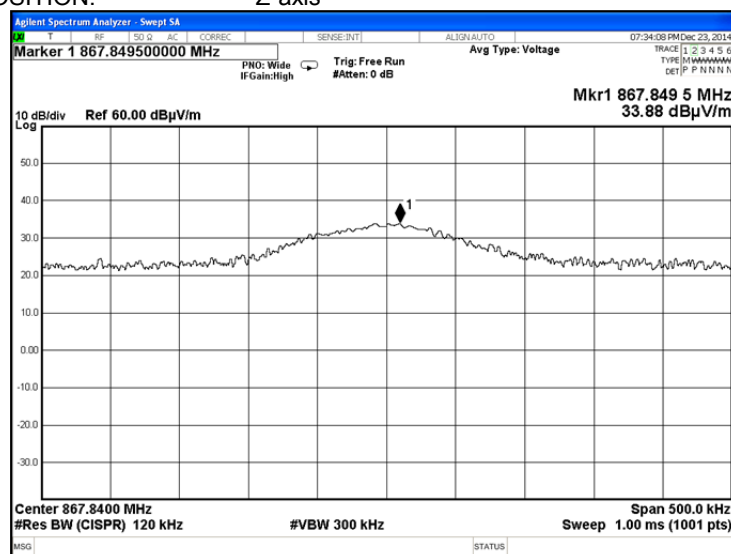
Plot 7.2.12 Radiated emission measurements at the second harmonic frequency

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



Plot 7.2.13 Radiated emission measurements at the second harmonic frequency

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



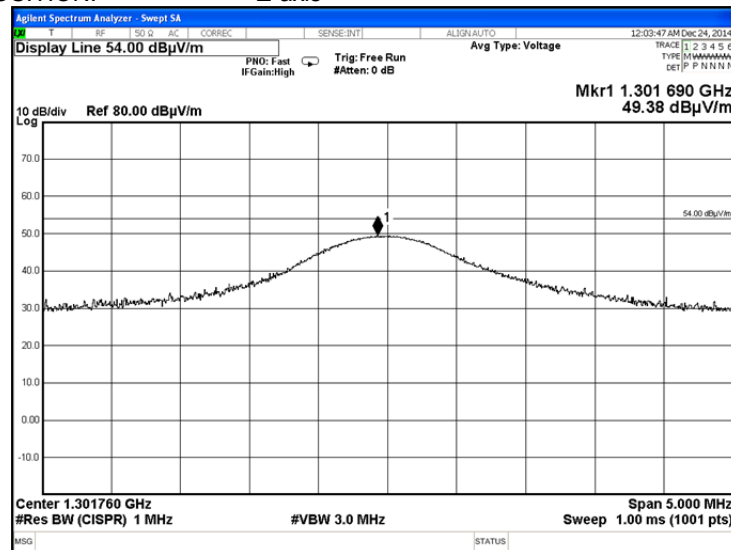


HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

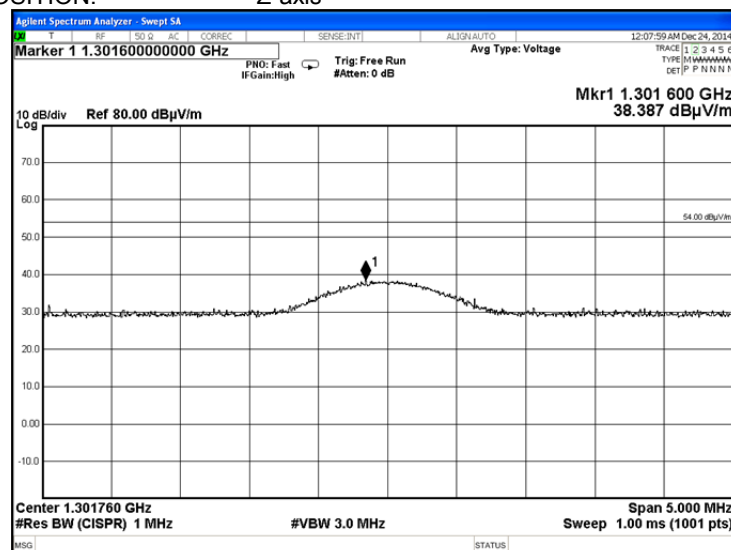
Plot 7.2.14 Radiated emission measurements at the third harmonic frequency

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



Plot 7.2.15 Radiated emission measurements at the third harmonic frequency

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

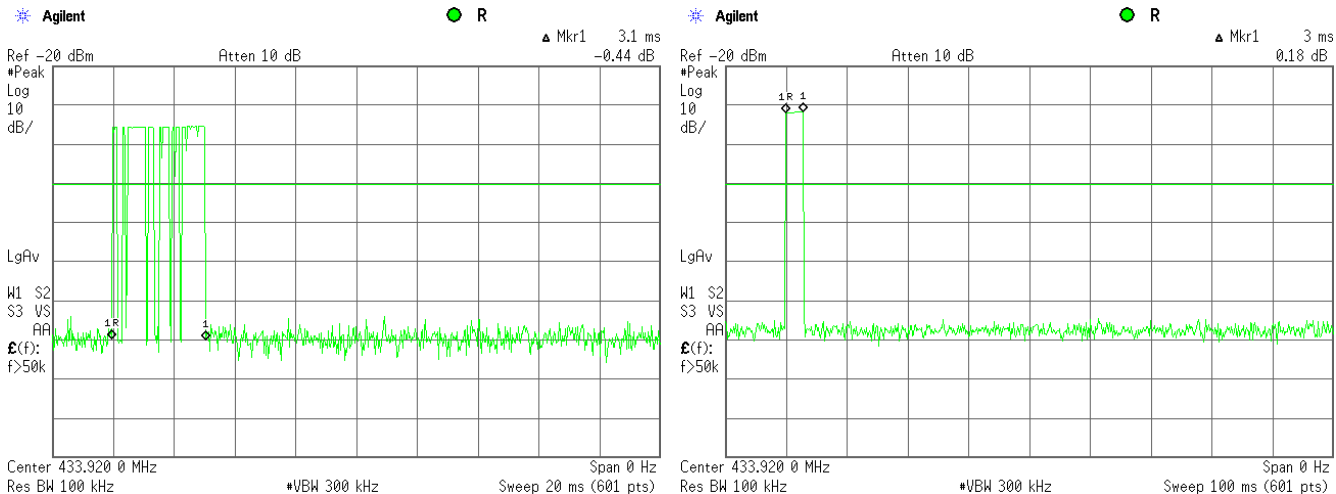




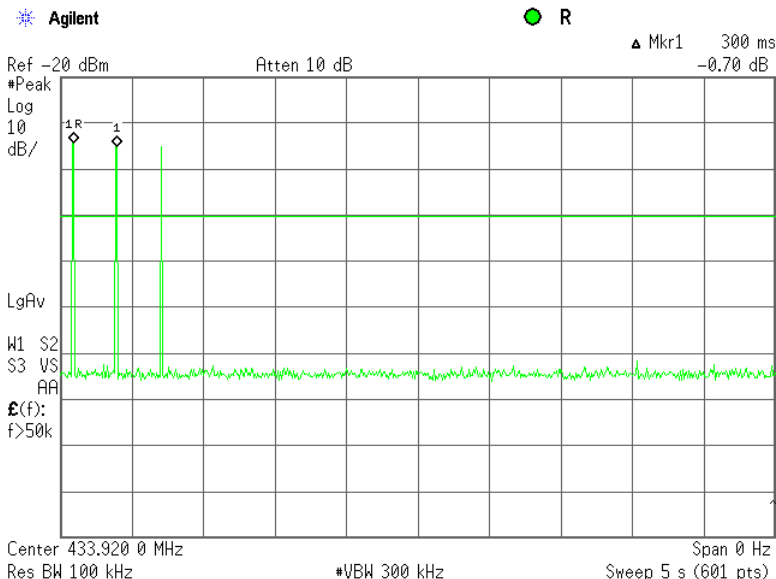
HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Dec-14		
Temperature: 23.6 °C	Air Pressure: 1017 hPa	Relative Humidity: 40 %	Power Supply: 3V battery
Remarks:			

Plot 7.2.16 Transmission pulse duration



Plot 7.2.17 Transmission pulse period



Test specification:		FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		01-Feb-15	
Temperature: 23 °C	Air Pressure: 1008 hPa	Relative Humidity: 53 %	Power Supply: 3V 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





Test specification:		FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		01-Feb-15	
Temperature: 23 °C	Air Pressure: 1008 hPa	Relative Humidity: 53 %	Power Supply: 3V battery
Remarks:			

Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 10 kHz
 VIDEO BANDWIDTH: 30 kHz
 MODULATION: ASK
 BIT RATE: 19.2 kbps

MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
433.92	61.765	0.25	1084.8	-1023.035	Pass

MODULATION ENVELOPE REFERENCE POINTS: 99 %

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
433.92	162.834	0.25	1084.8	-921.966	Pass

Reference numbers of test equipment used

HL 3818								
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Full description is given in Appendix A.



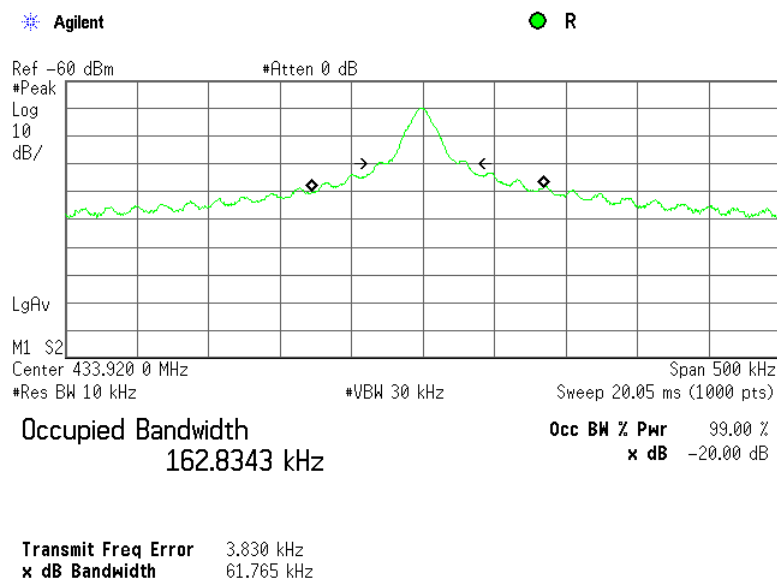
HERMON LABORATORIES

Report ID: ELPRAD_FCC.26351.docx

Date of Issue: 22-Feb-15

Test specification:		FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		01-Feb-15	
Temperature: 23 °C	Air Pressure: 1008 hPa	Relative Humidity: 53 %	Power Supply: 3V battery
Remarks:			

Plot 7.3.1 Occupied bandwidth test result



Test specification:		FCC Part 15, Section 203 / RSS-Gen, Section 8.3, Antenna requirements	
Test procedure:		Visual inspection / supplier declaration	
Test mode:	Compliance	Verdict:	PASS
Date(s):	01-Feb-15		
Temperature: 23 °C	Air Pressure: 1008 hPa	Relative Humidity: 53 %	Power Supply: 3V battery
Remarks:			

7.4 Antenna requirements

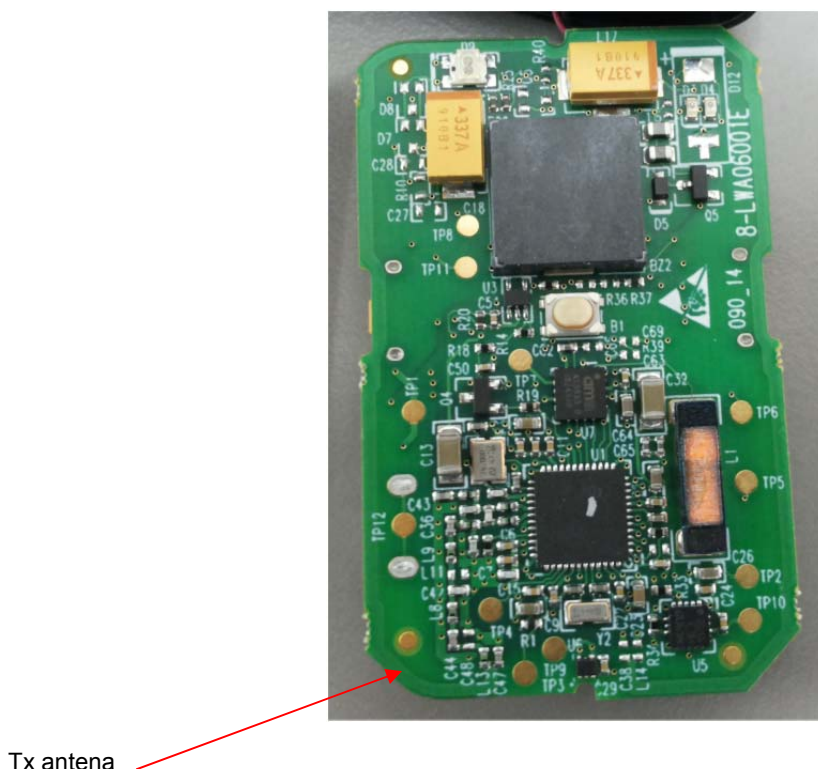
The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed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

Photograph 7.4.1 Antenna assembly



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V 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 8.1.2.

Table 8.1.1 Radiated emission limits according to FCC Part 15, Section 109 and ICES-003, Section 6.2

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*
960 - 5 th harmonic**	43.5*	54.0	49.5	60.0*

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

Table 8.1.2 Radiated emission limits according to RSS-Gen, Section 7.1.2

Frequency, MHz	Field strength limit at 3 m test distance, dB(μV/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

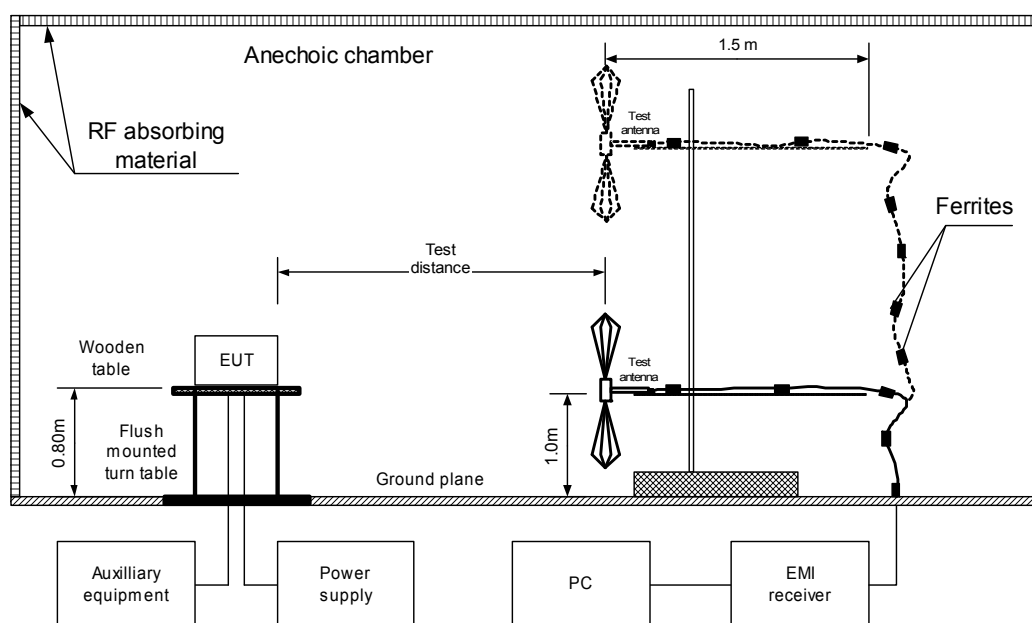
8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and associated photograph/s, energized and the performance check was conducted.

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:		FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4 / CISPR 22	
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery
Remarks:			

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



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery
Remarks:			

Photograph 8.1.1 Setup for radiated emission measurements



Photograph 8.1.2 Setup for radiated emission measurements





Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery
Remarks:			

Table 8.1.3 Radiated emission test results

EUT SET UP: TABLE-TOP
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

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

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK
FREQUENCY RANGE: 1000 MHz – 4.5 GHz
RESOLUTION BANDWIDTH: 1000 kHz

RECESSION BANDWIDTH:				1000 KHz			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
Frequency, MHz	Peak			Average						
	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										Pass

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

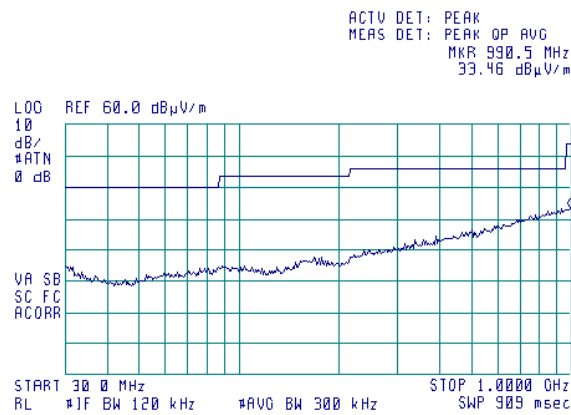
HL 0604	HL 1984	HL 3390	HL 4279	HL 4353	HL 4932		
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Full description is given in Appendix A.

Test specification:		FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission	
Test procedure:		ANSI C63.4, Sections 11.6 and 12.1.4 / CISPR 22	
Test mode:		Compliance	Verdict: PASS
Date(s):		03-Feb-15	
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery
Remarks:			

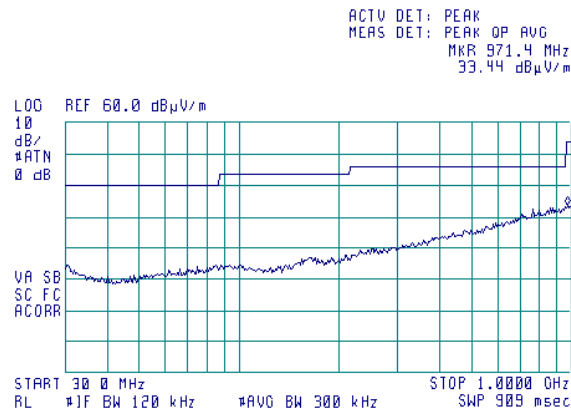
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



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

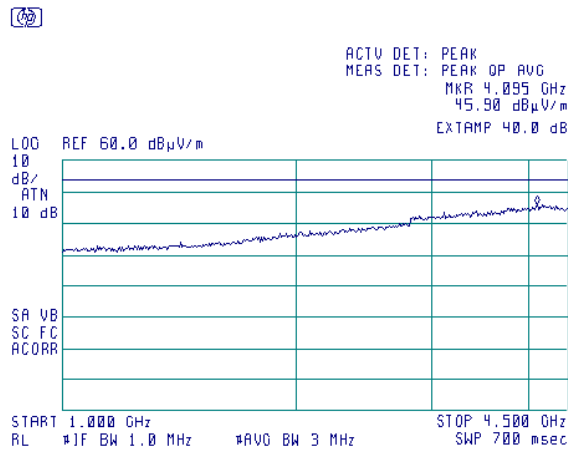
TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



Test specification:	FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4 / CISPR 22		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Feb-15		
Temperature: 21 °C	Air Pressure: 1013 hPa	Relative Humidity: 48 %	Power Supply: 3V battery
Remarks:			

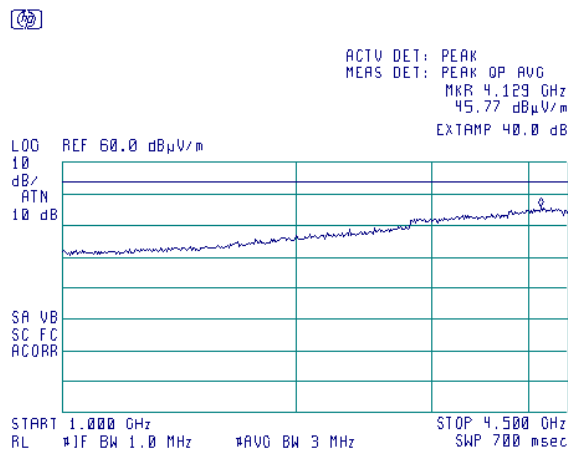
Plot 8.1.3 Radiated emission measurements above 1000 MHz, vertical antenna polarization

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



Plot 8.1.4 Radiated emission measurements above 1000 MHz, horizontal antenna polarization

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	22-May-14	22-May-15
1915	Antenna, Loop, Active Receiving, 1 kHz - 30 MHz	EMC Test Systems	6507	1457	13-Jan-15	13-Jan-16
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	07-Sep-14	07-Sep-15
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	23-Dec-14	23-Feb-16
3390	Microwave Cable Assembly, 26.5 GHz, 1.0 m, N type/N type	Suhner Sucoflex	104EA	3390	04-Feb-15	04-Feb-16
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	20-May-14	20-May-15
4279	Test Cable , DC-18 GHz, 4.6 m, N/M - N/M	Mini-Circuits	APC-15FT-NMNM+	0757A	20-Nov-14	20-Nov-15
4295	Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA	Huber-Suhner	Sucoflex P103	NA	04-Dec-14	04-Dec-15
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 003	16-Mar-14	16-Mar-15
4535	Microwave Cable Assembly, 6.5 GHz, 5.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	01-Jan-15	01-Jan-16
4541	Microwave Cable Assembly, 4.0 GHz, 1.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	01-Jan-15	01-Jan-16
4542	Amplifier, 9 kHz to 1 GHz, 32 dB gain	Sonoma Instrument	310	0002A056 39	31-Dec-14	31-Dec-15
4543	Broadband preamplifier, 0.5 to 18 GHz, 35 dB gain	Schwarzbeck mess-elektronik	BBV 9718	9718-134	29-Dec-14	29-Dec-15
4549	Cable RF, 6.8 m, N/N - type, up to 3 GHz	Suhner Switzerland	NA	07262	29-Dec-14	29-Dec-15
4551	Cable RF, 6.6 m, N/N - type, up to 18 GHz	Suhner Switzerland	Sucoflex 104E	22200/4E	29-Dec-14	29-Dec-15
4575	EXA Signal Analyzer, 9 kHz - 26.5 GHz	Agilent Technologies	N9010A	MY480301 10	25-Feb-15	25-Apr-15
4603	Horn Antenna, 1 - 18 GHz	Schwarzbeck mess-elektronik	BBHA 9120 D	9120D-611	12-Jun-14	12-Jun-15
4604	Biconilog Antenna, 26 - 2000 MHz	EMCO	3142B	9909-1421	22-May-14	22-May-15
4932	Microwave preamplifier, 500 MHz to 18 GHz, 40 dB Gain	COM-POWER CORPORATION	PAM-118A	551029	18-Nov-14	18-Nov-15

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
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 number IC 2186A-1 for OATS), 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: 2014	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
EMC Test Systems
Model 6507, S/N 1457, HL 1915

Frequency, kHz	Measured antenna factor, dBS/m
10	-22.3
20	-27.5
50	-31.2
75	-31.8
100	-32.1
150	-32.3
250	-32.5
500	-32.8
750	-33.0
1000	-33.1
2000	-33.4
3000	-33.7
4000	-34.0
5000	-34.2
10000	-35.2
15000	-35.3
20000	-36.0
25000	-37.6
30000	-36.0

The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ A/m.

Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011, HL 0604

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

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

Antenna factor
Horn antenna
Schwarzbeck mess-elektronik, Model BBHA 9120 D, serial number: 9120D-611, HL 4603

Frequency, MHz	Measured antenna factor, dB/m
1000	25.2
1500	25.7
2000	26.1
2500	27.5
3000	28.3
3500	29.0
4000	30.0
4500	30.8
5000	31.9
5500	32.2
6000	33.1
6500	34.6
7000	35.9
7500	36.6
8000	37.2
8500	36.6
9000	36.9
9500	37.5
10000	38.4
10500	39.5
11000	40.3
11500	40.0
12000	39.2
12500	38.7
13000	39.6
13500	40.8
14000	41.6
14500	42.1
15000	41.2
15500	39.1
16000	38.5
16500	39.9
17000	41.0
17500	44.1
18000	55.6

The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/m.

Antenna factor
Biconilog Antenna, 26 - 2000 MHz
EMCO, Model 3142B, serial number: 9909-1421, HL 4604

Frequency, MHz	Measured, dB/m
30	17.9
35	14.8
40	12.1
45	10.0
50	8.7
60	8.1
70	7.3
80	6.6
90	7.6
100	7.9
120	7.0
140	7.7
160	9.6
180	10.0
200	10.2
250	12.7
300	13.4
400	16.7
500	18.2
600	20.2
700	22.0
800	22.7
900	24.1
1000	25.0

The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/m

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		

Cable loss
Test cable, Mini-Circuits, S/N 0757A, 18 GHz, 4.6 m, N/M - N/M
APC-15FT-NMNM+, HL 4279

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.26	5000	4.23	10200	6.47	15400	8.46
30	0.26	5100	4.28	10300	6.53	15500	8.49
50	0.34	5200	4.32	10400	6.57	15600	8.50
100	0.50	5300	4.37	10500	6.59	15700	8.53
200	0.72	5400	4.41	10600	6.62	15800	8.56
300	0.90	5500	4.46	10700	6.64	15900	8.60
400	1.05	5600	4.51	10800	6.66	16000	8.62
500	1.20	5700	4.57	10900	6.69	16100	8.65
600	1.31	5800	4.61	11000	6.69	16200	8.68
700	1.44	5900	4.64	11100	6.70	16300	8.70
800	1.53	6000	4.70	11200	6.72	16400	8.72
900	1.63	6100	4.75	11300	6.74	16500	8.76
1000	1.74	6200	4.76	11400	6.79	16600	8.77
1100	1.83	6300	4.82	11500	6.83	16700	8.78
1200	1.92	6400	4.83	11600	6.85	16800	8.82
1300	2.01	6500	4.88	11700	6.89	16900	8.85
1400	2.09	6600	4.90	11800	6.94	17000	8.91
1500	2.17	6700	4.95	11900	7.00	17100	8.94
1600	2.25	6800	5.01	12000	7.04	17200	8.98
1700	2.33	6900	4.98	12100	7.10	17300	9.03
1800	2.39	7000	5.03	12200	7.18	17400	9.05
1900	2.47	7100	5.11	12300	7.23	17500	9.08
2000	2.53	7200	5.13	12400	7.29	17600	9.10
2100	2.60	7300	5.20	12500	7.34	17700	9.12
2200	2.67	7400	5.28	12600	7.39	17800	9.14
2300	2.74	7500	5.33	12700	7.45	17900	9.17
2400	2.80	7600	5.37	12800	7.49	18000	9.21
2500	2.87	7700	5.44	12900	7.53		
2600	2.92	7800	5.52	13000	7.58		
2700	3.00	7900	5.56	13100	7.62		
2800	3.06	8000	5.63	13200	7.67		
2900	3.12	8100	5.67	13300	7.71		
3000	3.18	8200	5.71	13400	7.74		
3100	3.24	8300	5.76	13500	7.79		
3200	3.30	8400	5.79	13600	7.82		
3300	3.35	8500	5.85	13700	7.84		
3400	3.41	8600	5.88	13800	7.87		
3500	3.46	8700	5.92	13900	7.90		
3600	3.51	8800	5.96	14000	7.94		
3700	3.56	8900	6.02	14100	7.98		
3800	3.61	9000	6.05	14200	8.01		
3900	3.66	9100	6.08	14300	8.05		
4000	3.71	9200	6.15	14400	8.10		
4100	3.77	9300	6.18	14500	8.12		
4200	3.83	9400	6.20	14600	8.16		
4300	3.89	9500	6.25	14700	8.22		
4400	3.94	9600	6.28	14800	8.26		
4500	3.99	9700	6.31	14900	8.29		
4600	4.05	9800	6.35	15000	8.33		
4700	4.09	9900	6.37	15100	8.39		
4800	4.15	10000	6.40	15200	8.41		
4900	4.19	10100	6.45	15300	8.44		

Cable loss
Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA, Huber-Suhner, S/N 4295,
Sucoflex P103, HL 4295

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.11	5000	2.09	10200	2.97	15400	3.63
30	0.18	5100	2.12	10300	3.01	15500	3.65
50	0.23	5200	2.13	10400	3.00	15600	3.63
100	0.31	5300	2.16	10500	3.05	15700	3.64
200	0.38	5400	2.19	10600	3.09	15800	3.64
300	0.43	5500	2.21	10700	3.05	15900	3.66
400	0.52	5600	2.21	10800	3.09	16000	3.71
500	0.60	5700	2.24	10900	3.10	16100	3.67
600	0.67	5800	2.24	11000	3.08	16200	3.71
700	0.72	5900	2.25	11100	3.11	16300	3.70
800	0.78	6000	2.27	11200	3.12	16400	3.71
900	0.83	6100	2.25	11300	3.12	16500	3.72
1000	0.89	6200	2.29	11400	3.20	16600	3.84
1100	0.94	6300	2.34	11500	3.16	16700	3.78
1200	0.98	6400	2.37	11600	3.16	16800	3.85
1300	1.03	6500	2.33	11700	3.20	16900	3.88
1400	1.06	6600	2.34	11800	3.19	17000	3.85
1500	1.11	6700	2.39	11900	3.21	17100	3.88
1600	1.14	6800	2.46	12000	3.28	17200	3.92
1700	1.19	6900	2.45	12100	3.23	17300	3.90
1800	1.22	7000	2.44	12200	3.26	17400	4.00
1900	1.26	7100	2.43	12300	3.30	17500	4.02
2000	1.30	7200	2.44	12400	3.25	17600	4.00
2100	1.34	7300	2.51	12500	3.26	17700	3.96
2200	1.37	7400	2.54	12600	3.30	17800	4.01
2300	1.40	7500	2.49	12700	3.26	17900	4.02
2400	1.44	7600	2.52	12800	3.34	18000	4.08
2500	1.47	7700	2.59	12900	3.37		
2600	1.50	7800	2.57	13000	3.30		
2700	1.55	7900	2.55	13100	3.35		
2800	1.58	8000	2.57	13200	3.31		
2900	1.60	8100	2.58	13300	3.33		
3000	1.63	8200	2.64	13400	3.42		
3100	1.64	8300	2.70	13500	3.43		
3200	1.67	8400	2.65	13600	3.40		
3300	1.69	8500	2.66	13700	3.47		
3400	1.73	8600	2.68	13800	3.45		
3500	1.74	8700	2.70	13900	3.43		
3600	1.76	8800	2.74	14000	3.52		
3700	1.79	8900	2.74	14100	3.51		
3800	1.82	9000	2.76	14200	3.54		
3900	1.85	9100	2.82	14300	3.55		
4000	1.87	9200	2.79	14400	3.52		
4100	1.90	9300	2.82	14500	3.52		
4200	1.92	9400	2.83	14600	3.56		
4300	1.93	9500	2.83	14700	3.55		
4400	1.94	9600	2.86	14800	3.55		
4500	1.97	9700	2.93	14900	3.59		
4600	1.99	9800	2.89	15000	3.56		
4700	2.01	9900	2.91	15100	3.59		
4800	2.02	10000	2.94	15200	3.59		
4900	2.04	10100	2.94	15300	3.59		

Cable loss
Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,
NC29-N1N1-244S/N 12025101 003,
HL 4353

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.20	9000	2.71
100	0.27	9500	2.81
300	0.47	10000	2.90
500	0.61	10500	2.97
1000	0.87	11000	3.06
1500	1.07	11500	3.13
2000	1.24	12000	3.20
2500	1.39	12500	3.26
3000	1.53	13000	3.34
3500	1.65	13500	3.39
4000	1.77	14000	3.47
4500	1.89	14500	3.54
5000	1.99	15000	3.62
5500	2.07	15500	3.69
6000	2.20	16000	3.76
6500	2.30	16500	3.83
7000	2.39	17000	3.86
7500	2.51	17500	3.94
8000	2.58	18000	4.02
8500	2.65		

Cable loss
Microwave Cable Assembly, 6.5 GHz, 5.0 m, N/M type-N/M type
Suhner Switzerland, HL 4535

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.10	1700	1.79	4400	3.53
15	0.13	1800	1.86	4500	3.60
20	0.15	1900	1.93	4600	3.72
30	0.18	2000	2.00	4700	3.80
40	0.21	2100	2.06	4800	3.87
50	0.24	2200	2.13	4900	3.94
60	0.26	2300	2.19	5000	3.99
70	0.29	2400	2.25	5100	4.06
80	0.31	2500	2.32	5200	4.12
90	0.33	2600	2.38	5300	4.17
100	0.35	2700	2.45	5400	4.25
150	0.43	2800	2.51	5500	4.31
200	0.50	2900	2.57	5600	4.40
300	0.63	3000	2.64	5700	4.47
400	0.74	3100	2.73	5800	4.54
500	0.85	3200	2.79	5900	4.64
600	0.94	3300	2.86	6000	4.73
700	1.03	3400	2.91	6100	4.79
800	1.12	3500	2.97	6200	4.89
900	1.20	3600	3.02	6300	5.00
1000	1.28	3700	3.07	6400	5.06
1100	1.35	3800	3.14	6500	5.13
1200	1.43	3900	3.20		
1300	1.50	4000	3.25		
1400	1.58	4100	3.32		
1500	1.65	4200	3.38		
1600	1.72	4300	3.46		

Cable loss
Microwave Cable Assembly, 4.0 GHz, 1.0 m, N/M type-N/M type
Suhner Switzerland, HL 4541

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.02	1700	0.45
15	0.03	1800	0.46
20	0.03	1900	0.48
30	0.04	2000	0.49
40	0.04	2100	0.52
50	0.05	2200	0.54
60	0.06	2300	0.55
70	0.06	2400	0.56
80	0.07	2500	0.58
90	0.07	2600	0.59
100	0.08	2700	0.61
150	0.10	2800	0.63
200	0.12	2900	0.64
300	0.15	3000	0.67
400	0.18	3100	0.70
500	0.20	3200	0.74
600	0.23	3300	0.77
700	0.25	3400	0.80
800	0.28	3500	0.82
900	0.30	3600	0.86
1000	0.31	3700	0.88
1100	0.33	3800	0.94
1200	0.35	3900	0.95
1300	0.37	4000	0.99
1400	0.39		
1500	0.41		
1600	0.43		

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(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
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

END OF TEST REPORT

15 APPENDIX G Manufacturer's declaration of similarity



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16/2/15

Declare under our own responsibility that the below so called Lone Worker tags are similar to each other in the following manner

All variants have the same Housing/enclosure, PCB , RF (ASK) Transmitter (433.92 MHZ) , LF Receiver(125 KHZ) , and 3 pushbuttons, and they vary in accordance with the following description:

5-LW241037-0 has also a fall detector and IR transmitter
5-LW240057-0 has also a fall detector and NO IR
5-LW241020-0 has also an IR transmitter, but NO fall detector
5-LW240020-0 Does NOT have fall detector nor IR

Regards

Arick

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