



ELECTRICAL TESTING  
0839.01

Hermon Laboratories Ltd.  
Harakevet Industrial Zone, Binyamina 30500,  
Israel  
Tel. +972-4-6288001  
Fax. +972-4-6288277  
E-mail: mail@hermonlabs.com

# TEST REPORT

ACCORDING TO: FCC CFR 47 part 15 subpart C, section 15.225

FOR:

**Essence Security International Ltd.**  
**Tag Reader**  
**Model:ES700TR5**  
**FCC ID:YXG-ES700TR5**

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## 1 Applicant information

**Client name:** Essence Security International Ltd.  
**Address:** 12 Abba Eban Avenue, Ackerstein Towers Bldg. D, P.O.B. 2073, Herzliya 4612001, Israel  
**Telephone:** +972 73 244 7735  
**Fax:** +972 9772 9962  
**E-mail:** israelgo@essence-grp.com  
**Contact name:** Mr. Israel Gottesman

## 2 Equipment under test attributes

**Product name:** Tag Reader  
**Product type:** Transmitter operating at 13.56 MHz  
**Model(s):** ES700TR5  
**Serial number:** 4013092e0032193b  
**Hardware version:** 1  
**Software release:** 3.0.2  
**Receipt date** 24-Nov-13

## 3 Manufacturer information

**Manufacturer name:** Essence Security International Ltd.  
**Address:** 12 Abba Eban Avenue, Ackerstein Towers Bldg. D, P.O.B. 2073, Herzliya 4612001, Israel  
**Telephone:** +972 73 244 7735  
**Fax:** +972 9772 9962  
**E-Mail:** israelgo@essence-grp.com  
**Contact name:** Mr. Israel Gottesman

## 4 Test details

**Project ID:** 25193  
**Location:** Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel  
**Test started:** 24-Nov-13  
**Test completed:** 16-Dec-13  
**Test specification(s):** FCC CFR 47 part 15 subpart C, §15.225



## 5 Tests summary

Test	Status
<b>Transmitter characteristics</b>	
Sections 15.225(a) (b) (c), In band radiated emissions	Pass
Sections 15.225(d), Out of band radiated emissions	Pass
Section 15.225(e), Frequency stability	Pass
Section 15.207(a), Conducted emission	Not required
Section 15.215(c), Occupied bandwidth	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.

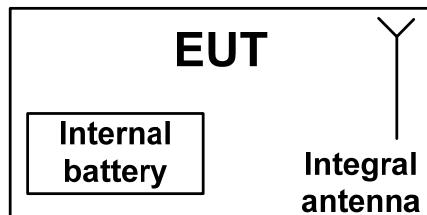
	Name and Title	Date	Signature
<b>Tested by:</b>	Mr. A. Chaplik, test engineer Mr. V. Einem, test engineer	December 16, 2013	
<b>Reviewed by:</b>	Mrs. M. Cherniavsky, certification engineer	December 29, 2013	
<b>Approved by:</b>	Mr. M. Nikishin, EMC and Radio group manager	January 8, 2014	

## 6 EUT description

### 6.1 General information

The EUT is a wireless access control tag reader operating at 916.5 MHz with 2FSK modulation. The EUT is equipped with an integral antenna and is powered by internal 4.5 V battery. The reader contains the RFID technology transmitter operating at 13.56 MHz.

### 6.2 Test configuration



### 6.3 Changes made in the EUT

No changes were implemented in the EUT during testing.



## 6.4 Transmitter characteristics of RFID transmitte

Type of equipment							
Stand-alone (Equipment with or without its own control provisions)							
V	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)							
Assigned frequency range		13.110-14.010 MHz					
Operating frequency range		13.56 MHz					
Maximum field strength		51.34 dB( $\mu$ V/m) at 3 m test distance					
Is transmitter output power variable?		V	No				
		Yes		continuous variable			
				stepped variable with stepsize			
				minimum RF power			
Antenna connection		maximum RF power					
V	unique coupling	standard connector		Integral	with temporary RF connector without temporary RF		
Antenna/s technical characteristics							
Type	Manufacturer		Model number	Gain			
Internal	Essence Security		Loop	NA			
Transmitter aggregate data rate/s		106 kbps					
Type of modulation		AM					
Transmitter duty cycle supplied for test		100%					
Transmitter power source							
V	Battery	Nominal rated voltage	4.5 VDC	Battery type	alkaline		
	DC	Nominal rated voltage					
	AC mains	Nominal rated voltage		Frequency			



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Test specification:	Sections 15.225(a) (b) (c), In band radiated emissions		
Test procedure:	ANSI C63.4, Sections 5.3 and 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	05-Dec-13		
Temperature: 23 °C	Air Pressure: 1011 hPa	Relative Humidity: 58 %	Power Supply: Battery
Remarks:	For TR		

## 7 Transmitter tests according to 47CFR part 15 subpart C requirements

### 7.1 In band radiated emissions

#### 7.1.1 General

This test was performed to measure field strength of fundamental emission and modulation products from the EUT within the assigned band. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Radiated emission limits

Frequency, MHz	Field strength at 30 m distance*		Field strength at 3 m distance*	
	µV/m	dB(µV/m)	µV/m	dB(µV/m)**
13.110 – 13.410	106	40.5	10600	80.5
13.410 – 13.553	334	50.5	33400	90.5
13.553 – 13.567	15848	84.0	1584800	124.0
13.567 – 13.710	334	50.5	33400	90.5
13.710 – 14.010	106	40.5	10600	80.5

\*- The limit is provided in quasi peak values.

\*\*- 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.

#### 7.1.2 Test procedure

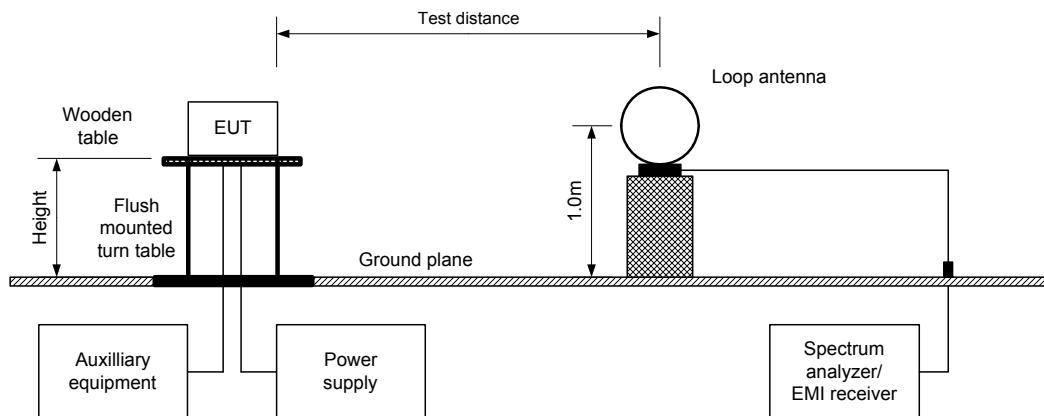
- 7.1.2.1 The EUT was set up as shown in Figure 7.1.1 energized and the performance check was conducted.
- 7.1.2.2 The specified frequency range was investigated with loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.
- 7.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.



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<b>Test specification:</b>	<b>Sections 15.225(a) (b) (c), In band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	05-Dec-13		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1011 hPa	<b>Relative Humidity:</b> 58 %	<b>Power Supply:</b> Battery
<b>Remarks:</b> For TR			

**Figure 7.1.1 Setup for in band radiated emission measurements**





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<b>Test specification:</b>	<b>Sections 15.225(a) (b) (c), In band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	05-Dec-13		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1011 hPa	<b>Relative Humidity:</b> 58 %	<b>Power Supply:</b> Battery
<b>Remarks:</b> For TR			

**Table 7.1.2 In band radiated emission test results**

TEST DISTANCE: 3 m  
 EUT POSITION: Typical (Vertical)  
 MODULATION: AM  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 INVESTIGATED FREQUENCY RANGE: 13.110 – 14.010 MHz  
 RESOLUTION BANDWIDTH: 9.0 kHz  
 VIDEO BANDWIDTH: 30.0 kHz

Carrier frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Azimuth**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*			
13.560221	51.58	51.34	124	-71.66	V	90	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 2780	HL 2871	HL 4353				
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Full description is given in Appendix A.

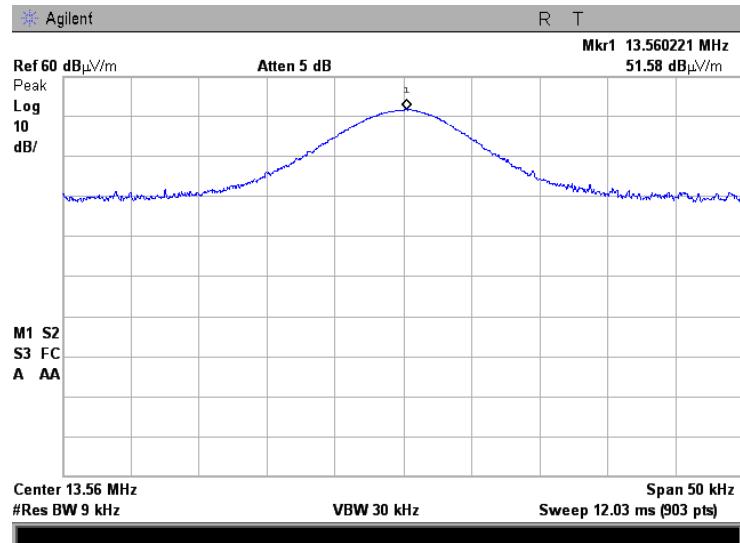


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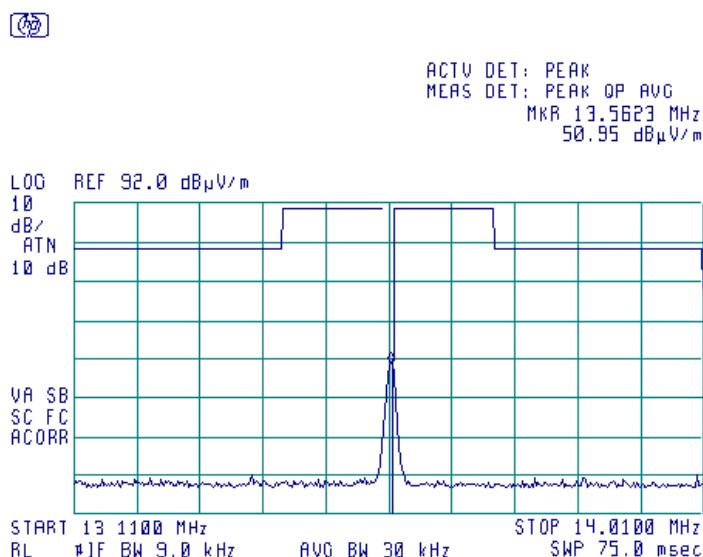
<b>Test specification:</b>	<b>Sections 15.225(a) (b) (c), In band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	05-Dec-13		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1011 hPa	<b>Relative Humidity:</b> 58 %	<b>Power Supply:</b> Battery
<b>Remarks:</b> For TR			

**Plot 7.1.1 Fundamental emission test result**

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 DETECTOR: Peak hold  
 EUT POSITION Typical (Vertical)

**Plot 7.1.2 In band radiated emission test results**

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 DETECTOR: Peak hold





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<b>Test specification:</b>	<b>Sections 15.225(d), Out of band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	28-Nov-13 - 11-Dec-13		
<b>Temperature:</b> 23.9 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 46 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

## 7.2 Out of band radiated emissions

### 7.2.1 General

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

Table 7.2.1 Radiated emission limits

Frequency, MHz	Field strength at 3 m within restricted bands, dB(µV/m)***		
	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		73.8 – 63.0**	
1.705 – 30.0*		69.5**	
30 – 88	NA	40.0	NA
88 – 216		43.5	
216 – 960		46.0	
960 - 1000		54.0	

\*- 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.

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

$$L_{m2} = L_{m1} + 40 \log (S_1/S_2),$$

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

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

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

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 The specified frequency range was investigated with 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 and the measuring antenna polarization was switched from vertical to horizontal.

7.2.2.3 The worst test results (the lowest margins) were recorded in Table 7.2.2 and shown in the associated plots.

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

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

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

7.2.3.3 The worst test results (the lowest margins) were recorded in Table 7.2.2 and shown in the associated plots.



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<b>Test specification:</b>	<b>Sections 15.225(d), Out of band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	28-Nov-13 - 11-Dec-13		
<b>Temperature:</b> 23.9 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 46 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Figure 7.2.1 Radiated emissions below 30 MHz test set up

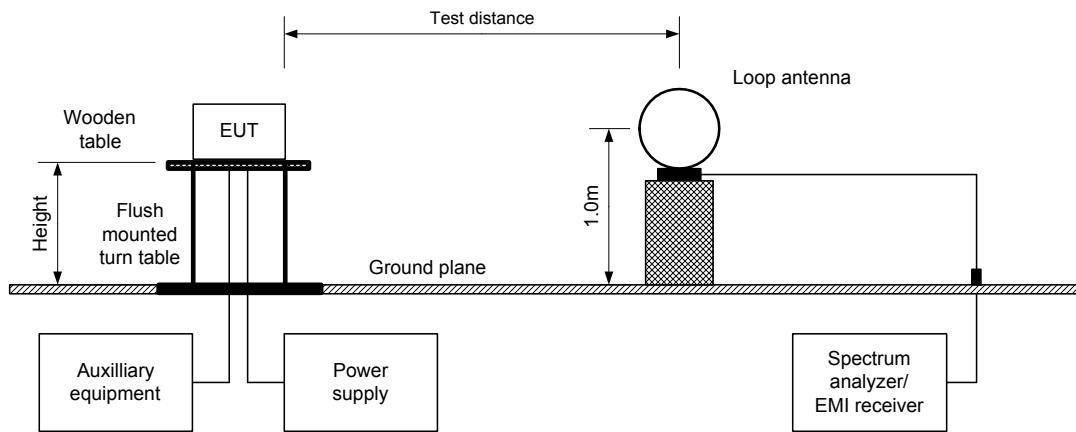
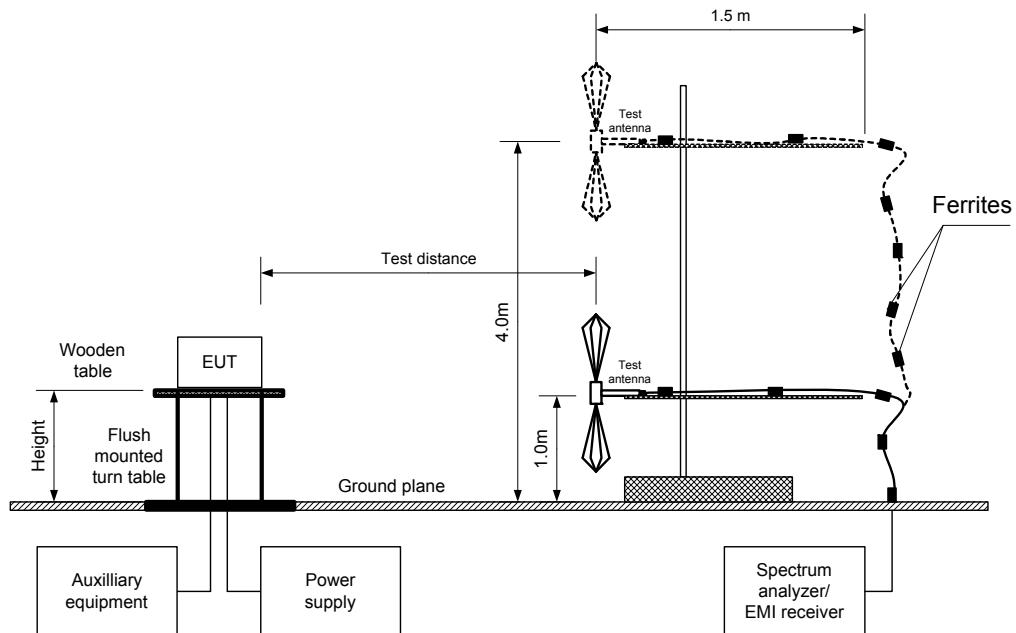


Figure 7.2.2 Radiated emissions above 30 MHz test set up





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<b>Test specification:</b>	<b>Sections 15.225(d), Out of band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	28-Nov-13 - 11-Dec-13		
<b>Temperature:</b> 23.9 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 46 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

**Table 7.2.2 Out of band radiated emissions test results**

TEST DISTANCE:	3 m
EUT POSITION:	Typical (Vertical)
MODULATION:	AM
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
RESOLUTION BANDWIDTH:	1.0 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz) ≥ Resolution bandwidth
VIDEO BANDWIDTH:	
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconilog (30 MHz – 1000 MHz)

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
189.8	31.9	30.9	43.5	-12.6	Horizontal	1.1	230	Pass
217.0	26.4	23.8	46.0	-22.2	Horizontal	1.4	230	
732.2	37.7	34.8	46.0	-11.2	Horizontal	1.0	10	
759.4	36.7	34.4	46.0	-11.6	Horizontal	1.0	360	
949.2	42.1	39.9	46.0	-6.1	Vertical	1.0	170	
976.3	43.8	42.0	54.0	-12.0	Vertical	1.0	180	

\*- Margin = Measured emission - specification limit.

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

**Reference numbers of test equipment used**

HL 0521	HL 0604	HL 1915	HL 2780	HL 2871	HL 4353		
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Full description is given in Appendix A.

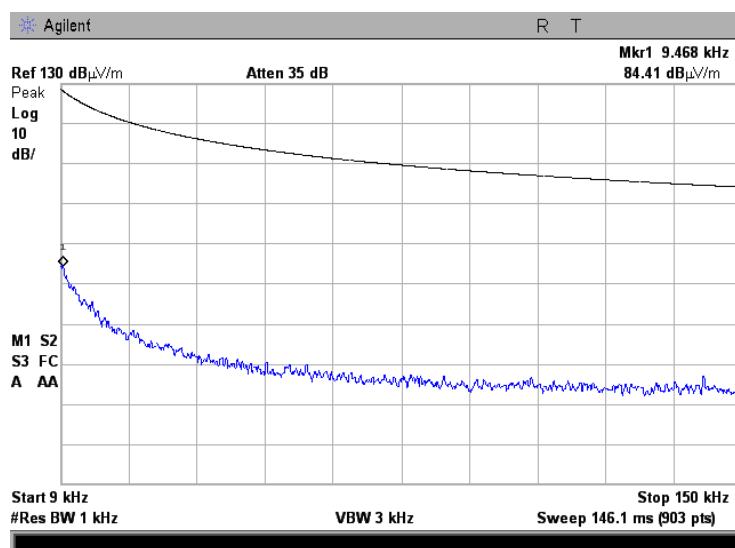


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<b>Test specification:</b>	<b>Sections 15.225(d), Out of band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	28-Nov-13 - 11-Dec-13		
<b>Temperature:</b> 23.9 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 46 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

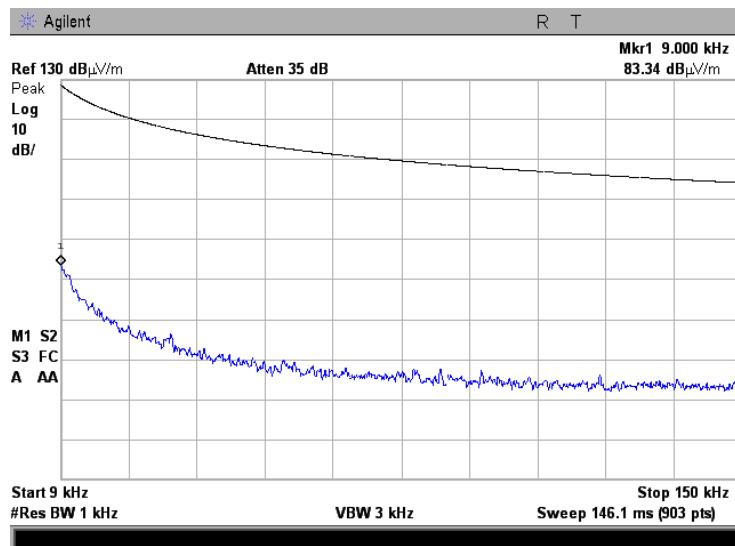
**Plot 7.2.1 Radiated emission measurements from 9 to 150 kHz**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
DETECTOR: Peak hold



**Plot 7.2.2 Radiated emission measurements from 9 to 150 kHz**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
DETECTOR: Peak hold



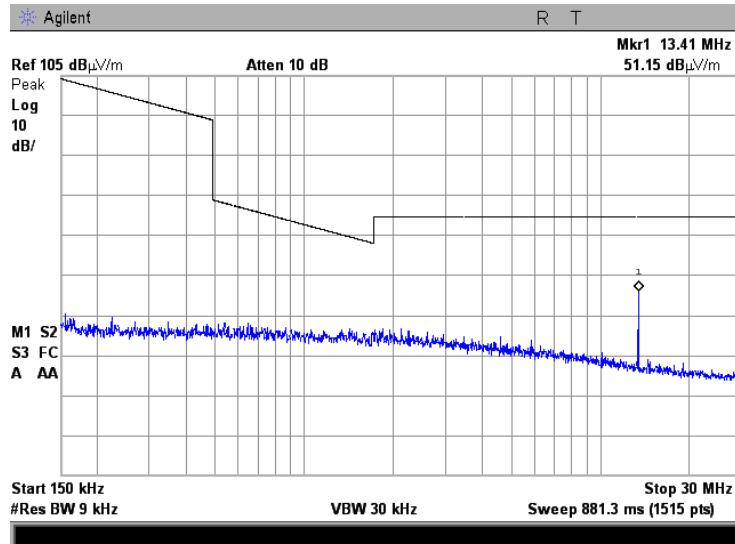


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<b>Test specification:</b>	<b>Sections 15.225(d), Out of band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	28-Nov-13 - 11-Dec-13		
<b>Temperature:</b> 23.9 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 46 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

#### Plot 7.2.3 Radiated emission measurements from 0.15 to 30 MHz

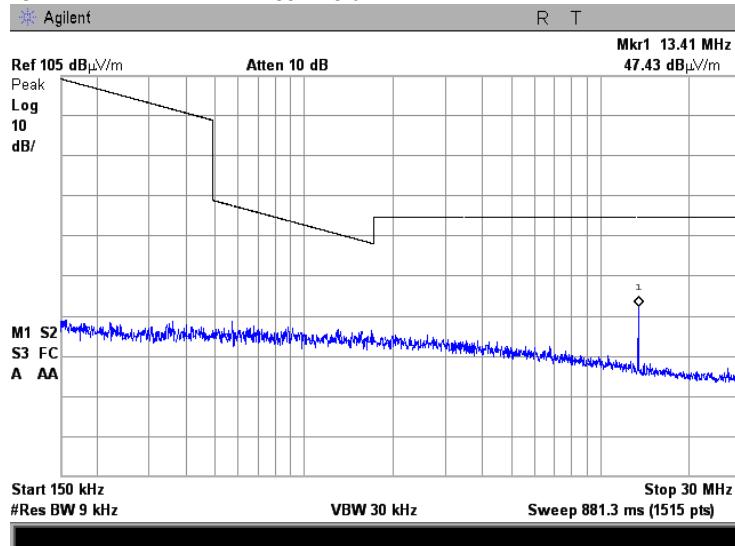
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
DETECTOR: Peak hold



No emissions were found, except fundamental frequency

#### Plot 7.2.4 Radiated emission measurements from 0.15 to 30 MHz

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
DETECTOR: Peak hold



No emissions were found, except fundamental frequency



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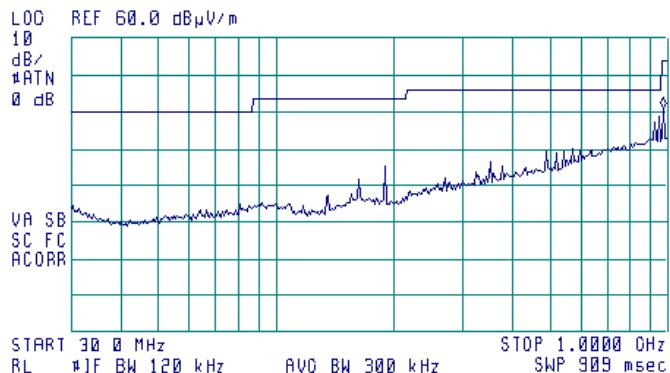
<b>Test specification:</b>	<b>Sections 15.225(d), Out of band radiated emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 5.3 and 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	28-Nov-13 - 11-Dec-13		
<b>Temperature:</b> 23.9 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 46 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

**Plot 7.2.5 Radiated emission measurements from 30 to 1000 MHz**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
DETECTOR: Peak hold



ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 971.4 MHz  
40.90 dB $\mu$ V/m

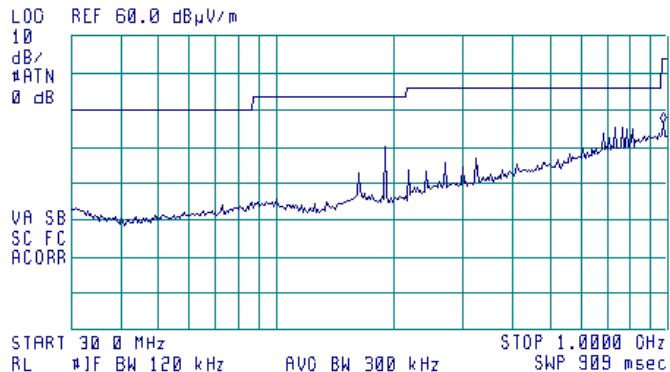


**Plot 7.2.6 Radiated emission measurements from 30 to 1000 MHz**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
DETECTOR: Peak hold



ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 971.4 MHz  
36.30 dB $\mu$ V/m





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<b>Test specification:</b>	<b>Section 15.225(e), Frequency stability</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.6		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	15-Dec-13		
<b>Temperature:</b> 20 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 44 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

## 7.3 Frequency stability test

### 7.3.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.3.1. The test results are provided in Table 7.3.2.

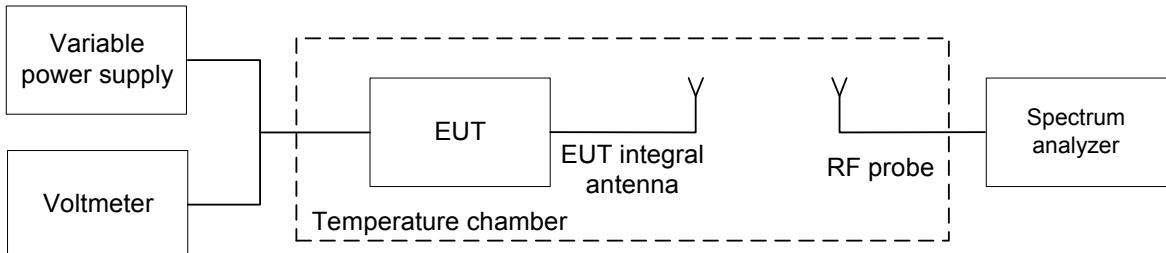
Table 7.3.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	%	Hz
13.560	± 0.01 %	1356

### 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 power was turned off. Temperature within test chamber was set to the required one and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.
- 7.3.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then after 2, 5 and 10 minutes. The EUT was powered off.
- 7.3.2.4 The above procedure was repeated at the rest of the test temperatures and voltages as provided in Table 7.3.2.
- 7.3.2.5 Frequency displacement was calculated and compared with the limit as provided in Table 7.3.2.

Figure 7.3.1 Frequency stability test setup





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<b>Test specification:</b>	<b>Section 15.225(e), Frequency stability</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.6		
<b>Test mode:</b>	Compliance	<b>Verdict:</b> <b>PASS</b>	
<b>Date(s):</b>	15-Dec-13		
<b>Temperature:</b> 20 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 44 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

**Table 7.3.2 Frequency stability test results**

OPERATING FREQUENCY: 13.560 MHz  
 NOMINAL POWER VOLTAGE: 4.5 V  
 TEMPERATURE STABILIZATION PERIOD: 20 min  
 POWER DURING TEMPERATURE TRANSITION: Off  
 SPECTRUM ANALYZER MODE: Counter  
 RESOLUTION BANDWIDTH: 1 kHz  
 VIDEO BANDWIDTH: 1 kHz  
 MODULATION: Unmodulated

Temperature, °C	Voltage, V	Frequency, MHz				Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	2 <sup>nd</sup> min	5 <sup>th</sup> min	10 <sup>th</sup> min	Positive	Negative			
-20	nominal	13.55993	13.55993	13.55993	13.55993	0	0		1356	
20	nominal +15%	13.55993	13.55993	13.55993	13.55993	0	0		1356	
20	nominal	13.55993	13.55993	13.55993	13.55993*	0	0	1356	1356	
20	nominal -15%	13.55993	13.55993	13.55993	13.55993	0	0		1356	
50	nominal	13.55983	13.55983	13.55983	13.55983	0	100		1256	

\* - Reference frequency

**Reference numbers of test equipment used**

HL 0493	HL 0758	HL 1424	HL 3310				
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Full description is given in Appendix A.



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<b>Test specification:</b>	<b>Section 15.215(c), Occupied bandwidth</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.7		
<b>Test mode:</b>	Compliance	<b>Verdict:</b> <b>PASS</b>	
<b>Date(s):</b>	16-Dec-13		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

## 7.4 Occupied bandwidth test

### 7.4.1 General

This test was performed to verify that the 20 dB bandwidth of the emissions was contained within the standard specified frequency band according to FCC §15.215 requirements. Specification test limits are given in Table 7.4.1.

**Table 7.4.1 Occupied bandwidth limits**

Assigned frequency, MHz	Modulation envelope reference points*, dBc
13.110 – 13.410	
13.410 – 13.553	
13.553 – 13.567	20.0
13.567 – 13.710	
13.710 – 14.010	

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

### 7.4.2 Test procedure

- 7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.
- 7.4.2.2 The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.
- 7.4.2.3 The peak of emission was measured. The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.4.2 and associated plot.
- 7.4.2.4 Modulation bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained modulation bandwidth was verified to be within the allowed frequency range.

**Figure 7.4.1 Occupied bandwidth test setup**





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<b>Test specification:</b>	<b>Section 15.215(c), Occupied bandwidth</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.7		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	16-Dec-13		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Table 7.4.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND 13.11 – 14.01 MHz  
DETECTOR USED: Peak hold  
RESOLUTION BANDWIDTH: 3 kHz  
VIDEO BANDWIDTH: 10 kHz  
MODULATION ENVELOPE REFERENCE POINTS: 20 dBc  
MODULATING SIGNAL: Enable

Band edge	Cross point frequency, MHz	Frequency drift, kHz		Modulation band edge, MHz	Assigned band edge, MHz	Verdict
		Negative	Positive			
Low	The 20 dB bandwidth of the emissions is contained within the standard specified frequency band			13.11	13.11	Pass
High				14.01	14.01	Pass

**Reference numbers of test equipment used**

HL 1915	HL 2780	HL 2871	HL 4353				
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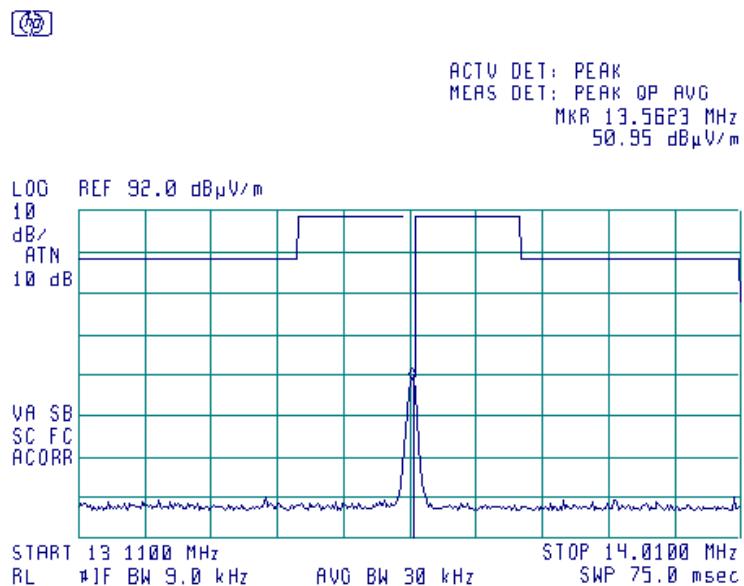
Full description is given in Appendix A.



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<b>Test specification:</b>	<b>Section 15.215(c), Occupied bandwidth</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.7		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	16-Dec-13		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Plot 7.4.1 Occupied bandwidth test result





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<b>Test specification:</b>	<b>Section 15.203, Antenna requirement</b>		
<b>Test procedure:</b>	Visual inspection / supplier declaration		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	16-Dec-13		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 42 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

## 7.5 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.

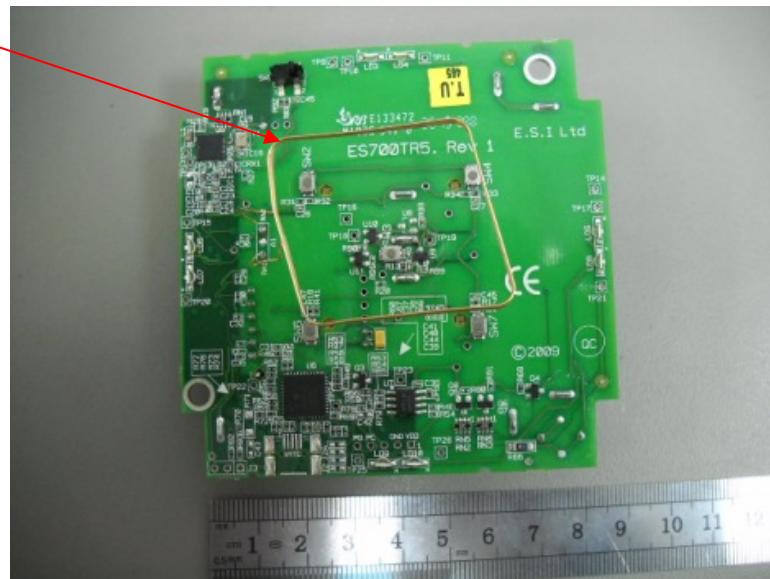
The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 7.5.1.

Table 7.5.1 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 7.5.1 RFID antenna assembly

Loop antenna





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## 8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./Check	Due Cal./Check
0493	Temperature Chamber -45...175 deg C	Thermotron	S-1.2 Mini-Max	14016	30-May-13	30-May-14
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	28-Oct-13	28-Oct-14
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	04-Jun-13	04-Jun-14
0758	Power supply, dual, 36 V, 1 A	Horizon Electronics	DHR 36-1	5361231	26-Jun-13	26-Jun-14
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies	8564EC	3946A002 19	10-Oct-13	10-Oct-14
1915	Antenna, Loop, Active Receiving, 1 kHz - 30 MHz	EMC Test Systems	6507	1457	31-Jan-13	31-Jan-14
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY451024 62	10-Jul-13	10-Jul-14
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	04-Dec-13	04-Dec-14
3310	Multimeter	Fluke	115C	94321810	14-Jul-13	14-Jul-14
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 003	06-Mar-13	06-Mar-14



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## 9 APPENDIX B Measurement uncertainties

### Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Radiated emissions at 10 m measuring distance Horizontal polarization	Biconilog antenna: $\pm 5.0$ dB Biconical antenna: $\pm 5.0$ dB Log periodic antenna: $\pm 5.1$ dB Double ridged horn antenna: $\pm 5.3$ dB
Vertical polarization	Biconilog antenna: $\pm 5.5$ dB Biconical antenna: $\pm 5.5$ dB Log periodic antenna: $\pm 5.6$ dB Double ridged horn antenna: $\pm 5.8$ dB
Radiated emissions at 3 m measuring distance Horizontal polarization	Biconilog antenna: $\pm 5.3$ dB Biconical antenna: $\pm 5.0$ dB Log periodic antenna: $\pm 5.3$ dB Double ridged horn antenna: $\pm 5.3$ dB
Vertical polarization	Biconilog antenna: $\pm 6.0$ dB Biconical antenna: $\pm 5.7$ dB Log periodic antenna: $\pm 6.0$ dB Double ridged horn antenna: $\pm 6.0$ dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: $\pm 2.6$ dB 2.9 GHz to 6.46 GHz: $\pm 3.5$ dB 6.46 GHz to 13.2 GHz: $\pm 4.3$ dB 13.2 GHz to 22.0 GHz: $\pm 5.0$ dB 22.0 GHz to 26.8 GHz: $\pm 5.5$ dB 26.8 GHz to 40.0 GHz: $\pm 4.8$ dB
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0$ %
Occupied bandwidth	$\pm 8.0$ %

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.



HERMON LABORATORIES

## 10 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.

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

Person for contact: Mr. Alex Usoskin, CEO.

## 11 APPENDIX D Specification references

FCC 47CFR part 15: 2012	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



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## 12 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	-22.7
20	-27.6
50	-31.3
75	-31.8
100	-32.2
150	-32.3
250	-32.6
500	-32.8
750	-33.0
1000	-33.1
2000	-33.4
3000	-33.7
4000	-34.0
5000	-34.3
10000	-34.9
15000	-35.6
20000	-35.9
25000	-36.1
30000	-36.7

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



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**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( $\mu$ V) to convert it into field strength in dB( $\mu$ V/m).



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

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



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**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		



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## 13 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(µV)	decibel referred to one microvolt
dB(µV/m)	decibel referred to one microvolt per meter
dB(µA)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
µs	microsecond
NA	not applicable
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

END OF DOCUMENT