HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

Hermon Laboratories Ltd.
P.O. Box 23, Binyamina 3055001, Israel
Tel. +972 4628 8001
Fax. +972 4628 8277
E-mail: mail@hermonlabs.com

TEST REPORT

ACCORDING TO: FCC CFR 47 part 15 subpart C, section 15.225 and subpart B; RSS-210 issue9 Annex B section B.6, ICES-003 Issue 6:2016

FOR:

Landa Corporation Ltd.
BIB Station module
Model p/n: 7753-300008-0
FCC ID:2API5A001

This report is in conformity with ISO/ IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested. This test report shall not be reproduced in any form except in full with the written approval of Hermon Laboratories Ltd.

Table of contents

1 Applicant information ... 3
2 Equipment under test attributes ... 3
3 Manufacturer information ... 3
4 Test details ... 3
5 Tests summary ... 4
6 EUT description ... 5
6.1 General information ... 5
6.2 Ports and lines ... 5
6.3 Test configuration ... 5
6.4 Changes made in EUT ... 5
6.5 Transmitter characteristics ... 6
7 Transmitter tests according to 47CFR part 15 subpart C and RSS-210 requirements ... 7
7.1 In band radiated emissions ... 7
7.2 Out of band radiated emissions ... 12
7.3 Frequency stability test ... 18
7.4 Conducted emissions ... 20
7.5 Occupied bandwidth test ... 24
7.6 Antenna requirements ... 27
8 Unintentional emissions ... 28
8.1 Conducted emissions ... 28
8.2 Radiated emission measurements ... 32
9 APPENDIX A Test equipment and ancillaries used for tests ... 38
10 APPENDIX B Measurement uncertainties ... 39
11 APPENDIX C Test laboratory description ... 40
12 APPENDIX D Specification references ... 40
13 APPENDIX E Test equipment correction factors ... 41
14 APPENDIX F Abbreviations and acronyms ... 51

1 Applicant information

Client name:	Landa Corporation Ltd.
Address:	Park Tamar, P.O.B. 4090, Ness Ziona 7414002, Israel
Telephone:	+972-77-344-4295
Fax:	+972-77-344-4295
E-mail:	Eli.Almog@LANDA-CORP.COM
Contact name:	Mr. Eli Almog

2 Equipment under test attributes

Product name:	BIB Station module
Product type:	Transmitter
Part number:	7753-300008-0
Hardware version:	7753-300008-0
Software release:	1.0.30.0
Receipt date	17-Oct-17

3 Manufacturer information

Manufacturer name:	Landa Corporation Ltd.
Address:	Park Tamar, P.O.B. 4090, Ness Ziona 7414002, Israel
Telephone:	+972-77-344-4295
Fax:	+972-77-344-4295
E-Mail:	Eli.Almog@LANDA-CORP.COM
Contact name:	Mr. Eli Almog

4 Test details

Project ID:	30110
Location:	Primary: Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel Satellite: Hermon Laboratories Ltd. Hefetz-Haim 10, Tel Aviv 6744124, Israel
Test started:	17-Oct-17
Test completed:	05-Nov-17
Test specification(s):	FCC CFR 47 part 15 subpart C, §15.225 and subpart B; RSS-210 issue 9 Annex B section B.6, RSS-Gen issue 5, ICES-003 issue 6:2016

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions	Pass
FCC Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions	Pass
FCC Section 15.225(e) / RSS-210, Section B.6, Frequency stability	Pass
FCC Section 15.207(a) / RSS-Gen, Section 8.8, Conducted emission	Pass
FCC Section 15.215(c) / RSS-Gen, Section 6.6, Occupied bandwidth	Pass
FCC Section 15.203/ RSS-Gen, Section 8.3, Antenna requirements	Pass
Unintentional emissions	
Section 15.107/ICES-003, Section 6.1, Class B, Conducted emission at AC power port	Pass
Section 15.109/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:	Mr. I. Zilberstein, test engineer	November 6, 2017	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	November 29, 2017	
Approved by:	Mr. K. Zushchyk, Projects & Customer Manager, EMC & Radio	May 24, 2018	

6 EUT description

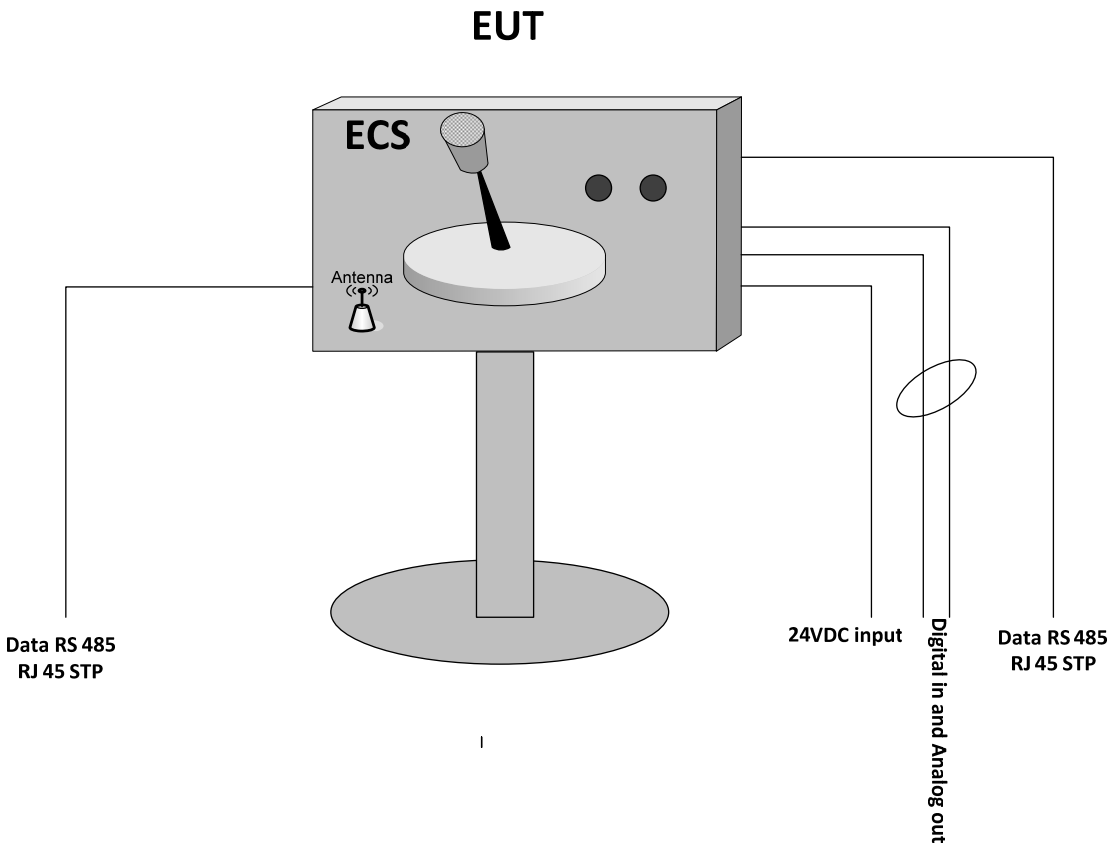
6.1 General information

The EUT is a BIB (Bag In Box) station module of a digital offset printing press. The EUT comprises RFID radio module operating at 13.56 MHz. The EUT is powered from 24 VDC.

6.2 Ports and lines

Port type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length	Indoor / outdoor
Power	DC power	EUT	Power supply	1	Unshielded	1.5 m	Indoor
Signal	Data RS 485	EUT	Open circuit	2	STP	3 m	Indoor
Signal	Digital in & Analog out	EUT	Open circuit	2	Shielded	3 m	Indoor

6.3 Test configuration



6.4 Changes made in EUT

No changes were implemented in the EUT during testing.

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)

Assigned frequency range	13.110-14.010 MHz
Operating frequency	13.56 MHz
Maximum field strength of carrier	68.8 dB(µV/m) at 3 m diatance

Is transmitter output power variable?	X	No			
		Yes		continuous variable	
				stepped variable with stepsize	
			minimum RF power		dBm
			maximum RF power		dBm

Antenna connection				
unique coupling	standard connector	X	integral	with temporary RF connector
				X without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Internal	Landa Digital Printing	Printed loop	NA

Type of modulation	ASK				
Transmitter duty cycle supplied for test	100%				

Transmitter power source					
	Battery	**Nominal rated voltage**		Battery type	
X	DC	**Nominal rated voltage**	24 VDC		
	AC mains	**Nominal rated voltage**		Frequency	

Test specification:	**Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Oct-17		
Temperature: 26.0 ºC	**Relative Humidity:** 39 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

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

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

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

7.1.2 Test procedure

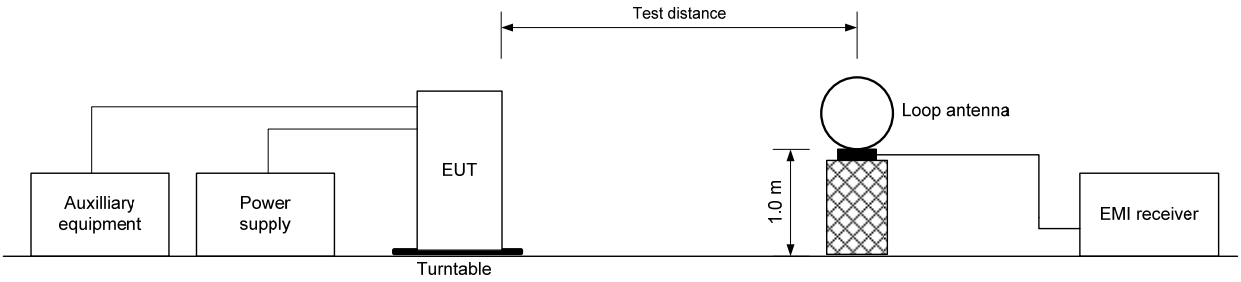
7.1.2.1 The EUT was set up as shown in Figure 7.1.1 energized and the performance check was conducted.

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 360^0, 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.

Test specification:	**Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Oct-17		
Temperature: 26.0 ºC	**Relative Humidity:** 39 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Figure 7.1.1 Setup for in band radiated emission measurements



Test specification:	**Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Oct-17		
Temperature: 26.0 ºC	**Relative Humidity:** 39 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Table 7.1.2 In band radiated emission test results

TEST DISTANCE: 3 m
EUT POSITION: Typical (Vertical)
MODULATION: ASK
MODULATING SIGNAL: ID code
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*			
Unom							Pass
13.5598	68.52	68.24	124	-55.76	Vertical	76.2	
115%Unom							
13.5605	69.06	68.79	124	-55.21	Vertical	76.2	
85%Unom							
13.5605	69.18	68.83	124	-55.17	Vertical	76.2	

*- Margin = Measured emission - specification limit.
**- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

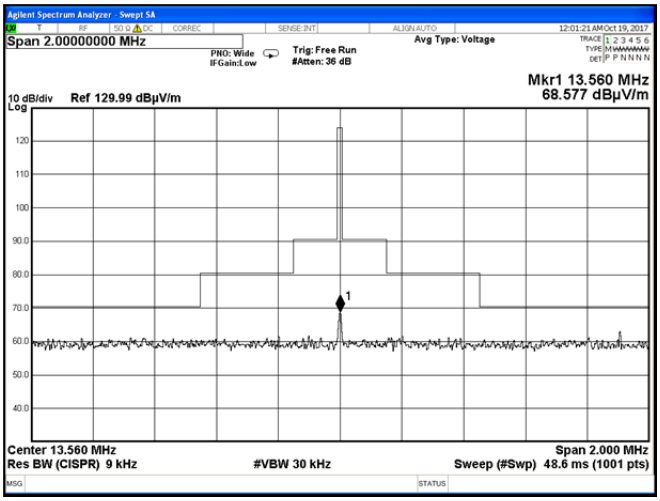
HL 1915	HL 4535	HL 4575	HL 5102				

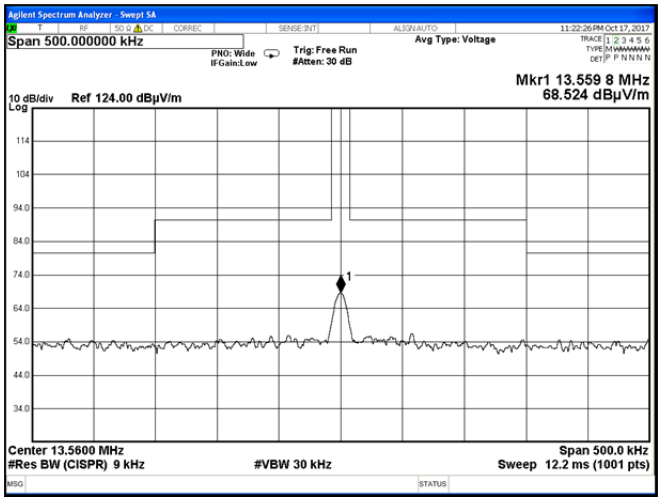
Full description is given in Appendix A.

Test specification:	**Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Oct-17		
Temperature: 26.0 ºC	**Relative Humidity:** 39 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Plot 7.1.1 Fundamental emission test result

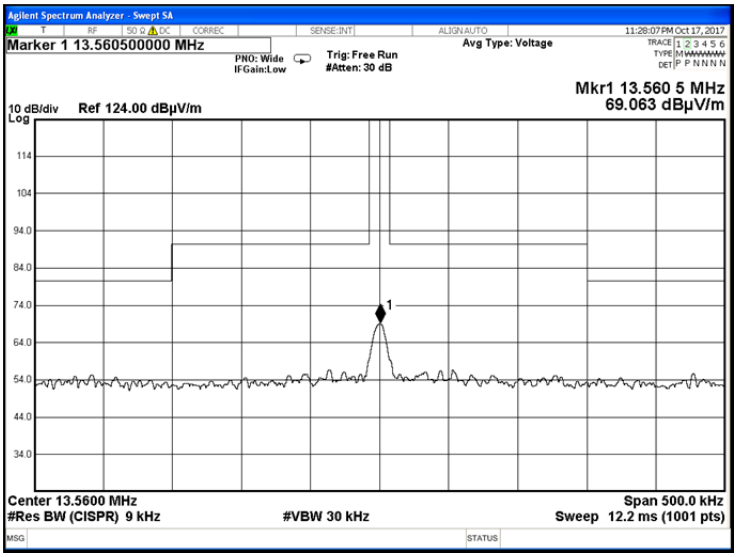
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
DETECTOR: Peak hold
EUT POSITION Typical
INPUT VOLTAGE: Unom





Plot 7.1.2 Fundamental emission test result

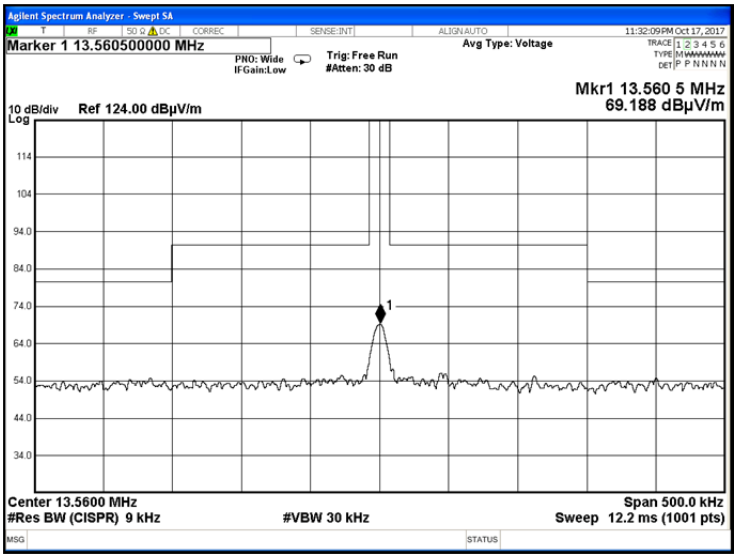
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
DETECTOR: Peak hold
EUT POSITION Typical
INPUT VOLTAGE: 115%Unom



Test specification:	**Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Oct-17		
Temperature: 26.0 ºC	**Relative Humidity:** 39 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Plot 7.1.3 Fundamental emission test result

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
DETECTOR:	Peak hold
EUT POSITION	Typical
INPUT VOLTAGE:	85%Unom



Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	17-Oct-17		
Temperature: 24.9 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

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	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	

*- 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:

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

where S_1 and S_2 – standard defined and test distance respectively in meters.
***- The limit decreases linearly with the logarithm of frequency.

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 360^0, 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 360^0, 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.

Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	17-Oct-17		
Temperature: 24.9 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Figure 7.2.1 Radiated emissions below 30 MHz test set up

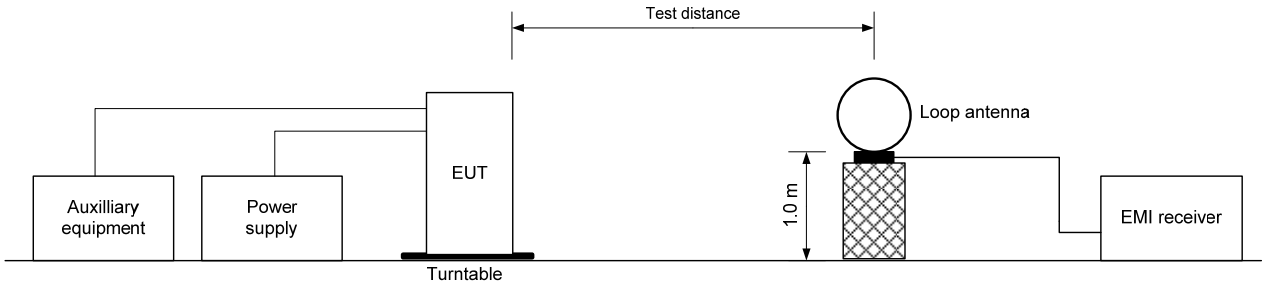
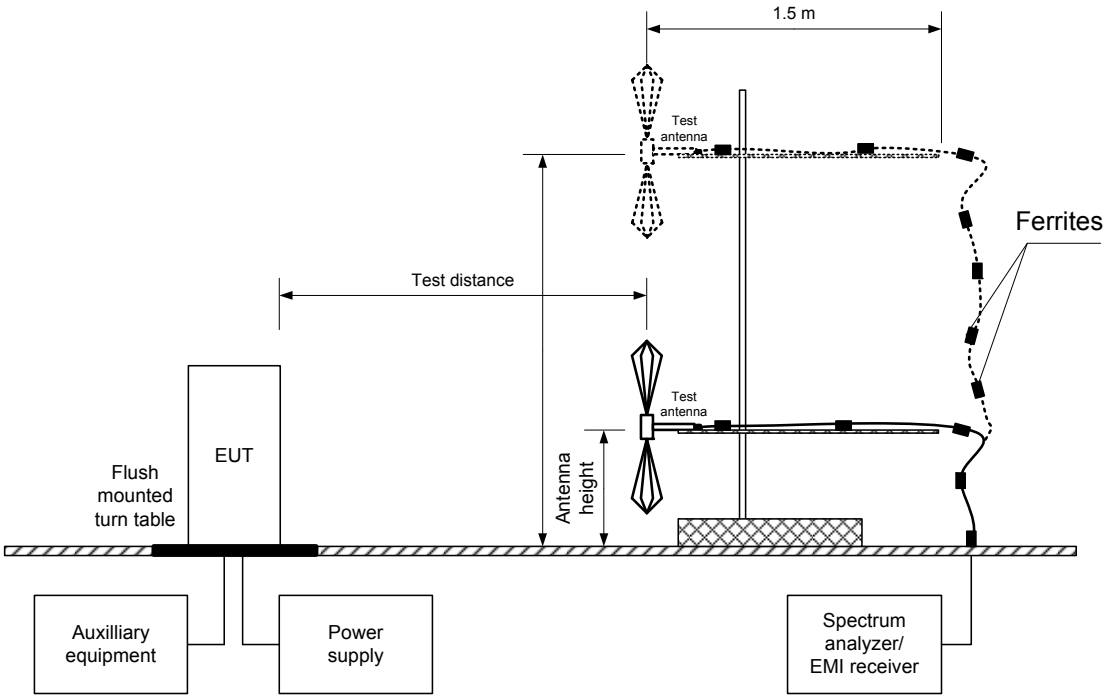


Figure 7.2.2 Radiated emissions above 30 MHz test set up



Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	17-Oct-17		
Temperature: 24.9 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Table 7.2.2 Out of band radiated emissions test results

TEST DISTANCE: 3 m
EUT POSITION: Typical Vertical
MODULATION: ASK
MODULATING SIGNAL: ID code
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
INVESTIGATED FREQUENCY RANGE: 0.009 – 30 MHz
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)
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*				
41.72	37.82	38.93	40.00	-1.07	H	1.5	3	Pass
79.99	38.07	37.65	40.00	-2.35	V	1.2	55	
104.32	41.12	42.25	43.50	-1.25	V	1.4	41	
473.07	38.48	37.12	46.00	-8.88	H	1.0	321	

*****- Margin = Measured emission - specification limit.
******- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

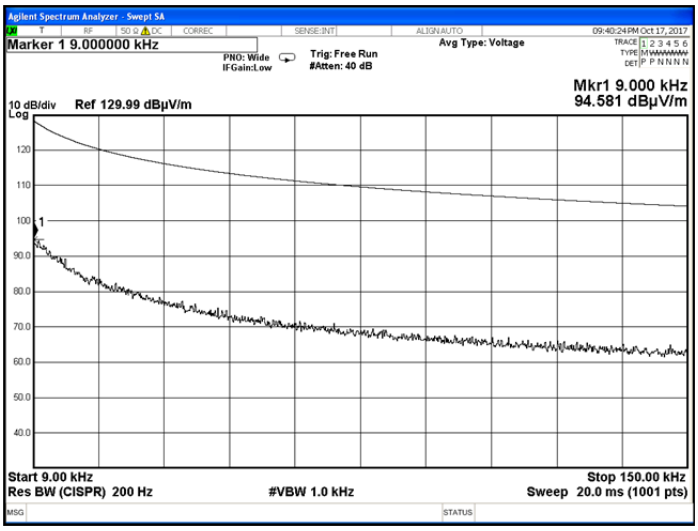
HL 0032	HL 0415	HL 0569	HL 4541	HL 4542	HL 4575	HL 4604	HL 4778
HL 5102	HL 5105	HL 5107					

Full description is given in Appendix A.

Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	17-Oct-17		
Temperature: 24.9 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

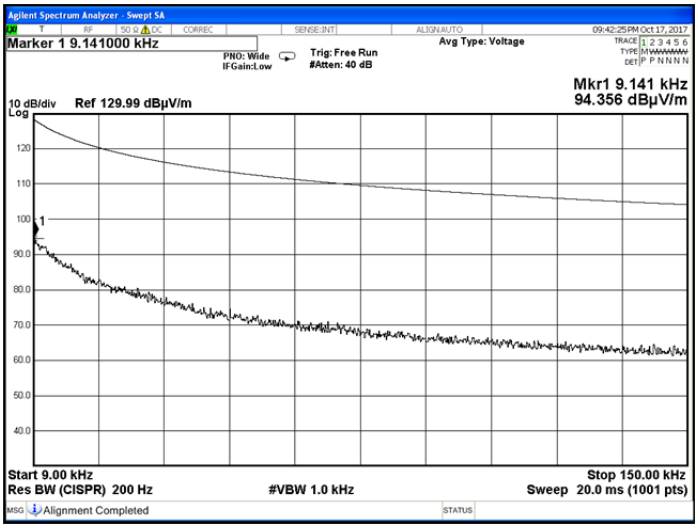
Plot 7.2.1 Radiated emission measurements from 9 to 150 kHz

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



Plot 7.2.2 Radiated emission measurements from 9 to 150 kHz

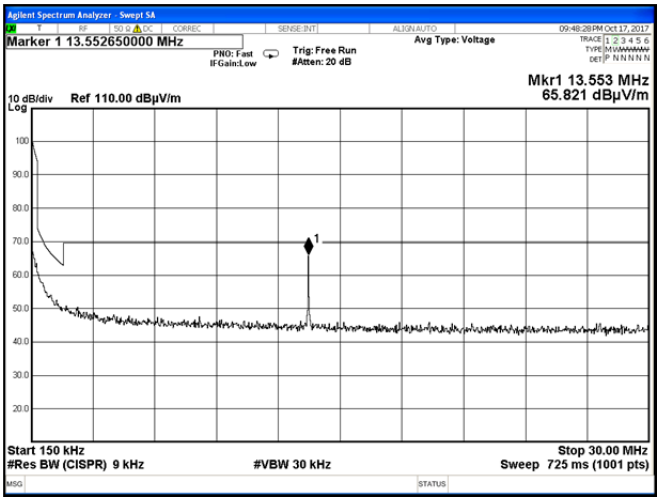
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
DETECTOR: Peak hold

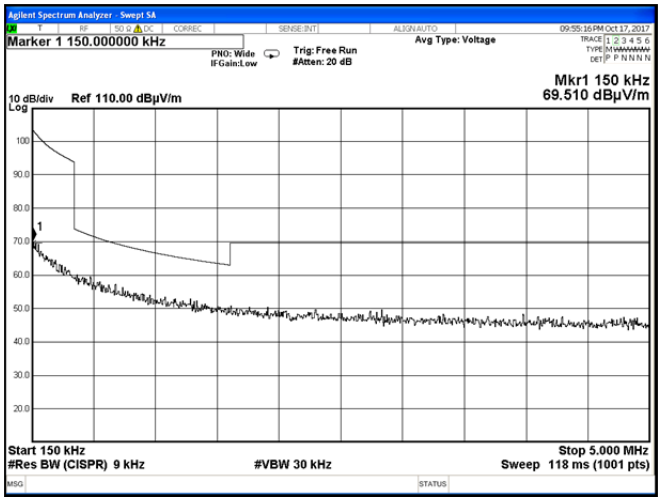


Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	17-Oct-17		
Temperature: 24.9 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

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

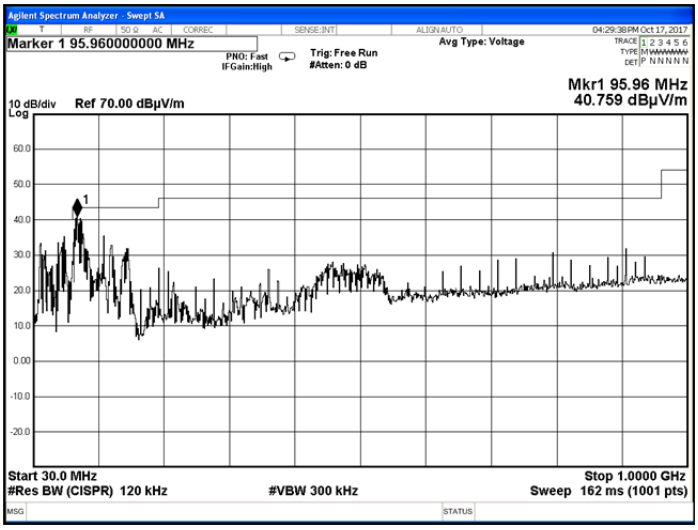




Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	17-Oct-17		
Temperature: 24.9 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

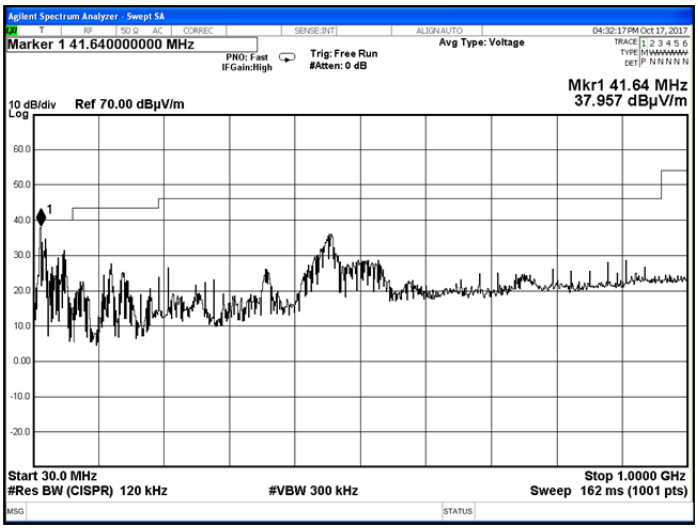
Plot 7.2.4 Radiated emission measurements from 30 to 1000 MHz

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



Plot 7.2.5 Radiated emission measurements from 30 to 1000 MHz

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



Test specification:	Section 15.225(e) / RSS-210, Section B.6, Frequency stability		
Test procedure:	ANSI C63.10 sections 6.8		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Oct-17		
Temperature: 25.6 ºC	Relative Humidity: 37 %	Air Pressure: 1016 hPa	Power: 24 VDC
Remarks:			

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.

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.

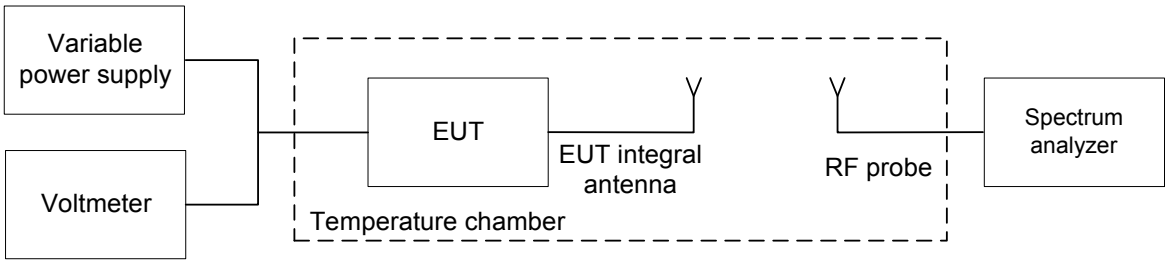
7.3.2.2 The EUT power was turned off. Temperature within test chamber was set to the required one and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

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



Test specification:	**Section 15.225(e) / RSS-210, Section B.6, Frequency stability**		
Test procedure:	ANSI C63.10 sections 6.8		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Oct-17		
Temperature: 25.6 ºC	**Relative Humidity:** 37 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY: 13.560 MHz
NOMINAL POWER VOLTAGE: 24 V
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 1 kHz
VIDEO BANDWIDTH: 3 kHz
MODULATION: Unmodulated

Temperature, ºC	Voltage, V	Frequency, MHz				Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	2nd min	5th min	10th min	Positive	Negative			
-20	nominal	13.559968	13.559971	13.559969	13.559965	3	3	1356	-1353	Pass
20	nominal +15%	13.559952	13.559990	13.559984	13.559992	0	47		-1309	
20	nominal	13.559928	13.559928	13.559928	13.559928	NA	NA		NA	
20	nominal -15%	13.559896	13.559874	13.559888	13.559861	91	0		-1265	
50	nominal	13.559990	13.559896	13.559892	13.559884	115	0		-1241	

* - Reference frequency

Reference numbers of test equipment used

HL 0493	HL 3233	HL 4550	HL 4575	HL 4649			

Full description is given in Appendix A.

Test specification:	**Section 15.207(a) / RSS-Gen, Section 8.8, Conducted emission**		
Test procedure:	ANSI C63.10 sections 6.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	05-Nov-17		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** hPa	**Power:** 120 VAC
Remarks:			

7.4 Conducted emissions

7.4.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μV)	
	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5.0	56	46
5.0 - 30	60	50

* The limit decreases linearly with the logarithm of frequency.

7.4.2 Test procedure

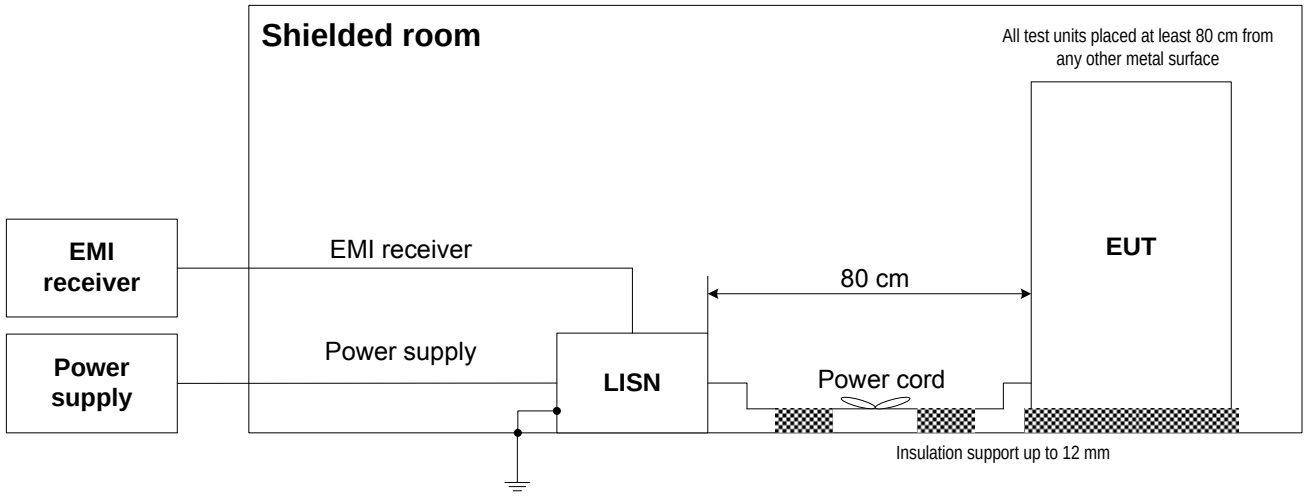
7.4.2.1 The EUT was set up as shown in Figure 7.4.1 and associated photographs, energized and the performance check was conducted.

7.4.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.4.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

7.4.2.3 The position of the device cables was varied to determine maximum emission level.

7.4.2.4 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.

Figure 7.4.1 Setup for conducted emission measurements,



Test specification:	**Section 15.207(a) / RSS-Gen, Section 8.8, Conducted emission**		
Test procedure:	ANSI C63.10 sections 6.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	05-Nov-17		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** hPa	**Power:** 120 VAC
Remarks:			

Table 7.4.2 Conducted emission test results

LINE: AC mains
EUT SET UP: FLOOR STANDING
EUT OPERATING MODE: Transmit
TEST SITE: SHIELDED ROOM
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE: 150 kHz - 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(μV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*	Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*		
0.15	40.5	36.2	66.0	-29.8	30.3	56.0	-25.7	L1	Pass
0.16	42.3	42.0	65.8	-23.8	27.7	55.8	-28.1		
13.20	41.5	36.1	60.0	-23.9	26.6	50.0	-23.4		
14.05	41.0	36.6	60.0	-23.4	26.5	50.0	-23.5		
16.14	39.0	34.4	60.0	-25.6	26.8	50.0	-23.2		
27.12	41.0	40.0	60.0	-20.0	39.6	50.0	-10.4		
0.15	41.3	37.5	66.0	-28.5	32.0	56.0	-24.0	L2	Pass
0.50	38.4	31.4	65.8	-34.4	21.1	55.8	-34.7		
13.20	38.4	34.7	60.0	-25.3	24.9	50.0	-25.1		
13.94	39.6	35.3	60.0	-24.7	24.6	50.0	-25.4		
15.68	40.1	35.6	60.0	-24.4	28.0	50.0	-22.0		
27.12	40.1	39.0	60.0	-29.8	38.5	50.0	-11.5		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

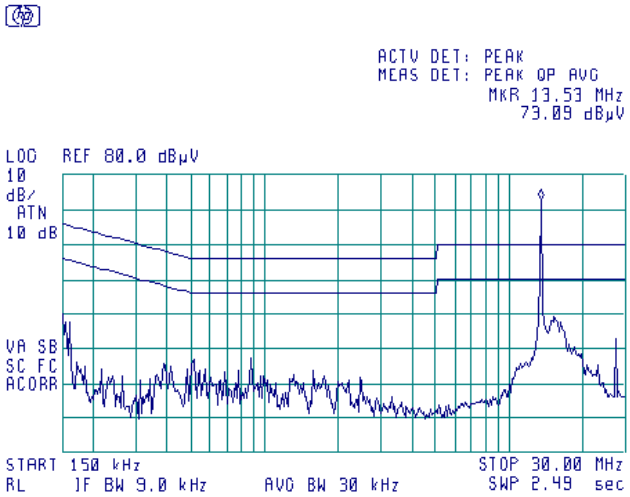
HL 0447	HL 0521	HL 0787	HL 1553				

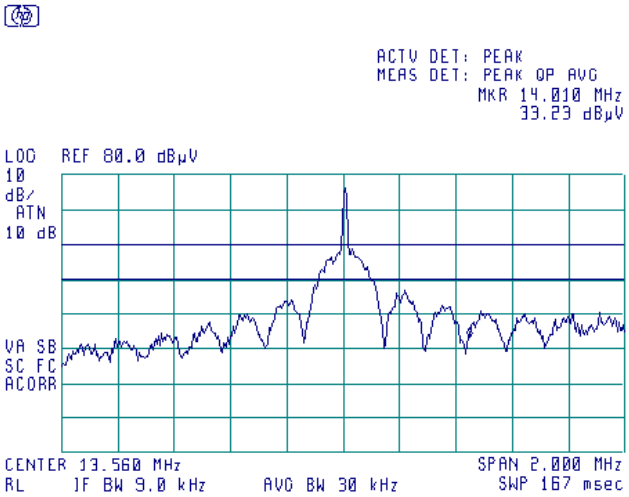
Full description is given in Appendix A.

Test specification:	**Section 15.207(a) / RSS-Gen, Section 8.8, Conducted emission**		
Test procedure:	ANSI C63.10 sections 6.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	05-Nov-17		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** hPa	**Power:** 120 VAC
Remarks:			

Plot 7.4.1 Conducted emission measurements

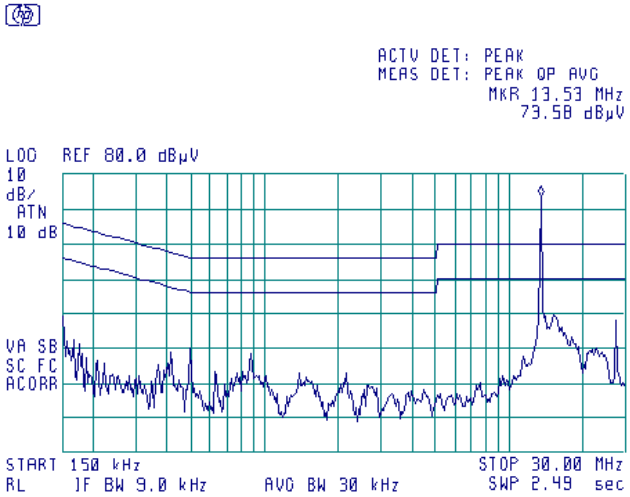
LINE: L1
EUT OPERATING MODE: Transmit with antenna
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

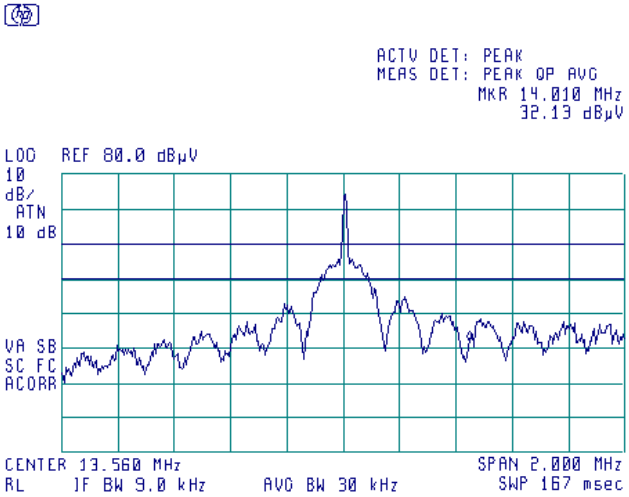




Plot 7.4.2 Conducted emission measurements

LINE: L2
EUT OPERATING MODE: Transmit with antenna
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

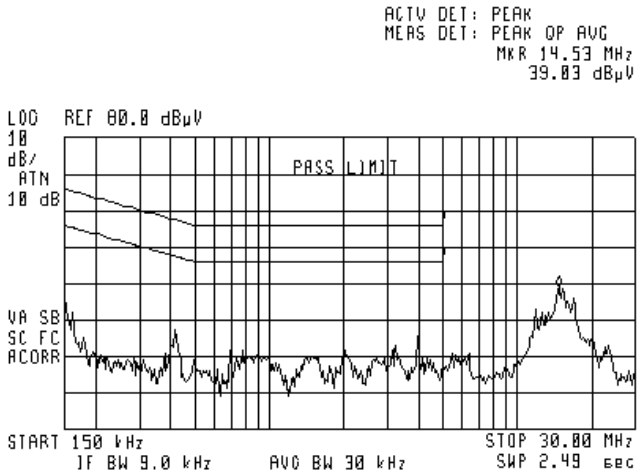




Test specification:	**Section 15.207(a) / RSS-Gen, Section 8.8, Conducted emission**		
Test procedure:	ANSI C63.10 sections 6.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	05-Nov-17		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** hPa	**Power:** 120 VAC
Remarks:			

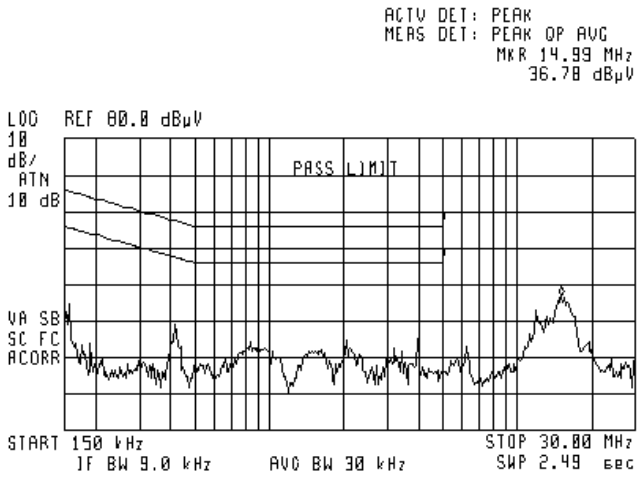
Plot 7.4.3 Conducted emission measurements

LINE: L1
EUT OPERATING MODE: Transmit with termination
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 7.4.4 Conducted emission measurements

LINE: L2
EUT OPERATING MODE: Transmit with termination
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth		
Test procedure:	ANSI C63.10 section 6.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Oct-17		
Temperature: 25.6 ºC	Relative Humidity: 37 %	Air Pressure: 1016 hPa	Power: 24 VDC
Remarks:			

7.5 Occupied bandwidth test

7.5.1 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 7.5.1.

Table 7.5.1 Occupied bandwidth limits

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

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

7.5.2 Test procedure

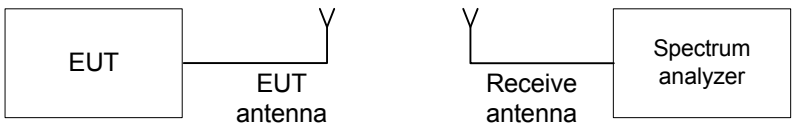
7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.

7.5.2.2 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.

7.5.2.3 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 7.5.2 and associated plot.

7.5.2.4 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 7.5.1 Occupied bandwidth test setup



Test specification:	**Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth**		
Test procedure:	ANSI C63.10 section 6.9.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Oct-17		
Temperature: 25.6 ºC	**Relative Humidity:** 37 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Table 7.5.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND	13.11 – 14.01 MHz
DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	1 kHz
VIDEO BANDWIDTH:	3 kHz
MODULATION ENVELOPE REFERENCE POINTS:	20 dBc
MODULATION:	ASK
MODULATING SIGNAL:	enable

Band edge	Cross point frequency, MHz	Frequency drift, kHz		Modulation band edge, MHz	Assigned band edge, MHz	Verdict
		Negative	Positive			
Low	13.558465	47	N/A	13.558418	13.553	Pass
High	13.561440	N/A	115	13.561555	13.567	Pass

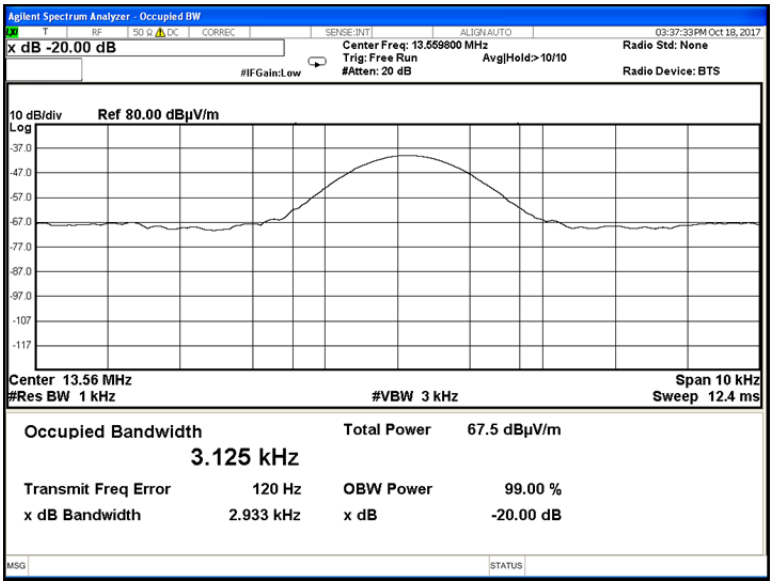
Reference numbers of test equipment used

HL 1915	HL 4535	HL 4575	HL 5102					

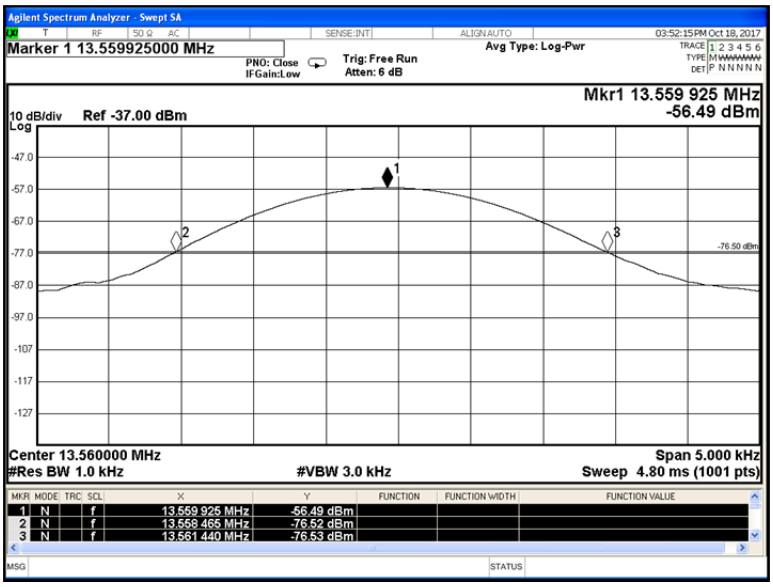
Full description is given in Appendix A.

Test specification:	**Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth**		
Test procedure:	ANSI C63.10 section 6.9.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Oct-17		
Temperature: 25.6 ºC	**Relative Humidity:** 37 %	**Air Pressure:** 1016 hPa	**Power:** 24 VDC
Remarks:			

Plot 7.5.1 Occupied bandwidth test result



Plot 7.5.2 Occupied bandwidth test result



Test specification:	**FCC Section 15.203/ RSS-Gen, Section 7.1.4, Antenna requirement**		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	9-Aug-17		
Temperature: 22 ºC	**Air Pressure:** 1011 hPa	**Relative Humidity:** 54 %	**Power Supply:** 24 VDC
Remarks:			

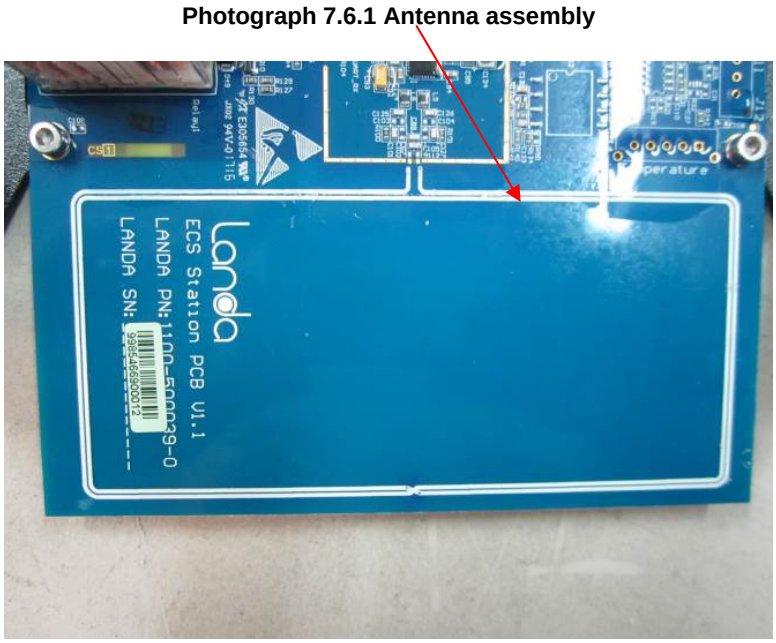
7.6 Antenna requirements

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 7.6.1.

Table 7.6.1 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 7.6.1 Antenna assembly



Test specification:	**Section 15.107, ICES-003, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Section 12.2.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	05-Nov-17		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** hPa	**Power:** 120 VAC
Remarks:			

8 Unintentional emissions

8.1 Conducted emissions

8.1.1 General

This test was performed to measure common mode conducted emissions at the mains power port. Specification test limits are given in Table 8.1.1.

Table 8.1.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μV)		Class A limit, dB(μV)	
	QP	AVRG	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*	79	66
0.5 - 5.0	56	46	73	60
5.0 - 30	60	50	73	60

* The limit decreases linearly with the logarithm of frequency.

8.1.2 Test procedure

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

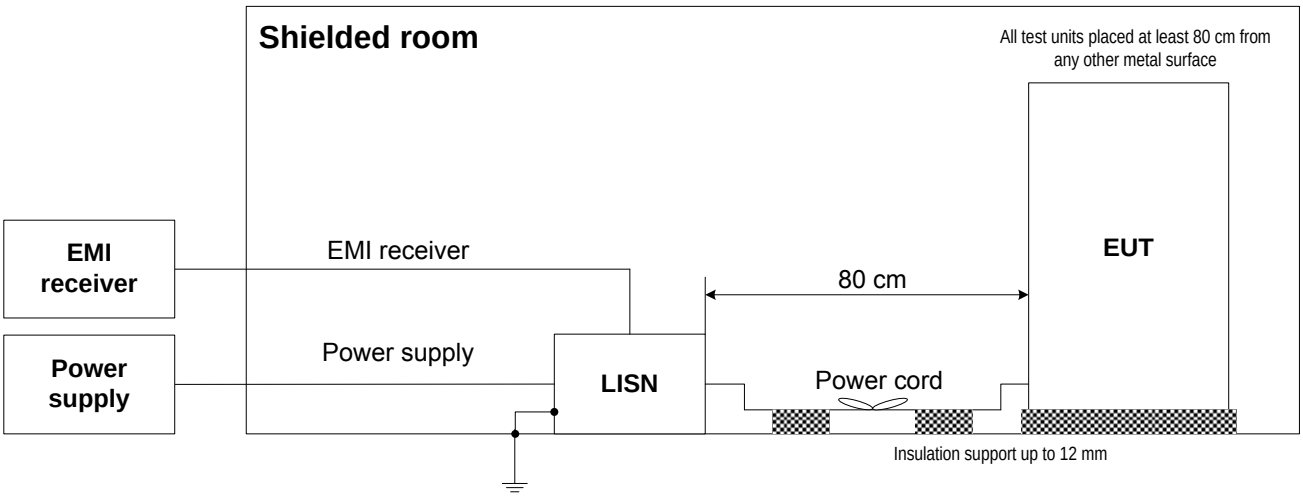
8.1.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 8.1.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

8.1.2.3 The position of the device cables was varied to determine maximum emission level.

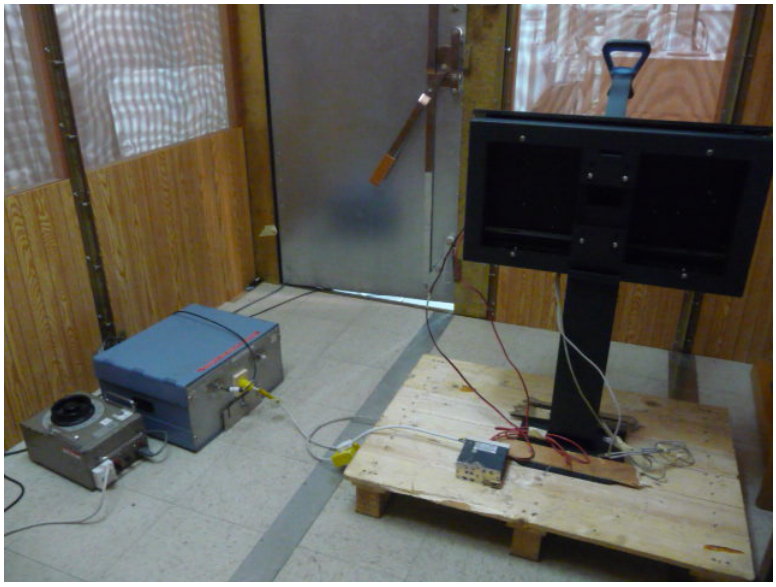
8.1.2.4 The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.

Test specification:	**Section 15.107, ICES-003, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Section 12.2.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	05-Nov-17		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** hPa	**Power:** 120 VAC
Remarks:			

Figure 8.1.1 Setup for conducted emission measurements, table-top equipment



Photograph 8.1.1 Setup for conducted emission measurements



Test specification:	**Section 15.107, ICES-003, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Section 12.2.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	05-Nov-17		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** hPa	**Power:** 120 VAC
Remarks:			

Table 8.1.2 Conducted emission test results

LINE: AC mains
LIMIT: Class B
EUT OPERATING MODE: Stand-by
EUT SET UP: FLOOR STANDING
TEST SITE: SHIELDED ROOM
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE: 150 kHz - 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(μV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*	Measured emission, dB(μV)	Limit, dB(μV)	Margin, dB*		
0.15	41.8	34.9	66.0	-31.1	27.4	56.0	-28.6	L1	Pass
0.16	38.5	31.0	65.5	-34.5	26.1	55.5	-29.4		
0.40	27.3	25.3	57.8	-32.5	24.6	47.8	-23.2		
0.97	23.9	21.0	56.0	-35.0	18.8	46.0	-27.2		
14.7	35.1	29.9	60.0	-30.1	22.7	50.0	-27.3		
15.2	40.1	34.8	60.0	-25.2	26.5	50.0	-23.5		
0.16	39.5	30.7	65.5	-34.8	28.3	55.5	-27.2	L2	Pass
0.18	35.1	28.2	64.4	-36.2	23.7	54.4	-30.7		
0.41	27.3	24.6	57.8	-33.2	23.7	47.8	-24.1		
0.54	27.8	23.1	56.0	-32.9	17.6	46.0	-28.4		
14.3	33.2	28.9	60.0	-31.1	20.6	50.0	-29.4		
15.2	39.6	34.3	60.0	-25.7	25.8	50.0	-24.2		

*****- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

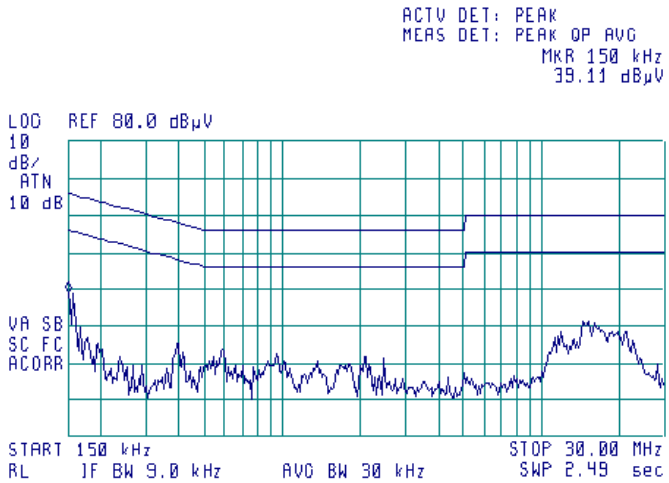
HL 0447	HL 0521	HL 0787	HL 1553				

Full description is given in Appendix A.

Test specification:	**Section 15.107, ICES-003, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Section 12.2.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	05-Nov-17		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** hPa	**Power:** 120 VAC
Remarks:			

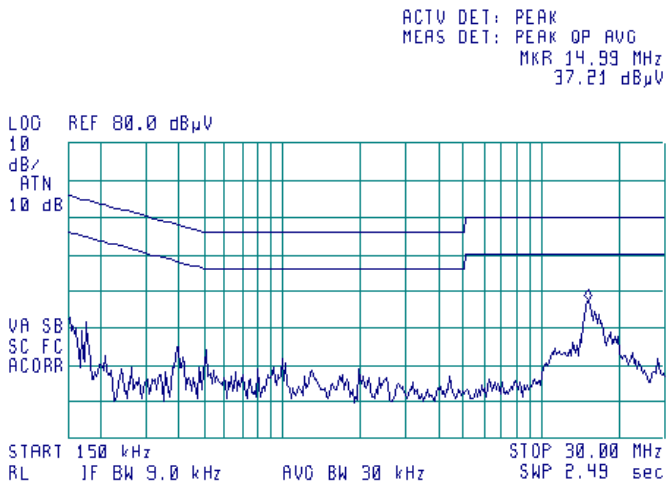
Plot 8.1.1 Conducted emission measurements

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.2 Conducted emission measurements

LINE: L2
LIMIT: B
EUT OPERATING MODE: Receive / Stand-by
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.109, ICES-003, Class B, Radiated emission		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	03-Nov-17		
Temperature: 25 ºC	Relative Humidity: 42 %	Air Pressure: 1010 hPa	Power: 24 VDC
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.2.1.

Table 8.2.1 Radiated emission test limits

Frequency, MHz	Class B limit, dB(μV/m)		Class A limit, dB(μV/m)	
	10 m distance	3 m distance	10 m distance	3 m distance
30 - 88	29.5*	40.0	39.0	49.5*
88 - 216	33.0*	43.5	43.5	54.0*
216 - 960	35.5*	46.0	46.4	56.9*
Above 960	43.5*	54.0	49.5	60.0*

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
where S_1 and S_2 – standard defined and test distance respectively in meters.

8.2.2 Test procedure

8.2.2.1 The EUT was set up as shown in Figure 8.2.1 and associated photographs, energized and the performance check was conducted.

8.2.2.2 Preliminary measurements were performed in the anechoic chamber at 3 m test distance. The specified frequency range was investigated with biconical and log periodic antennas connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

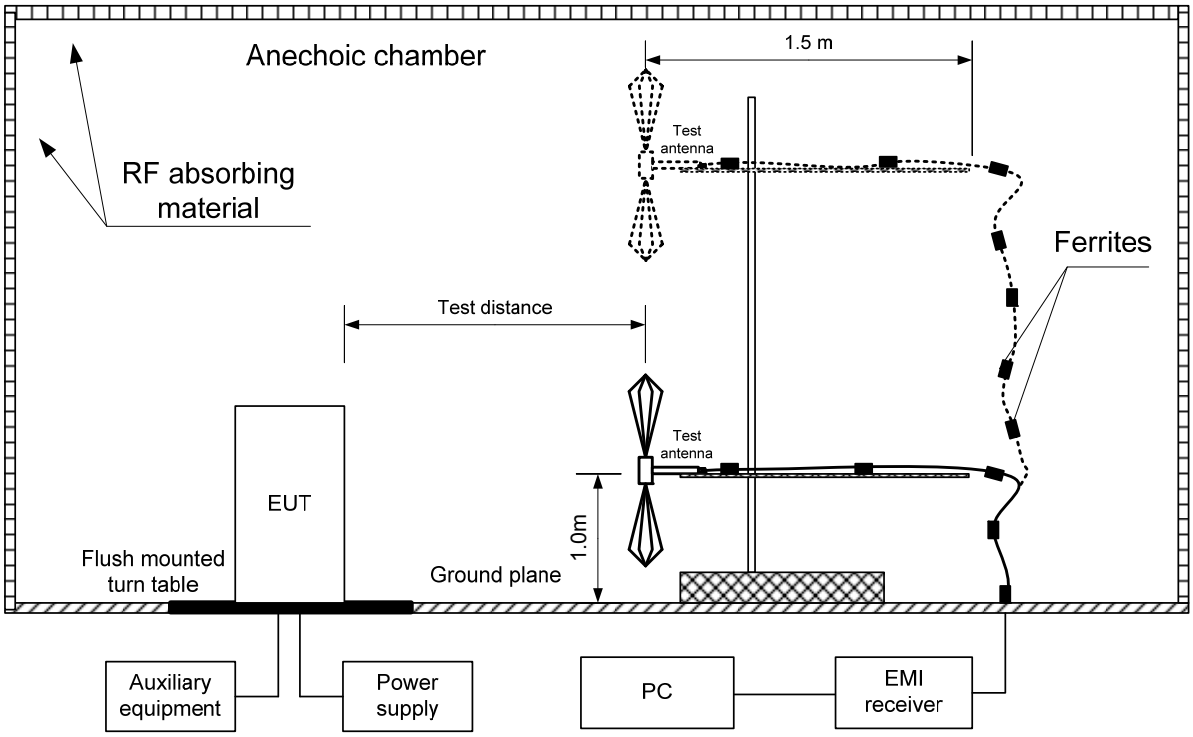
8.2.2.3 The EUT was set up as shown in Figure 8.2.2, energized and the performance check was conducted.

8.2.2.4 Final measurements were performed at the open area test site at 3 m test distance. The EUT wires and cables were arranged to produce maximum emission as it was found during preliminary measurements. The frequencies yield the worst test results (the lowest margins) during preliminary testing were investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m and its polarization was changed from vertical to horizontal..

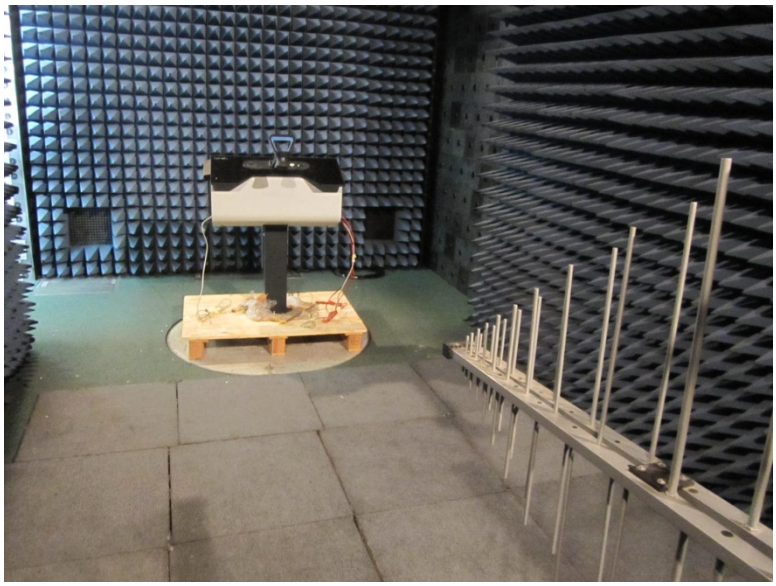
8.2.2.5 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

Test specification:	**Section 15.109, ICES-003, Class B, Radiated emission**		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	03-Nov-17		
Temperature: 25 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1010 hPa	**Power:** 24 VDC
Remarks:			

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber, floor standing equipment

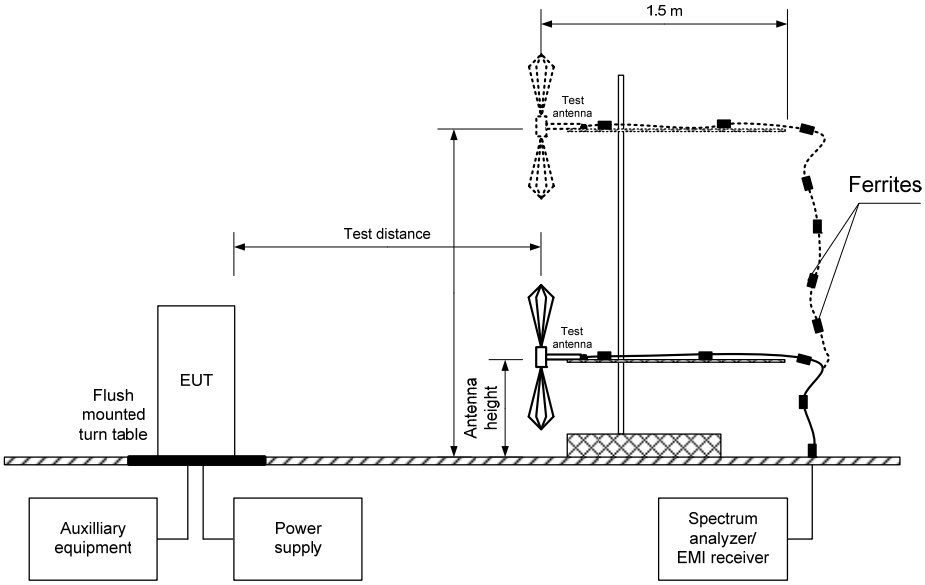


Photograph 8.2.1 Setup for radiated emission measurements in anechoic chamber



Test specification:	**Section 15.109, ICES-003, Class B, Radiated emission**		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	03-Nov-17		
Temperature: 25 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1010 hPa	**Power:** 24 VDC
Remarks:			

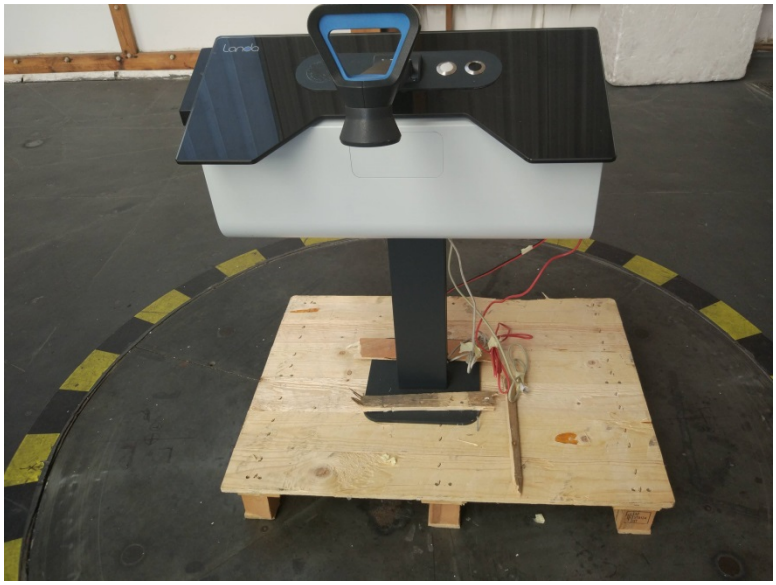
Figure 8.2.2 Setup for radiated emission measurements at OATS, floor standing equipment



Photograph 8.2.2 Setup for radiated emission measurements, general view

Test specification:	**Section 15.109, ICES-003, Class B, Radiated emission**		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	03-Nov-17		
Temperature: 25 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1010 hPa	**Power:** 24 VDC
Remarks:			

Photograph 8.2.3 Setup for radiated emission measurements, EUT cabling



Test specification:	**Section 15.109, ICES-003, Class B, Radiated emission**		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	03-Nov-17		
Temperature: 25 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1010 hPa	**Power:** 24 VDC
Remarks:			

Table 8.2.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Stand-by
TEST SITE: OATS
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
41.72	37.82	38.93	40.00	-1.07	H	1.5	3	Pass
79.99	38.07	37.65	40.00	-2.35	V	1.2	55	
104.32	41.12	42.25	43.50	-1.25	V	1.4	41	
473.07	38.48	37.12	46.00	-8.88	H	1.0	321	

*- Margin = Measured emission - specification limit.
**- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

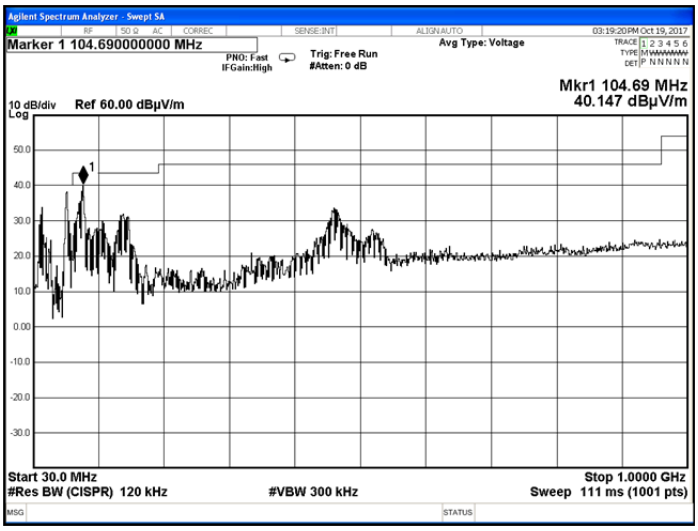
HL 0032	HL 0415	HL 0569	HL 4541	HL 4542	HL 4575	HL 4604	HL 4778
HL 5102	HL 5105	HL 5107					

Full description is given in Appendix A.

Test specification:	**Section 15.109, ICES-003, Class B, Radiated emission**		
Test procedure:	ANSI C63.4, Section 12.2.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	03-Nov-17		
Temperature: 25 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1010 hPa	**Power:** 24 VDC
Remarks:			

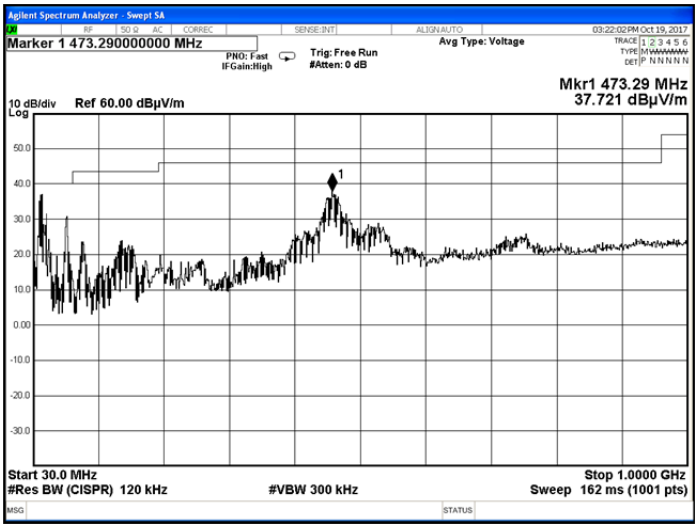
Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

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



Plot 8.2.2 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization

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



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0032	Antenna, Biconical, 20 - 200 MHz	Electro-Metrics	BIA 25/30	3577	12-May-17	12-May-18
0415	Cable, Coax, RF, RG-214, 12.3 m	Hermon Laboratories	CC-3	056	18-Dec-16	18-Dec-17
0447	LISN, 16/2, 300V RMS, 50 Ohm/50 uH + 5 Ohm, STD CISPR 16-1	Hermon Laboratories	LISN 16 - 1	066	08-Nov-17	08-Nov-18
0493	emperature Chamber -45…175 deg C	Thermotron	S-1.2 Mini-Max	14016	04-Jun-17	04-Jun-18j
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	31-Oct-17	31-Oct-18
0569	Antenna, Log Periodic, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	1953	05-May-17	05-May-18
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A018 77	24-Oct-17	24-Oct-18
1553	Cable RF, 3.5 m, N/N-type	Alpha Wire	RG-214	1553	01-Jan-17	01-Jan-18
1915	Antenna, Loop, Active Receiving, 1 kHz - 30 MHz	EMC Test Systems	6507	1457	19-Jan-17	19-Jan-18
3233	Multimeter	Fluke	115C	93771523	17-Jul-17	17-Jul-18
4535	Microwave Cable Assembly, 6.5 GHz, 5.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	04-Jun-17	04-Jun-18
4541	Microwave Cable Assembly, 4.0 GHz, 1.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	10-Sep-17	10-Sep-18
4542	Amplifier, 9 kHz to 1 GHz, 32 dB gain	Sonoma Instrument	310	0002A056 39	15-Mar-17	15-Mar-18
4550	Cable RF, 8.5 m, BNC/BNC, up to 1 GHz	Suhner Switzerland	RG-58	NA	04-Oct-17	04-Oct-18
4575	EXA Signal Analyzer, 9 kHz - 26.5 GHz	Agilent Technologies	N9010A	MY480301 10	06-Apr-17	06-Apr-18
4604	Biconilog Antenna, 26 - 2000 MHz	EMCO	3142B	9909-1421	12-May-17	12-May-18
4649	DC Power Supply, 0-80 VDC, 0-42 A,	TDK-Lambda Ltd	GEN80-42	NA	12-Mar-17	12-Mar-18
4778	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL4777	Hewlett Packard	8542E	30807A00 262, 3427A001 23	02-Nov-17	02-Nov-18
5102	RF cable, 18 GHz, 6 m, N-type	Huber-Suhner	SF106A/1 1N/11N/6 000MM	500848/6A	27-Jul-17	27-Jul-18
5105	RF cable, 18 GHz, 6 m, N-type Cable RF	Huber-Suhner	SF106A/1 1N/11N/6 000MM	500851/6A	27-Jul-17	27-Jul-18
5107	RF cable, 18 GHz, 4.5 m, N-type	Huber-Suhner	SF106A/1 1N/11N/4 500MM	500845/6A	27-Jul-17	27-Jul-18

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization Vertical polarization	 Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB

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, Radio, Safety, Environmental and Telecommunication testing facility.
Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for 1, 2, 15, 18 parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; registered 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-869 for RE measurements above 1 GHz, C-845 for conducted emissions site and T-1606 for conducted emissions at telecommunication ports).
The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

Address: P.O. Box 23, Binyamina 3055001, Israel.
Telephone: +972 4628 8001
Fax: +972 4628 8277
e-mail: mail@hermonlabs.com
website: www.hermonlabs.com

Person for contact: Mr. Michael Nikishin, EMC&Radio group manager

12 APPENDIX D Specification references

FCC 47CFR part 15: 2017	Radio Frequency Devices
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.4: 2014	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 9: 2016	Licence- Exempt Radio Apparatus: Category I Equipment
RSS-Gen Issue 5: 2018	General Requirements for Compliance of Radio Apparatus
ICES-003 issue 6:2016	Information Technology Equipment (ITE) – Limits and methods of measurement

13 APPENDIX E Test equipment correction factors

Correction factor
Line impedance stabilization network
Model LISN 16 - 1
Hermon Laboratories, HL 0447

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.

Antenna factor
Biconical antenna
Electro-Metrics, model BIA-25/30
Ser.No.3577, HL 0032

Frequency MHz	Antenna Factor dB(1/m)	Frequency MHz	Antenna Factor dB(1/m)
20	15.1	115	16.7
25	14.6	120	14.1
30	13.7	125	13.1
35	11.8	130	13.0
40	11.4	135	12.9
45	11.7	140	12.7
50	11.4	145	12.5
55	10.5	150	14.3
60	10.3	155	14.8
65	8.9	160	14.7
70	7.6	165	15.1
75	7.3	170	15.6
80	7.3	175	16.5
85	7.8	180	16.7
90	9.4	185	17.3
95	10.6	190	17.9
100	11.8	195	17.6
105	12.5	200	17.9
110	13.7		

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

Antenna factor
Log periodic antenna
Electro-Metrics, model LPA-25/30
Ser.No.1953, HL 0569

Frequency MHz	Antenna Factor dB(1/m)	Frequency MHz	Antenna Factor dB(1/m)
200	15.2	625	25.2
225	15.1	650	25.8
250	16.3	675	27.2
275	17.2	700	27.6
300	19.6	725	27.6
325	18.4	750	27.6
350	19.0	775	28.0
375	20.0	800	28.2
400	20.9	825	29.4
425	21.3	850	29.9
450	22.1	875	30.0
475	22.7	900	30.4
500	23.2	925	30.6
525	23.9	950	30.8
550	24.2	975	31.6
575	24.6	1000	32.1
600	24.7		

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

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 dBμV to obtain field strength in dBμA/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 dBμV to obtain field strength in dBμV/m

Cable loss
Cable coax, RG-214, 12.3 m, s/n 056, HL 0415

No.	Frequency, MHz	Cable loss, dB	Measured uncertainty, dB
1	10	0.23	±0.12
2	30	0.44	±0.12
3	50	0.60	±0.12
4	100	0.89	±0.12
5	150	1.11	±0.13
6	200	1.30	±0.13
7	250	1.45	±0.13
8	300	1.61	±0.13
9	400	1.94	±0.13
10	500	2.18	±0.13
11	600	2.45	±0.14
12	700	2.67	±0.14
13	800	2.94	±0.14
14	900	3.16	±0.14
15	1000	3.38	±0.14

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		

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m, N- type,
SF106A/11N/11N/6000MM, S/N 500848/6A
HL 5102

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.00	5500	2.43
50	0.23	6000	2.54
100	0.31	6500	2.65
200	0.44	7000	2.76
300	0.54	7500	2.87
400	0.62	8000	2.98
500	0.69	8500	3.06
600	0.76	9000	3.16
700	0.82	9500	3.27
800	0.87	10000	3.36
900	0.94	10500	3.45
1000	0.98	11000	3.55
1100	1.03	11500	3.63
1200	1.08	12000	3.72
1300	1.13	12500	3.82
1400	1.17	13000	3.90
1500	1.21	13500	3.99
1600	1.25	14000	4.06
1700	1.30	14500	4.15
1800	1.33	15000	4.24
1900	1.37	15500	4.30
2000	1.41	16000	4.37
2500	1.59	16500	4.45
3000	1.75	17000	4.53
3500	1.90	17500	4.62
4000	2.04	18000	4.67
4500	2.17		
5000	2.30		

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m, N- type,
SF106A/11N/11N/6000MM, S/N 500851/6A
HL 5105

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.01	5500	2.41
50	0.22	6000	2.53
100	0.31	6500	2.64
200	0.43	7000	2.75
300	0.53	7500	2.85
400	0.61	8000	2.96
500	0.68	8500	3.05
600	0.75	9000	3.15
700	0.81	9500	3.26
800	0.87	10000	3.34
900	0.93	10500	3.44
1000	0.98	11000	3.53
1100	1.03	11500	3.61
1200	1.07	12000	3.71
1300	1.12	12500	3.81
1400	1.16	13000	3.89
1500	1.21	13500	3.97
1600	1.25	14000	4.05
1700	1.28	14500	4.13
1800	1.32	15000	4.21
1900	1.37	15500	4.29
2000	1.40	16000	4.36
2500	1.58	16500	4.43
3000	1.74	17000	4.49
3500	1.89	17500	4.58
4000	2.03	18000	4.67
4500	2.17		
5000	2.29		

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m, N- type,
SF106A/11N/11N/4500MM, S/N 500845/6A
HL 5107

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.01	5500	1.75
50	0.16	6000	1.84
100	0.22	6500	1.92
200	0.31	7000	2.00
300	0.38	7500	2.07
400	0.44	8000	2.15
500	0.49	8500	2.23
600	0.54	9000	2.29
700	0.58	9500	2.38
800	0.63	10000	2.43
900	0.67	10500	2.50
1000	0.71	11000	2.57
1100	0.74	11500	2.63
1200	0.77	12000	2.69
1300	0.81	12500	2.76
1400	0.84	13000	2.82
1500	0.87	13500	2.87
1600	0.91	14000	2.93
1700	0.93	14500	3.00
1800	0.96	15000	3.06
1900	0.99	15500	3.12
2000	1.01	16000	3.18
2500	1.14	16500	3.22
3000	1.26	17000	3.28
3500	1.37	17500	3.36
4000	1.47	18000	3.43
4500	1.57		
5000	1.66		

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
dB(μA)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
WB	wideband

END OF DOCUMENT