

TEST REPORT

ACCORDING TO: FCC CFR 47 part 15 subpart C, §15.225 and subpart B

FOR:

LogiTag Systems Ltd.

**System for automating reordering
operations with RFID reader**

Product name: StockBox

**Part numbers: LT-SB-G001,
LT-SB-001**

FCC ID:Z97-STB01

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1 Applicant information

Client name: LogiTag Systems Ltd.
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Telephone: +972 9835 4848
Fax: +972 9865 6262
E-mail: golank@Logi-tag.com
Contact name: Mr. Golan Kormian

2 Equipment under test attributes

Product type: System for automating reordering operations with RFID reader
Product name: StockBox
Part number: LT-SB-G001
Serial number: SBG001
Hardware version: A01
Software release: 28-10-2011
Receipt date: 10/9/2011

3 Manufacturer information

Manufacturer name: LogiTag Systems Ltd.
Address: 2 Hamelacha street, Poleg Industrial Zone, Netanya 42504, Israel
Telephone: +972 9835 4848
Fax: +972 9865 6262
E-Mail: golank@Logi-tag.com
Contact name: Mr. Golan Kormian





4 Test details

Project ID: 22570
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 10/24/2011
Test completed: 11/09/2011
Test specification(s): FCC CFR 47 part 15 subpart C, §15.225 and subpart B class B

5 Tests summary

Test	Status
Transmitter characteristics	
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	Pass
Section 15.215(c), Occupied bandwidth	Pass
Section 15.203, Antenna requirements	Pass
Unintentional emissions	
Section 15.107 Class B, Conducted emission at AC power port	Pass
Section 15.109 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. Sloushch, test engineer Mr. A. Tseitlin, test engineer	November 9, 2011	 
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	November 13, 2011	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	November 14, 2011	

6 EUT description

6.1 General information

The EUT, RFID reader operating at 13.56 MHz frequency, is a part of the StockBox system containing the following elements in the common enclosure:

- switching board MUX with 8 channels output, antenna input connector and channels control connected to the reader;
- controller based on Microchip chip, controlling the reader and MUX with RS232 connection to the reader; contains relays, RS232, Ethernet and GPRS connections to the external world;
- 2 antennas 13.56 MHz main frequency, connected to the MUX outputs 1 and 2;
- GPRS module connects to controller with antenna connector at the StockBox panel connectors. The GPRS module, manufactured by Telit Communications S.p.A., is modular approved under FCC ID:RI7GE864. The EUT part number LT-SB-G001 containing the GPRS module was tested as the whole model. The EUT part number which does not include the GPRS module is LT-SB-001.

The system is powered from the mains via 12 V/0.5A power supply adaptor, manufactured by Shenzhen FUJIA Appliance, model FJ-SW 1201000E.

6.2 Ports and lines

Port type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length, m
Power	AC power	AC mains	AC/DC adaptor	1	NA	NA
Power	DC power	AC/DC adaptor	EUT	1	Unshielded	2
Signal	RS-232	PC	EUT	1	Shielded	3
Signal	LAN	Switch Ethernet	EUT	1	FTP	10
Signal	LAN	Switch Ethernet	PC	1	FTP	2
RF	Antenna	Antenna	EUT	2	Shielded	3

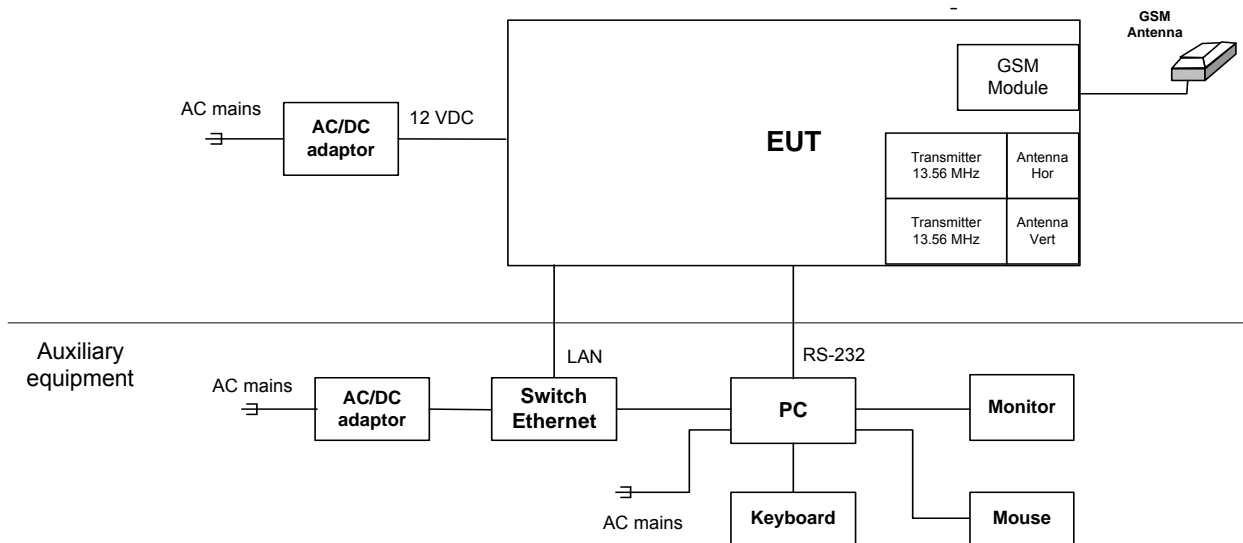
6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
PC	NA	NA	NA
Monitor	ViewSonic	P775	KP73701102
Keyboard	Compaq	269513-BB6	B17520R39IQA Q5
Mouse	Microsoft	X08-70400	4240747-4
Switch Ethernet	TP-LINK	TLSF1005D	11184103784
AC/DC adapter	TP-LINK	TO90060-2C1	NA

6.4 Operating frequencies

Source	Frequency, MHz		
Tx	13.56	800	1800
Clock	16	25	

6.5 Test configuration



6.6 Transmitter characteristics

Type of equipment				
<input type="checkbox"/> Stand-alone (Equipment with or without its own control provisions)				
<input checked="" type="checkbox"/> Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
<input type="checkbox"/> Plug-in card (Equipment intended for a variety of host systems)				
Intended use		Condition of use		
<input type="checkbox"/> fixed		Always at a distance more than 2 m from all people		
<input checked="" type="checkbox"/> mobile		Always at a distance more than 20 cm from all people		
<input type="checkbox"/> portable		May operate at a distance closer than 20 cm to human body		
Assigned frequency ranges		13.553 – 13.567 MHz		
Operating frequencies		13.56 MHz		
Is transmitter output power variable?		<input checked="" type="checkbox"/> X	<input type="checkbox"/> No	
		<input type="checkbox"/> Yes	<input type="checkbox"/> continuous variable	
			<input type="checkbox"/> stepped variable with stepsize	dB
			<input type="checkbox"/> minimum RF power	dBm
			<input type="checkbox"/> maximum RF power	dBm
Antenna connection				
<input type="checkbox"/> unique coupling	<input type="checkbox"/> standard connector	<input checked="" type="checkbox"/> X	<input type="checkbox"/> integral	
		<input checked="" type="checkbox"/> X	<input type="checkbox"/> without temporary RF connector	
Type of modulation		AM		
Transmitter power source				
<input checked="" type="checkbox"/> X	AC mains	Nominal rated voltage	120 VAC via AC/DC adapter	
Common power source for transmitter and receiver		<input checked="" type="checkbox"/> X	<input type="checkbox"/> yes <input type="checkbox"/> No	

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):	10/25/2011		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

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

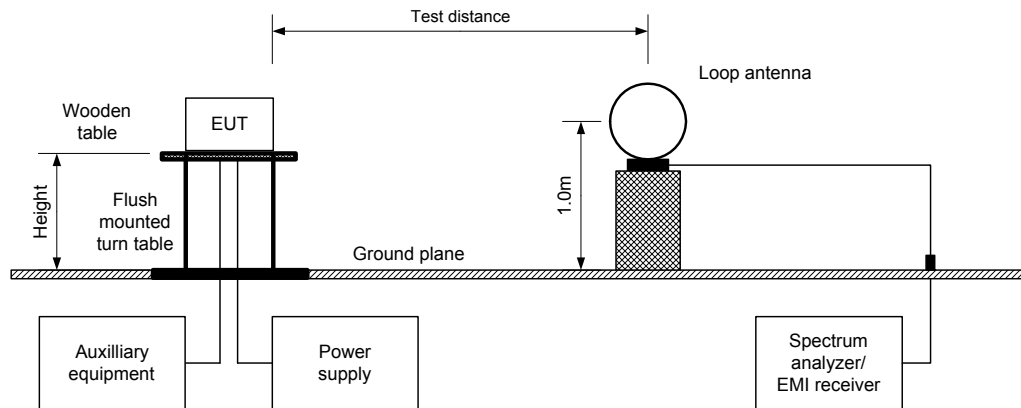
7.1.2.1 The EUT was set up as shown in Figure 7.1.1 energized and the performance check was conducted.

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.

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):		10/25/2011	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Figure 7.1.1 Setup for in band radiated emission measurements



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):	10/25/2011		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Table 7.1.2 In band radiated emission test results

TEST DISTANCE: 3 m
EUT POSITION: Typical
MODULATION: Unmodulated
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												
13.56	66.8	66.4	124	-57.6	V	23	Pass					
115%Unom												
13.56	66.7	66.3	124	-57.7	V	25						
85%Unom												
13.56	66.6	66.3	124	-57.7	V	21						

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

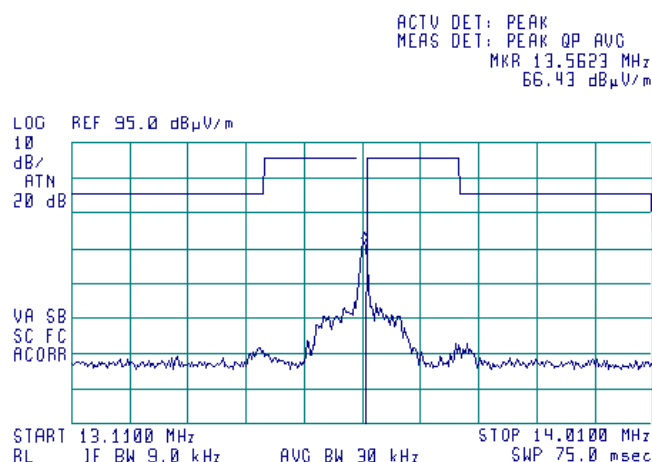
HL 0521	HL 1915	HL 2871	HL 3123				
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Full description is given in Appendix A.

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):		10/25/2011	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

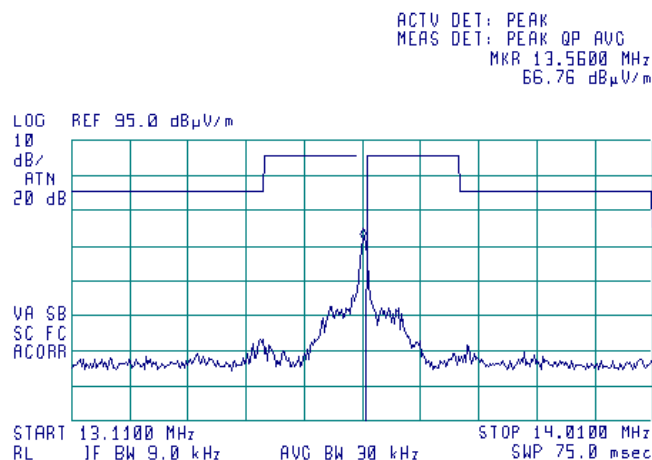
Plot 7.1.1 Fundamental emission test result

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



Plot 7.1.2 Fundamental emission test result

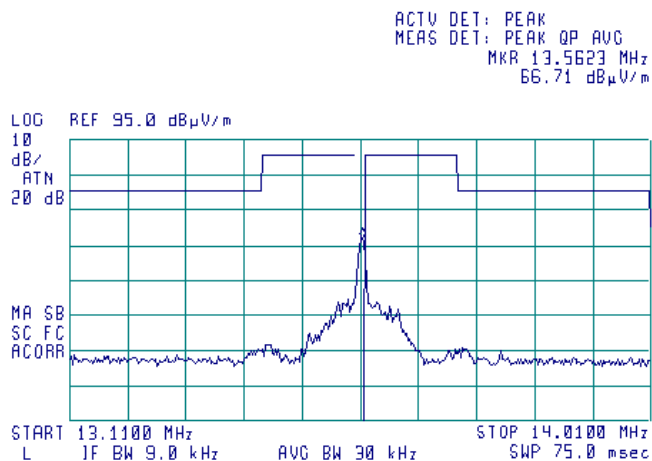
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
DETECTOR: Peak hold
INPUT VOLTAGE: 115%Unom



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):		10/25/2011	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Plot 7.1.3 Fundamental emission test result

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



Test specification:		Sections 15.225(d), Out of band radiated emissions	
Test procedure:		ANSI C63.4, Sections 5.3 and 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date(s):	10/25/2011		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
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:

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

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°, 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.

Test specification:		Sections 15.225(d), Out of band radiated emissions	
Test procedure:		ANSI C63.4, Sections 5.3 and 13.1.4	
Test mode:	Compliance	Verdict: PASS	
Date(s):	10/25/2011		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Figure 7.2.1 Radiated emissions below 30 MHz test set up

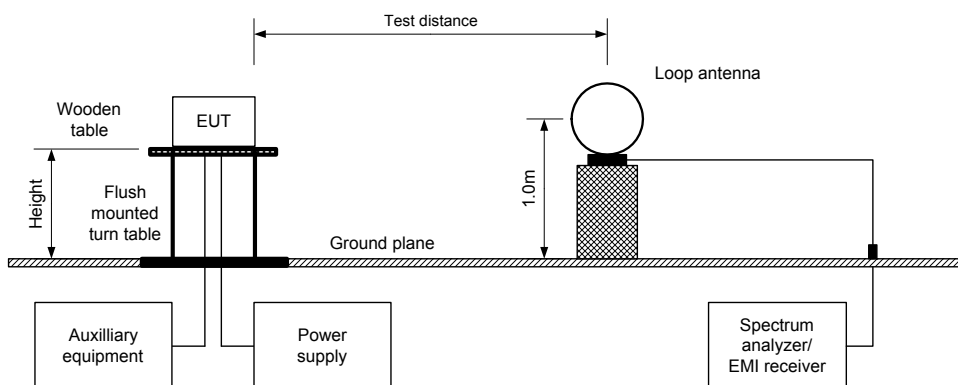
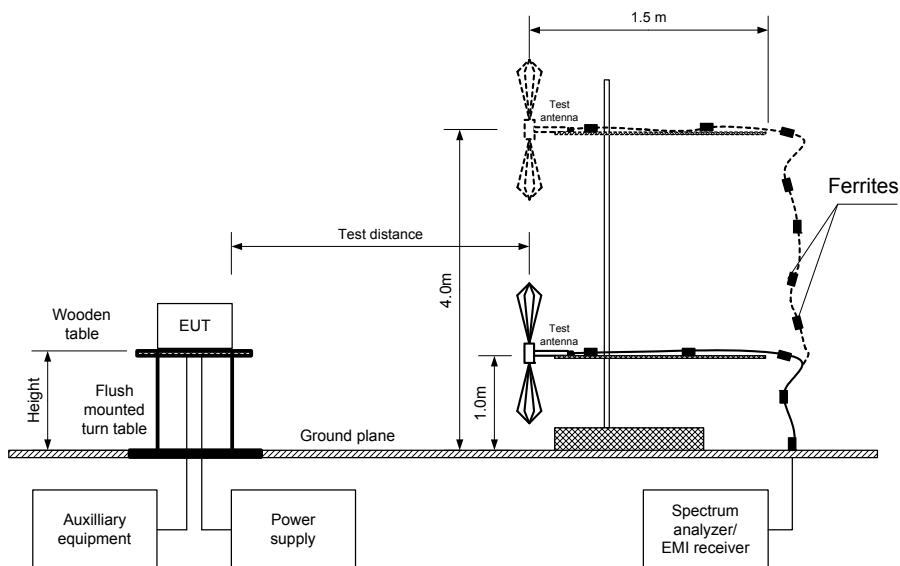


Figure 7.2.2 Radiated emissions above 30 MHz test set up



Test specification:		Sections 15.225(d), Out of band radiated emissions	
Test procedure:		ANSI C63.4, Sections 5.3 and 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date(s):	10/25/2011		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Table 7.2.2 Out of band radiated emissions test results

TEST DISTANCE: 3 m
 EUT POSITION: Typical
 MODULATION: AM
 MODULATING SIGNAL: ID code
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 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*				
81.36	41.13	39.31	40.5	-1.19	V	1.2	360	Pass
94.92	40.69	38.69	43.5	-4.81	V	1	220	
108.48	38.09	35.51	43.5	-7.99	V	1	87	
122.04	41.65	38.62	43.5	-4.88	V	1	360	
135.59	40.00	38.50	43.5	-5.00	V	1.4	145	
189.82	31.00	29.40	43.5	-14.10	V	1.4	362	
399.99	45.35	44.31	46.00	-1.69	V	1.4	195	

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

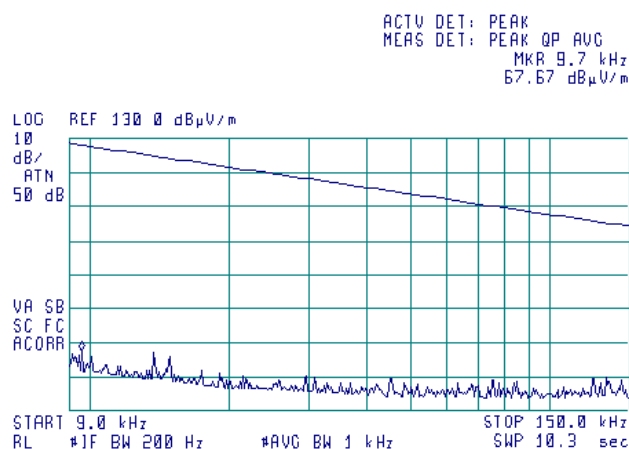
HL 0446	HL 0521	HL 0604	HL 2871	HL 3623			
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Full description is given in Appendix A.

Test specification:		Sections 15.225(d), Out of band radiated emissions	
Test procedure:		ANSI C63.4, Sections 5.3 and 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		10/25/2011	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

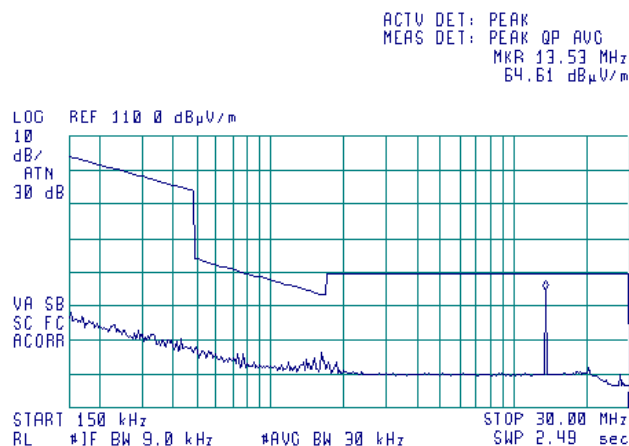
Plot 7.2.1 Radiated emission measurements from 9 to 150 kHz

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



Plot 7.2.2 Radiated emission measurements from 0.15 to 30 MHz

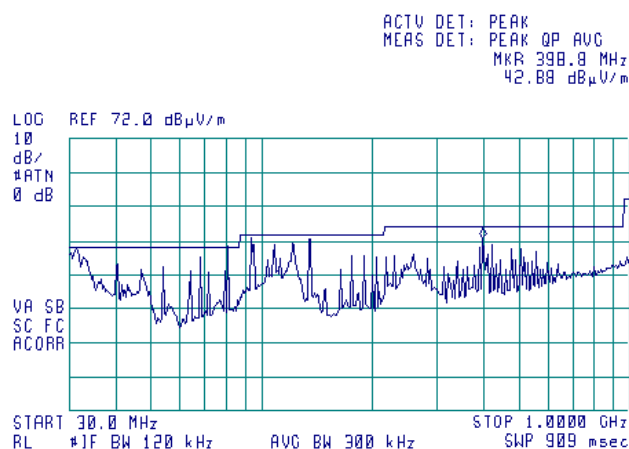
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak hold



Test specification:		Sections 15.225(d), Out of band radiated emissions	
Test procedure:		ANSI C63.4, Sections 5.3 and 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		10/25/2011	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

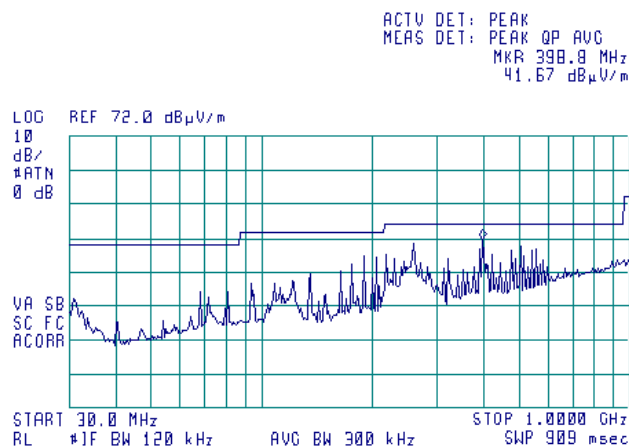
Plot 7.2.3 Radiated emission measurements from 30 to 1000 MHz

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



Plot 7.2.4 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), Frequency stability		
Test procedure:	ANSI C63.4, Section 13.1.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10/25/2011		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
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.

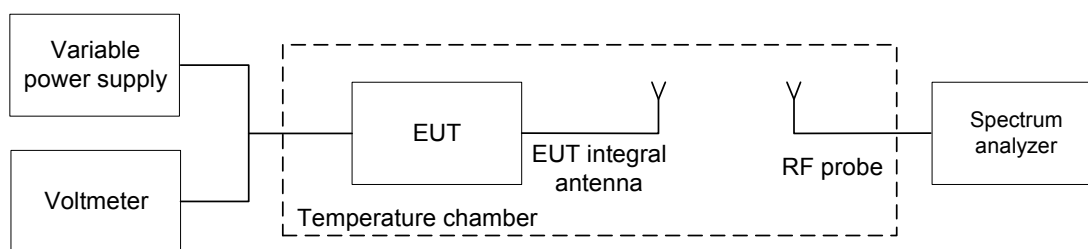
Table 7.3.1 Frequency stability limits

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), Frequency stability		
Test procedure:	ANSI C63.4, Section 13.1.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10/25/2011		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 42 %	Power Supply: 120 VAC
Remarks:			

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY: 13.560 MHz
 NOMINAL POWER VOLTAGE: 120 VAC
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Counter
 RESOLUTION BANDWIDTH: 9KHz
 VIDEO BANDWIDTH: 30KHz
 MODULATION: Unmodulated

Temperature, °C	Voltage, V	Frequency, MHz				Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	2 nd min	5 th min	10 th min	Positive	Negative			
-20	nominal	13.558875	13.558875	13.558875	13.559000	125.00	0.00	±1356	1231.00	Pass
20	nominal+15%	13.558875	13.558875	13.558875	13.558875	0.00	0.00		1356.00	
20	nominal	13.558875	13.558875	13.558875	13.558875*	NA	NA		NA	
20	nominal -15%	13.558875	13.558750	13.558875	13.558875	0.00	125.00		1231.00	
50	nominal	13.558875	13.558875	13.558875	13.558875	0.00	0.00		1356.00	

* - Reference frequency

Reference numbers of test equipment used

HL 2952	HL 3001	HL 3286					
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Full description is given in Appendix A.

Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict: PASS	
Date(s):	11/1/2011		
Temperature: 23 °C	Air Pressure: 1018 hPa	Relative Humidity: 40 %	Power Supply: 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

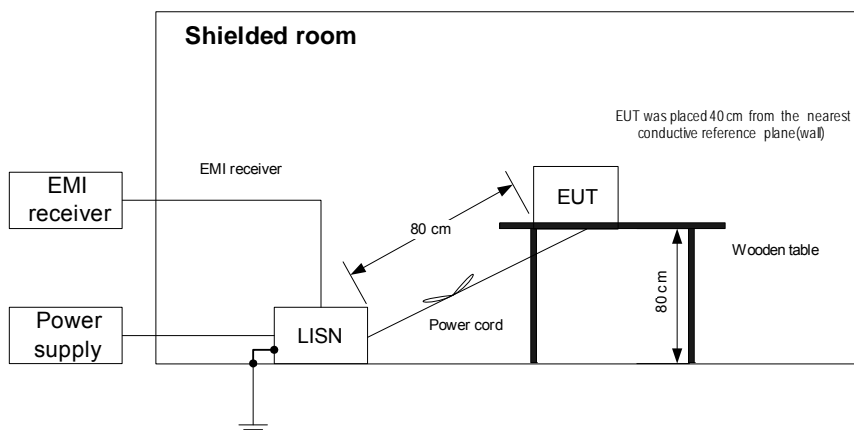
7.4.2.1 The EUT was set up as shown in Figure 7.4.1 and associated photographs, energized and the performance check was conducted.

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, table-top equipment



Test specification:		Section 15.207(a), Conducted emission	
Test procedure:		ANSI C63.4, Section 13.1.3	
Test mode:		Compliance	Verdict: PASS
Date(s):		11/1/2011	
Temperature: 23 °C	Air Pressure: 1018 hPa	Relative Humidity: 40 %	Power Supply: 120 VAC
Remarks:			

Table 7.4.2 Conducted emission test results

LINE: AC mains
 EUT OPERATING MODE: Transmit
 EUT SET UP: TABLE-TOP
 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*		
0.178710	52.97	50.82	64.60	-13.78	36.76	54.60	-17.84	L1	Pass
0.575575	48.59	45.83	56.00	-10.17	31.61	46.00	-14.39		
1.057170	49.70	46.63	56.00	-9.37	33.20	46.00	-12.80		
1.145625	52.37	49.19	56.00	-6.81	36.29	46.00	-9.71		
1.204000	55.40	52.90	56.00	-3.10	39.70	46.00	-6.30		
11.715785	55.08	49.41	60.00	-10.59	37.57	50.00	-12.43		
0.177625	50.52	47.99	64.65	-16.66	30.35	54.65	-24.30	L2	Pass
0.574825	50.94	48.42	56.00	-7.58	33.64	46.00	-12.36		
0.621900	46.46	44.32	56.00	-11.68	28.02	46.00	-17.98		
0.994575	48.59	46.36	56.00	-9.64	34.32	46.00	-11.68		
1.146165	54.40	52.40	56.00	-3.60	40.00	46.00	-6.00		
11.889755	56.31	50.32	60.00	-9.68	35.86	50.00	-14.14		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

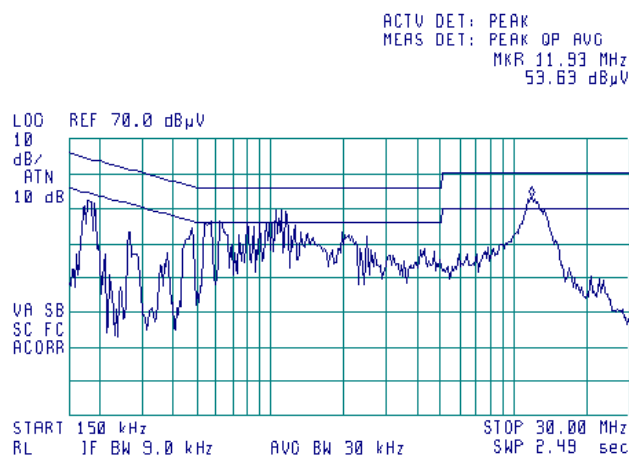
HL 0787	HL 1425	HL 1513	HL 2888	HL 3612			
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Full description is given in Appendix A.

Test specification:		Section 15.207(a), Conducted emission	
Test procedure:		ANSI C63.4, Section 13.1.3	
Test mode:		Compliance	Verdict: PASS
Date(s):		11/1/2011	
Temperature: 23 °C	Air Pressure: 1018 hPa	Relative Humidity: 40 %	Power Supply: 120 VAC
Remarks:			

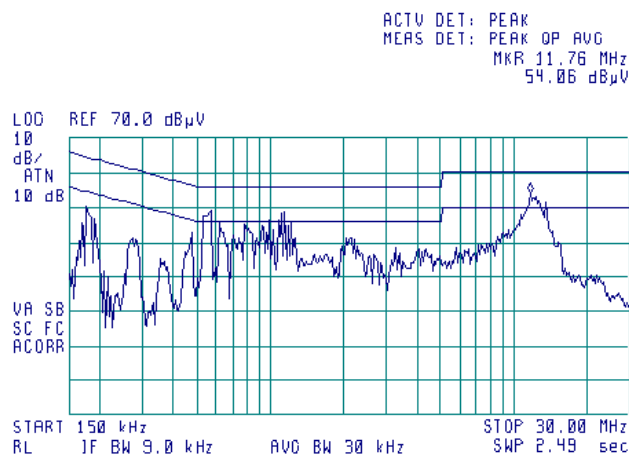
Plot 7.4.1 Conducted emission measurements

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



Plot 7.4.2 Conducted emission measurements

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



Test specification:		Section 15.215(c), Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		11/1/2011	
Temperature: 24 °C	Air Pressure: 1018 hPa	Relative Humidity: 36 %	Power Supply: 120 VAC
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 the 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), Occupied bandwidth			
Test procedure:		ANSI C63.4, Section 13.1.7			
Test mode:		Compliance		Verdict: PASS	
Date(s):		11/1/2011			
Temperature: 24 °C		Air Pressure: 1018 hPa		Relative Humidity: 36 %	Power Supply: 120 VAC
Remarks:					

Table 7.5.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND: 13.11 – 14.01 MHz
 DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 10 kHz
 VIDEO BANDWIDTH: 30 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 20 dBc
 MODULATION: AM
 MODULATING SIGNAL: enable

Band edge	Cross point frequency, MHz	Frequency drift, kHz		Modulation band edge, MHz	Assigned band edge, MHz	Verdict
		Negative	Positive			
Low	13.5025	0.125	NA	13.502375	13.11	Pass
High	13.6100	NA	0.125	13.610125	14.01	Pass

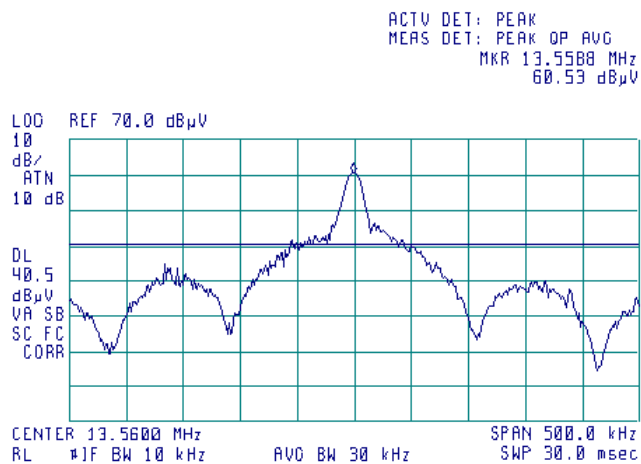
Reference numbers of test equipment used

HL 1425	HL 3618							
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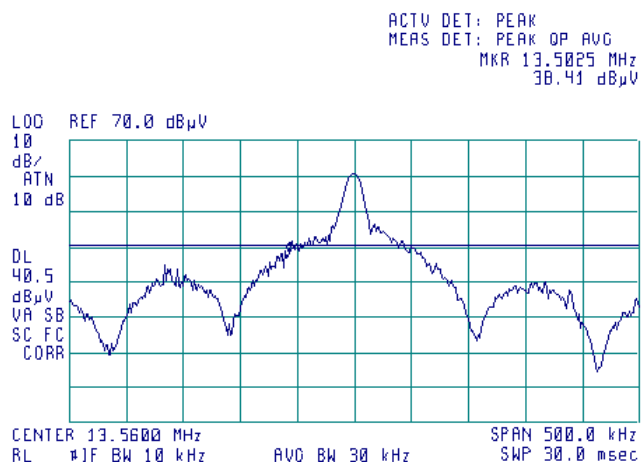
Full description is given in Appendix A.

Test specification:		Section 15.215(c), Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		11/1/2011	
Temperature: 24 °C	Air Pressure: 1018 hPa	Relative Humidity: 36 %	Power Supply: 120 VAC
Remarks:			

Plot 7.5.1 Occupied bandwidth test result reference

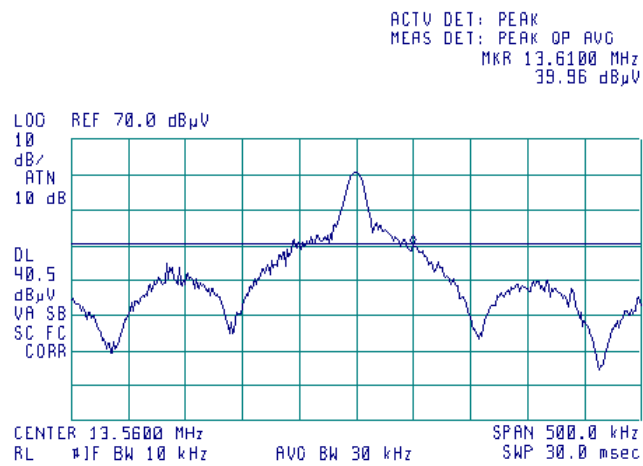


Plot 7.5.2 Occupied bandwidth test result low frequency



Test specification:		Section 15.215(c), Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		11/1/2011	
Temperature: 24 °C	Air Pressure: 1018 hPa	Relative Humidity: 36 %	Power Supply: 120 VAC
Remarks:			

Plot 7.5.3 Occupied bandwidth test result high frequency



Test specification:		Section 15.203, Antenna requirement	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		11/9/2011	
Temperature: 23°C	Air Pressure: 1012 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
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	

Test specification:		Section 15.107 Class B, AC power lines conducted emissions	
Test procedure:		ANSI C63.4, Section 11.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		10/30/2011	
Temperature: 22 °C	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

8 Emissions tests according to FCC 47CFR part 15 subpart B requirements

8.1 Conducted emissions

8.1.1 General

This test was performed to measure the common mode conducted emissions at the EUT power port. The 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

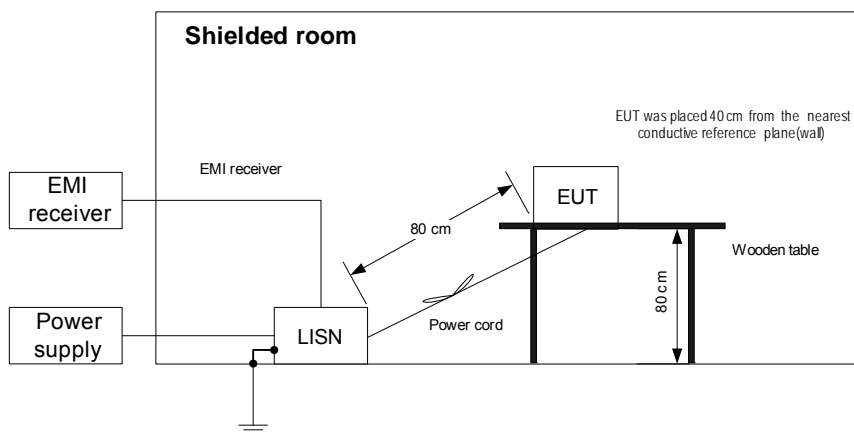
8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and the EUT performance was checked.

8.1.2.2 The measurements were performed at the EUT power terminals with the LISN connected to the EMI receiver in the frequency range referred to in Table 8.1.2. The unused coaxial connector of the LISN was terminated with 50 Ohm.

8.1.2.3 The position of the EUT cables was varied to find the highest emission.

8.1.2.4 The worst test results with respect to the limits were recorded in Table 8.1.2 and shown in the associated plots.

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



Test specification:		Section 15.107 Class B, AC power lines conducted emissions			
Test procedure:		ANSI C63.4, Section 11.5			
Test mode:		Compliance		Verdict: PASS	
Date(s):		10/30/2011			
Temperature: 22 °C		Air Pressure: 1015 hPa		Relative Humidity: 48 %	
Remarks:				Power Supply: 120 VAC	

Table 8.1.2 Conducted emission test results

LINE: AC mains
 EUT SET UP: TABLE-TOP
 LIMIT: Class B
 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*		
0.178710	52.97	50.82	64.60	-13.78	36.76	54.60	-17.84	L1	Pass
0.575575	48.59	45.83	56.00	-10.17	31.61	46.00	-14.39		
1.057170	49.70	46.63	56.00	-9.37	33.20	46.00	-12.80		
1.145625	52.37	49.19	56.00	-6.81	36.29	46.00	-9.71		
1.204000	55.40	52.90	56.00	-3.10	39.70	46.00	-6.30		
11.715785	55.08	49.41	60.00	-10.59	37.57	50.00	-12.43		
0.177625	50.52	47.99	64.65	-16.66	30.35	54.65	-24.30	L2	Pass
0.574825	50.94	48.42	56.00	-7.58	33.64	46.00	-12.36		
0.621900	46.46	44.32	56.00	-11.68	28.02	46.00	-17.98		
0.994575	48.59	46.36	56.00	-9.64	34.32	46.00	-11.68		
1.146165	54.40	52.40	56.00	-3.60	40.00	46.00	-6.00		
11.889755	56.31	50.32	60.00	-9.68	35.86	50.00	-14.14		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

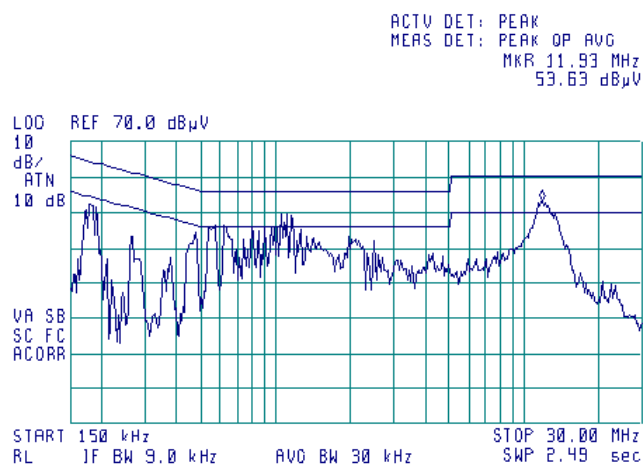
HL 0787	HL 1425	HL 1513	HL 2888	HL 3612			
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Full description is given in Appendix A.

Test specification:		Section 15.107 Class B, AC power lines conducted emissions	
Test procedure:		ANSI C63.4, Section 11.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		10/30/2011	
Temperature: 22 °C	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

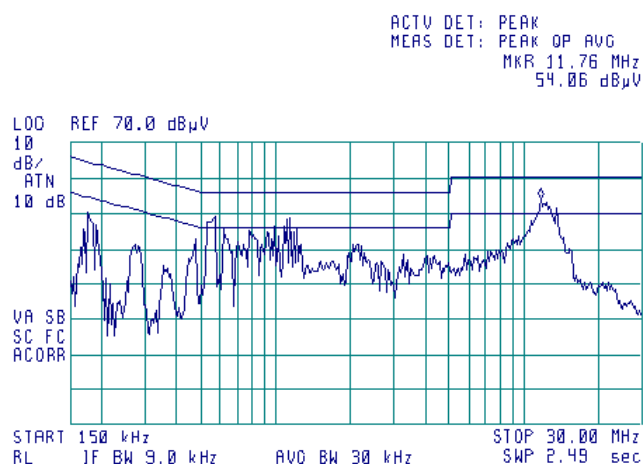
Plot 8.1.1 Conducted emission measurements

LINE: L1
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.2 Conducted emission measurements

LINE: L2
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:		Section 15.109 Class B, Radiated emissions	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		10/24/2011	
Temperature: 22 °C	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. The 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 a test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $\text{Lim}_{S_2} = \text{Lim}_{S_1} + 20 \log (S_1/S_2)$, where S_1 and S_2 – the standard defined and the test distance respectively in meters.

8.2.2 Test procedure for measurements in semi-anechoic chamber

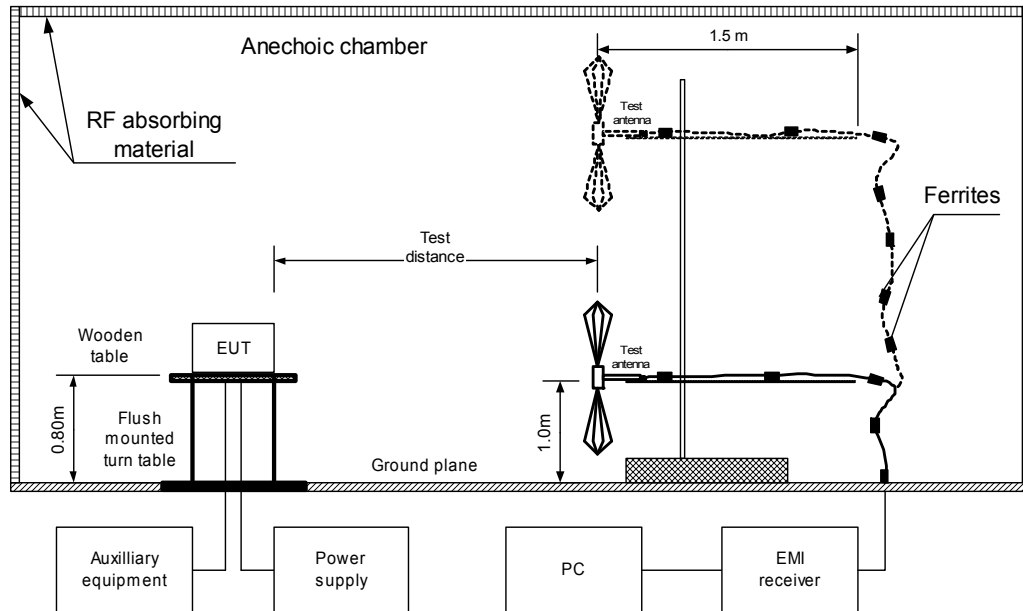
8.2.2.1 The EUT was set up as shown in Figure 8.2.1, energized and the EUT performance was checked.

8.2.2.2 The measurements were performed in the anechoic chamber at 3 m test distance. The specified frequency range was investigated with the antenna connected to the EMI receiver. To find the highest emission the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal polarizations. The EUT cables position was varied to maximize emission.

8.2.2.3 The worst test results with respect to the limits were recorded in Table 8.2.2 and shown in the associated plots.

Test specification:		Section 15.109 Class B, Radiated emissions	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		10/24/2011	
Temperature: 22 °C	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber, table-top EUT



Test specification:		Section 15.109 Class B, Radiated emissions	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		10/24/2011	
Temperature: 22 °C	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

Table 8.2.2 Radiated emission test results

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

Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
81.362900	41.13	39.31	40.00	-0.69	V	1.2	0	Pass
94.918650	40.69	38.69	43.50	-4.81	V	1.0	220	
108.479000	38.09	35.51	43.50	-7.99	V	1.0	87	
122.044000	41.65	38.62	43.50	-4.88	V	1.0	0	
135.593000	40.00	38.50	43.50	-5.00	V	1.35	185	
189.832375	31.00	29.40	43.50	-14.10	V	1.0	230	
399.992950	45.35	44.31	46.00	-1.69	V	1.4	195	

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

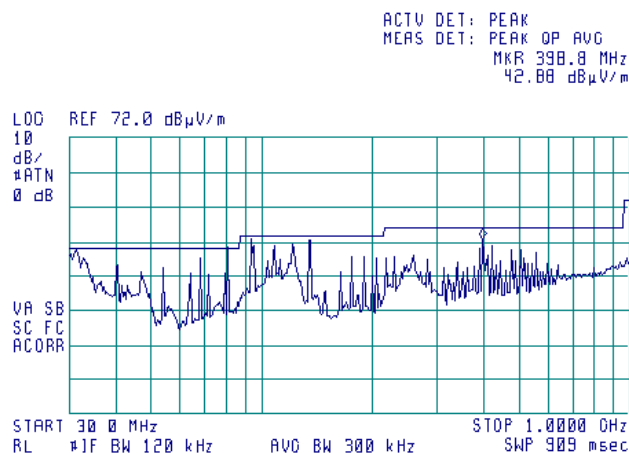
HL 0521	HL 0604	HL 2871	HL 3622				
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Full description is given in Appendix A.

Test specification:		Section 15.109 Class B, Radiated emissions	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		10/24/2011	
Temperature: 22 °C	Air Pressure: 1015 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

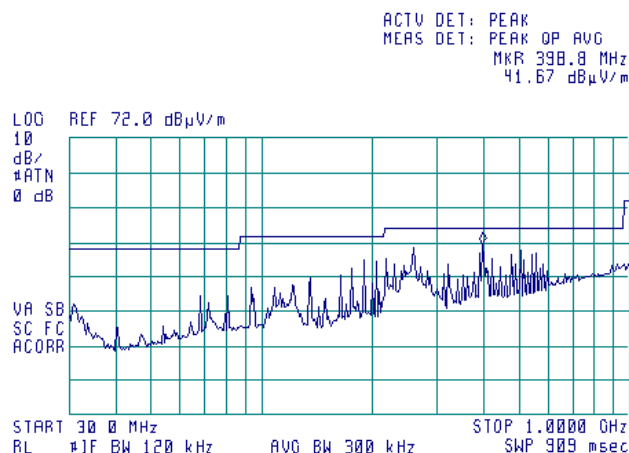
Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



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

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	03-Jul-11	03-Jul-12
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	29-Aug-11	29-Sep-12
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	11-Jan-11	11-Jan-12
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A018 77	18-Oct-11	18-Oct-12
1425	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427	Agilent Technologies	8542E	3710A002 22, 3705A002 04	24-Aug-11	24-Aug-12
1513	Cable RF, 8 m, BNC/BNC	Belden	M17/167 MIL-C-17	1513	01-Sep-11	01-Sep-12
1915	Antenna, Loop, Active Receiving, 10 kHz - 30 MHz	EMC Test Systems	6507	1457	03-Jul-11	03-Jul-12
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	20-Sep-11	20-Sep-12
2888	LISN Two-line V-Network 50 Ohm / 50 uH + 5 Ohm, 16A, MIL STD 461E, CISPR 16-1	Rolf Heine	NNB-2/16Z	02/10018	10-Jul-11	10-Jul-12
2952	Cable, RF, 18 GHz, 1.2 m, SMA-SMA	Gore	10020014	NA	03-Oct-11	03-Oct-12
3001	EMC Analyzer, 9 kHz to 3 GHz	Agilent Technologies	E7402A	US394401 80	26-Dec-10	26-Dec-11
3123	Microwave Cable Assembly, 18 GHz, 5.0 m, SMA - SMA	Huber-Suhner	198-9155-00	3123	30-Dec-10	30-Dec-11
3286	Temperature Chamber, (-50 to +170) °C	Thermotron	EL-8-CH-1-1-CO2	21-9048	11-Sep-11	11-Sep-12
3612	Cable RF, 17.5 m, N type-N type	Teldor	RG-214/U	NA	01-Dec-10	01-Dec-11
3618	Cable RF, 2.5 m, N type-N type, DC-6.5 GHz	Alpha Wire	RG-214/U	NA	19-May-11	19-May-12
3622	Cable RF, 6.0 m, N type-N type, DC-6.5 GHz	Alpha Wire	RG 214/U	NA	30-Dec-10	30-Dec-11
3623	Cable RF, 6.0 m, N type-N type, DC-6.5 GHz	Belden	MIL C-17	NA	30-Dec-10	30-Dec-11

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 10 m measuring distance Horizontal polarization Vertical polarization	Biconilog antenna: ± 5.0 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.1 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 5.5 dB Biconical antenna: ± 5.5 dB Log periodic antenna: ± 5.6 dB Double ridged horn antenna: ± 5.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization 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, safety, environmental and telecommunication testing facility.

Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file numbers IC 2186A-1 for OATS, IC 2186A-2 for anechoic chamber, IC 2186A-3 for full-anechoic chamber for RE measurements above 1 GHz), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01). The FCC Designation Number is US1003.

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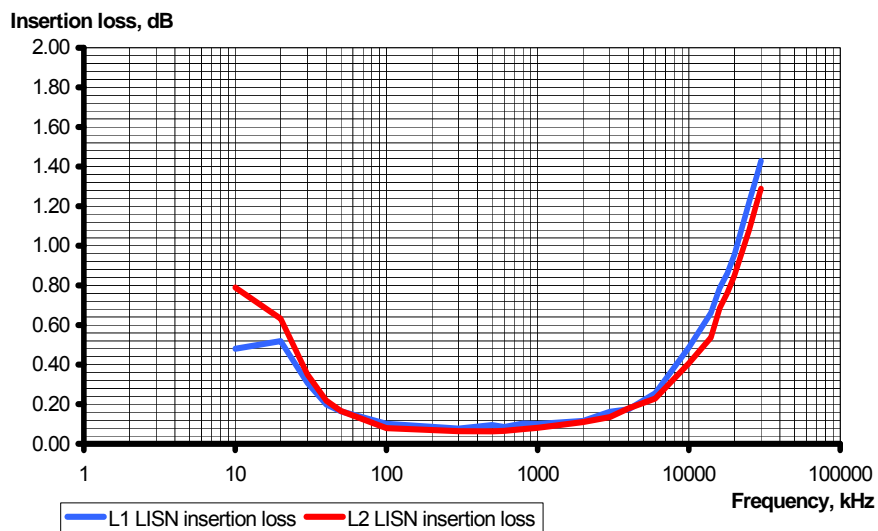
12 APPENDIX D Specification references

47CFR part 15: 2010	Radio Frequency Devices.
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

13 APPENDIX E Test equipment correction factors

Correction factor Line impedance stabilization network Model NNB-2/16Z, Rolf Heine, HL 2888

Frequency, kHz	Insertion loss, dB		Measurement Uncertainty, dB
	L1	N	
10	0.48	0.79	±0.6
20	0.52	0.63	
30	0.31	0.35	
40	0.20	0.22	
50	0.16	0.17	
100	0.10	0.08	
300	0.08	0.06	
500	0.10	0.06	
600	0.09	0.07	
800	0.10	0.07	
1000	0.10	0.08	
2000	0.12	0.11	
3000	0.16	0.14	
4000	0.17	0.18	
6000	0.26	0.23	
10000	0.49	0.41	
14000	0.66	0.54	
16000	0.79	0.69	
18000	0.86	0.76	
20000	0.96	0.85	
25000	1.22	1.08	
28000	1.35	1.21	
30000	1.43	1.29	



**Antenna factor
Active loop antenna
Model 6502, S/N 2857, HL 0446**

Frequency, MHz	Magnetic antenna factor, dB	Electric antenna factor, dB
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.8
0.750	-41.9	9.7
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.2
4.000	-41.4	10.1
5.000	-41.5	10.1
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

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

Antenna factor
Active loop antenna
EMC Test Systems
Model 6507, S/N 1457, HL 1915

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

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

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

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

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

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

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

Cable loss
Cable coaxial, Gore, 18 GHz, 1.2 m, SMA-SMA, S/N 10020014
HL 2952

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.03	5750	0.97	12000	1.50
30	0.05	6000	1.01	12250	1.45
100	0.11	6250	1.03	12500	1.48
250	0.19	6500	1.06	12750	1.57
500	0.26	6750	1.08	13000	1.51
750	0.32	7000	1.10	13250	1.64
1000	0.38	7250	1.13	13500	1.60
1250	0.43	7500	1.13	13750	1.63
1500	0.47	7750	1.21	14000	1.59
1750	0.53	8000	1.20	14250	1.66
2000	0.55	8250	1.24	14500	1.60
2250	0.59	8500	1.29	14750	1.65
2500	0.63	8750	1.23	15000	1.72
2750	0.66	9000	1.27	15250	1.68
3000	0.69	9250	1.27	15500	1.73
3250	0.72	9500	1.29	15750	1.70
3500	0.75	9750	1.30	16000	1.82
3750	0.78	10000	1.38	16250	1.79
4000	0.82	10250	1.44	16500	1.81
4250	0.84	10500	1.47	16750	1.91
4500	0.86	10750	1.45	17000	1.92
4750	0.90	11000	1.50	17250	1.98
5000	0.91	11250	1.46	17500	2.05
5250	0.94	11500	1.47	17750	2.04
5500	0.96	11750	1.44	18000	2.05

Cable loss
Microwave Cable Assembly, 18 GHz, 6.4 m, SMA – SMA, Huber-Suhner, model 198-9155-00
HL 3123

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.11	3600	1.97	7400	3.12	11200	3.90	15100	4.74
30	0.17	3700	1.97	7500	3.13	11300	3.93	15200	4.70
50	0.25	3800	2.03	7600	3.16	11400	3.88	15300	4.73
100	0.32	3900	2.04	7700	3.18	11500	3.87	15400	4.78
200	0.46	4000	2.10	7800	3.20	11600	3.90	15500	4.75
300	0.58	4100	1.97	7900	3.23	11700	3.86	15600	4.76
400	0.65	4200	1.97	8000	3.25	11800	3.88	15700	4.75
500	0.74	4300	2.03	8100	3.26	11900	3.86	15800	4.78
600	0.82	4400	2.04	8200	3.28	12000	3.89	15900	4.79
700	0.89	4500	2.10	8300	3.31	12100	3.94	16000	4.73
800	0.95	4600	1.97	8400	3.31	12200	3.92	16100	4.78
900	1.01	4700	1.97	8500	3.32	12300	3.96	16200	4.84
1000	1.07	4800	2.03	8600	3.34	12400	4.01	16300	4.90
1100	1.11	4900	2.04	8700	3.35	12500	4.07	16400	4.87
1200	1.17	5000	2.10	8800	3.37	12600	4.08	16500	4.90
1300	1.22	5100	2.53	8900	3.39	12700	4.17	16600	4.98
1400	1.27	5200	2.55	9000	3.42	12800	4.26	16700	5.05
1500	1.29	5300	2.60	9100	3.43	12900	4.16	16800	5.04
1600	1.35	5400	2.61	9200	3.51	13000	4.21	16900	5.02
1700	1.40	5500	2.64	9300	3.52	13100	4.24	17000	5.09
1800	1.44	5600	2.70	9400	3.54	13200	4.27	17100	5.07
1900	1.51	5700	2.67	9500	3.63	13300	4.31	17200	5.10
2000	1.49	5800	2.71	9600	3.61	13400	4.33	17300	5.13
2100	1.55	5900	2.74	9700	3.71	13500	4.25	17400	5.23
2200	1.58	6000	2.80	9800	3.66	13600	4.27	17500	5.21
2300	1.62	6100	2.79	9900	3.77	13700	4.33	17600	5.22
2400	1.72	6200	2.81	10000	3.75	13800	4.33	17700	5.36
2500	1.76	6300	2.83	10100	3.77	13900	4.31	17800	5.35
2600	1.78	6400	2.86	10200	3.80	14000	4.30	17900	5.45
2700	1.80	6500	2.88	10300	3.79	14100	4.30	18000	5.43
2800	1.86	6600	2.90	10400	3.87	14200	4.31		
2900	1.90	6700	2.92	10500	3.83	14300	4.37		
3000	1.90	6800	2.98	10600	3.88	14400	4.35		
3100	1.97	6900	2.98	10700	3.86	14600	4.53		
3200	1.97	7000	3.00	10800	3.87	14700	4.50		
3300	2.03	7100	3.02	10900	3.90	14800	4.62		
3400	2.04	7200	3.04	11000	3.84	14900	4.65		
3500	2.10	7300	3.06	11100	3.88	15000	4.79		

Cable loss
Cable coaxial, RG-214/U, N type-N type, 17 m
Teldor, HL 3612

Frequency, MHz	Cable loss, dB
0.1	0.05
0.5	0.07
1	0.10
3	0.22
5	0.29
10	0.39
30	0.68
50	0.90
100	1.27
150	1.58
200	1.80
250	2.12
300	2.36
350	2.60
400	2.82
450	2.99
500	3.23
550	3.40
600	3.56
650	3.71
700	3.90
750	4.04
800	4.23
850	4.39
900	4.55
950	4.65
1000	4.79

Cable loss
Cable coaxial, RG-214/U, N type-N type, 6 m
Alpha Wire, HL 3622

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.13	2100	2.95	4400	4.99
30	0.24	2200	2.99	4500	5.00
50	0.32	2300	3.11	4600	5.17
100	0.47	2400	3.16	4700	5.18
200	0.70	2500	3.31	4800	5.33
300	0.88	2600	3.36	4900	5.34
400	1.05	2700	3.46	5000	5.50
500	1.21	2800	3.52	5100	5.56
600	1.36	2900	3.65	5200	5.76
700	1.49	3000	3.70	5300	5.76
800	1.63	3100	3.82	5400	5.85
900	1.72	3200	3.88	5500	5.88
1000	1.84	3300	3.99	5600	5.96
1100	1.96	3400	4.08	5700	6.02
1200	2.06	3500	4.19	5800	6.06
1300	2.15	3600	4.28	5900	6.14
1400	2.28	3700	4.42	6000	6.17
1500	2.35	3800	4.40	6100	6.28
1600	2.43	3900	4.51	6200	6.36
1700	2.57	4000	4.62	6300	6.47
1800	2.62	4100	4.70	6400	6.51
1900	2.75	4200	4.78	6500	6.65
2000	2.80	4300	4.83		

Cable loss
Cable coaxial, MIL C-17, N type-N type, 6 m
Belden, HL 3623

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.13	2600	4.38	5400	7.76
30	0.25	2700	4.53	5500	7.79
50	0.33	2800	4.64	5600	7.88
100	0.49	2900	4.79	5700	7.93
200	0.76	3000	4.93	5800	8.05
300	0.97	3100	5.02	5900	8.03
400	1.18	3200	5.18	6000	8.07
500	1.38	3300	5.27	6100	8.14
600	1.54	3400	5.41	6200	8.21
700	1.71	3500	5.57	6300	8.28
800	1.88	3600	5.65	6400	8.35
900	2.04	3700	5.82	6500	8.43
1000	2.19	3800	5.89		
1100	2.38	3900	6.02		
1200	2.61	4000	6.15		
1300	2.63	4100	6.26		
1400	2.79	4200	6.37		
1500	2.90	4300	6.52		
1600	3.08	4400	6.63		
1700	3.21	4500	6.74		
1800	3.31	4600	6.86		
1900	3.47	4700	6.98		
2000	3.59	4800	7.09		
2100	3.74	4900	7.17		
2200	3.86	5000	7.30		
2300	3.98	5100	7.41		
2400	4.12	5200	7.59		
2500	4.24	5300	7.71		

14 APPENDIX F Abbreviations and acronyms

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

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