

TEST REPORT

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

FOR:

CartaSense Ltd.

Wireless Gateway Mobile

Model: Dashboard USG

FCC ID:2AAEP-DASBRDUSG01

IC:11128A-DASBRDUSG01

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1 Applicant information

Client name: CartaSense Ltd.
Address: 6 Ravnitzki St., Industrial Zone Segula, Petah-Tikva 49277, Israel
Telephone: +972 3922 8772
Fax: +972 (151) 548-046-947
E-mail: aviv.peled@cartasense.com
Contact name: Mr. Aviv Peled

2 Equipment under test attributes

Product name: Wireless Gateway Mobile
Product type: Transceiver
Product model: Dashboard USG
Serial number: 0360021301001492
Hardware version: 05
Software release: 4.83
Receipt date 3/14/2013

3 Manufacturer information

Manufacturer name: CartaSense Ltd.
Address: 6 Ravnitzki St., Industrial Zone Segula, Petah-Tikva 49277, Israel
Telephone: +972 3922 8772
Fax: +972 (151) 548-046-947
E-Mail: aviv.peled@cartasense.com
Contact name: Mr. Aviv Peled

4 Test details

Project ID: 24191
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 3/14/2013
Test completed: 3/17/2013
Test specification(s): FCC 47CFR part 15, subpart C, §15.231(e); subpart B;
RSS-210 issue 8 Annex 1, RSS-Gen issue 3; ICES-003 Issue 5:2012




5 Tests summary

Test	Status
Transmitter characteristics	
FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements	Pass
FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	Pass
FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	Pass
FCC Part 15, Section 207 / RSS-Gen, Section 7.2.4, Conducted emission	Pass
FCC Part 15, Section 203 / RSS-Gen, Section 7.1.2, Antenna requirements	Pass
Unintentional emissions	
FCC section 15.107 / ICES-003, Section 6.1 class B Conducted emission at AC power port	Pass
FCC 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.

This test report supersedes the previously issued test report identified by Doc ID:CARRAD_FCC.24191_rev2.

	Name and Title	Date	Signature
Tested by:	Mr. S.Samokha , test engineer	March 17, 2013	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	May 21, 2013	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	July 7, 2014	

6 EUT description

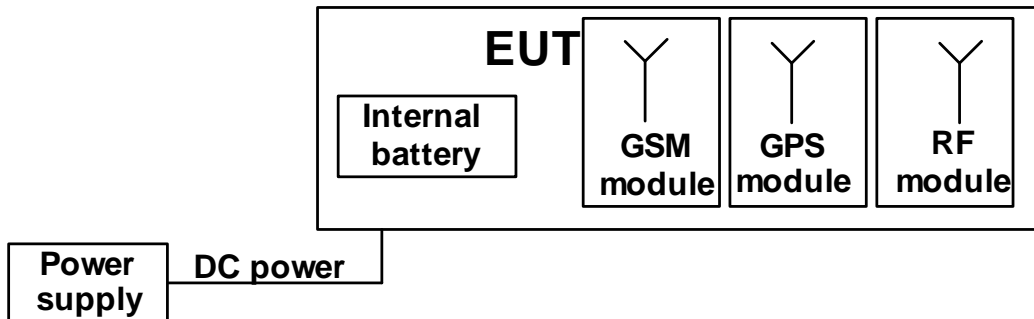
6.1 General information

The EUT, a wireless mobile gateway, acts as an access point for the wireless sensor network. It manages the wireless sensors, collects measurements from the sensors network and sends the measurements to a server over the internet (using wireless cellular connection). The EUT is equipped with a GPS and with a GSM module manufactured by Telit, type G24, FCC ID:RI7T56FV2. The EUT is powered from 12 VDC obtained from 12 VDC cigarette lighter power adapter. The EUT is equipped with 3.7V internal battery.

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

6.3 Test configuration



6.4 Changes made in EUT

To withstand the standard requirements the following change was implemented in the EUT: three capacitors $1\mu\text{F} \times 50\text{ V}$ were installed in parallel on the 12 VDC input as shown in Photograph 6.4.1. It is manufacturer responsibility to implement the changes in the production version of the EUT. In any case the test report applies to the tested item only.

Photograph 6.4.1 Changes made in the EUT





6.5 Transceiver characteristics

Type of equipment						
X	Stand-alone (Equipment with or without its own control provisions)					
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)					
	Plug-in card (Equipment intended for a variety of host systems)					
Operating frequencies		433.75 MHz, 433.90 MHz, 434.05 MHz, 434.20 MHz				
Maximum rated output power		Field strength at 3 m distance		49.75 dB(μ V/m)		
Is transmitter output power variable?		X	No			
		Yes	continuous variable			
			stepped variable with stepsize			
			dB			
			dBm			
		maximum RF power				
		dBm				
Antenna connection						
unique coupling	X	standard connector	X	integral	with temporary RF connector	
					X without temporary RF connector	
Antenna/s technical characteristics						
Type	Manufacturer		Model number		Antenna gain	
Omni-directional	RF Solutions		ANT-PUKDB		2 dBi	
Omni-directional	Panorama Antennas		MFXU-433		-1 dBi	
Transmitter aggregate data rate/s		19.2 kbps				
Type of modulation		GFSK				
Modulating test signal (baseband)		PRBS				
Maximum transmitter duty cycle		0.85 %				
Transmitter power source						
X	Battery	Nominal rated voltage	3.7 VDC	Battery type	Lithium	
X	DC	Nominal rated voltage	12 VDC via AC/DC adapter			
	AC mains	Nominal rated voltage		Frequency		
Common power source for transmitter and receiver			X	yes	no	

Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements	
Test procedure:		Supplier declaration	
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/14/2013		
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C and RSS-210 issue 8 Annex 1 requirements

7.1 Periodic operation requirements

7.1.1 General

The EUT was verified for compliance with periodic operation requirements listed below:

- Continuous transmissions such as voice, video and the radio control of toys are not permitted;
- Duration of each transmission shall not be greater than 1 second;
- Silent period between transmissions shall be at least 30 times the duration of the transmission;
- Silent period between transmissions shall be in no case less than 10 seconds.

The rationale for compliance with the above requirements was either test results or supplier declaration. The summary of results is provided in Table 7.1.1.

7.1.2 Test procedure for transmitter shut down test

7.1.2.1 The EUT was set up as shown in Figure 7.1.1.

7.1.2.2 The spectrum analyzer center frequency was adjusted to the EUT carrier, span set to zero and video triggered for transmission.

7.1.2.3 The transmitter was activated either manually or automatically. Once manually operated transmitter was activated, the switch was immediately released.

7.1.2.4 The transmission time was captured and shown in the associated plots. The test results were recorded in Table 7.1.2.

Figure 7.1.1 Setup for transmitter shut down test





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Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/14/2013		
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

Table 7.1.1 Periodic operation requirements

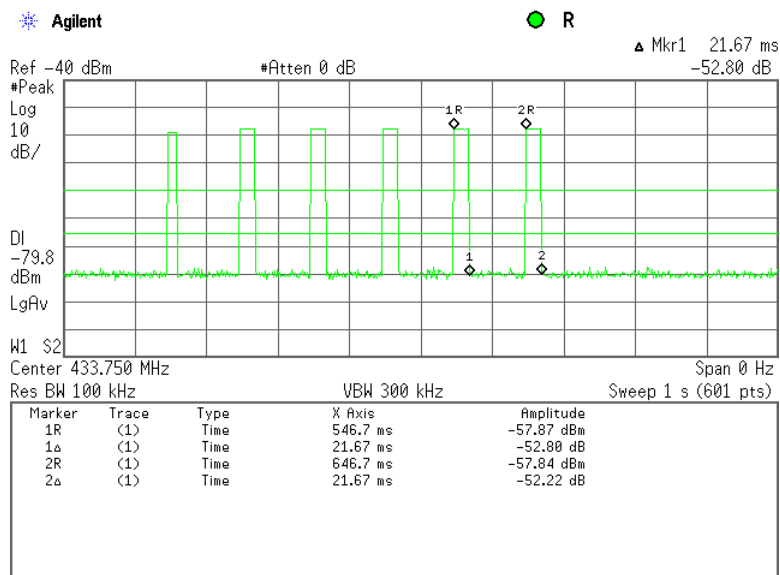
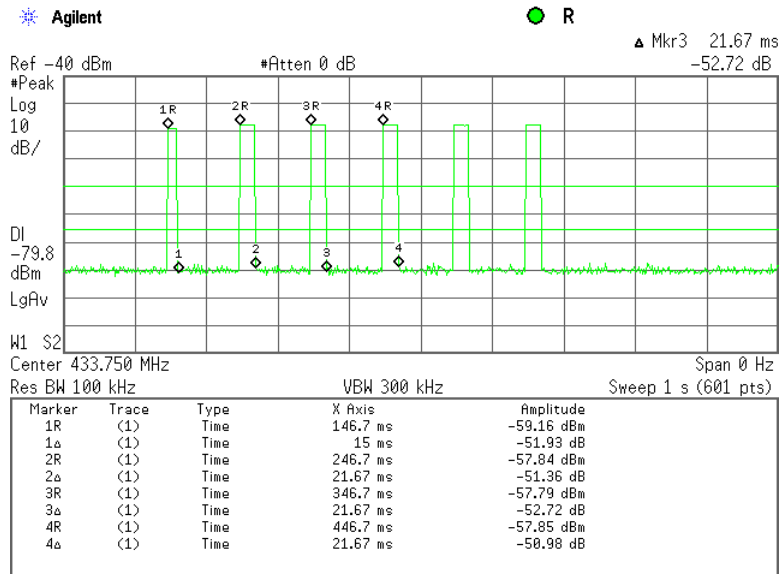
Requirement	Rationale	Verdict
Continuous transmissions are not permitted	Supplier declaration	Comply
Duration of each transmission shall not be greater than 1 second	Plot 7.1.1	Comply
Silent period between transmissions shall be at least 30 times the duration of the transmission	Plot 7.1.2 to Plot 7.1.4	Comply
Silent period between transmissions shall be in no case less than 10 seconds	Plot 7.1.4	Comply



HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/14/2013		
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

Plot 7.1.1 Transmitter pulse duration

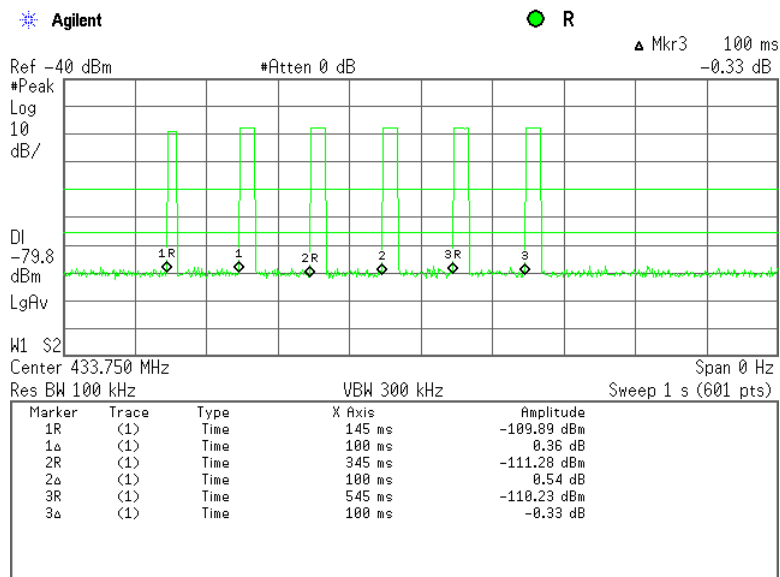




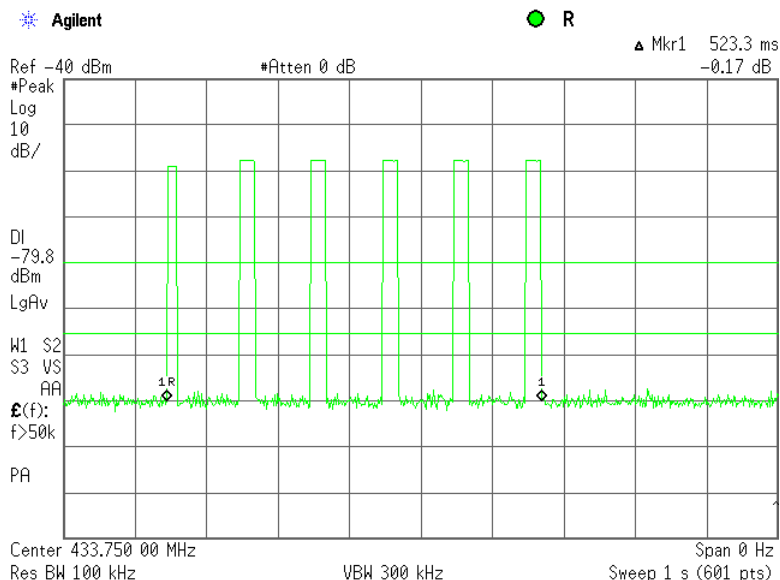
HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/14/2013		
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

Plot 7.1.2 Transmission pulse period



Plot 7.1.3 Transmission burst duration

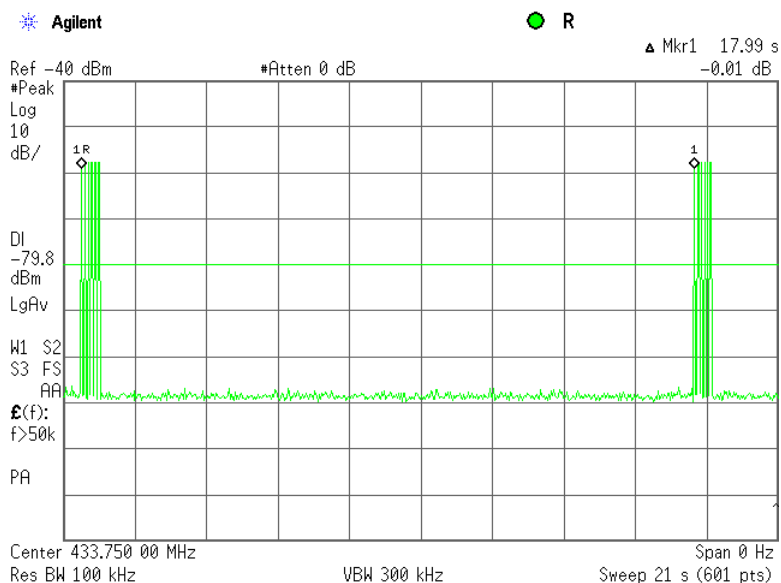




HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/14/2013		
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

Plot 7.1.4 Transmission burst period





HERMON LABORATORIES

Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict: PASS	
Date(s):	3/14/2013		
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

Table 7.1.2 Total duration of transmissions

Pulse duration, ms	Pulse period, ms	Total transmission duration, ms	Silent period between transmissions, s	Silent period between transmissions limit, s	Margin, s	Verdict
21.67	100.0	153.75	17.99	10.0	-7.99	Pass

Reference numbers of test equipment used

HL 0337	HL 3818						
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Full description is given in Appendix A.



Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/17/2013	
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

7.2 Field strength of emissions

7.2.1 General

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

Table 7.2.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
433.75	92.9	72.9
434.20	92.9	72.9

Table 7.2.2 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)				
	Within restricted bands			Outside restricted bands	
	Peak	Quasi Peak	Average	Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	72.9	52.9
0.090 – 0.110	NA	108.5 – 106.8**	NA		
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**		
0.490 – 1.705	NA	73.8 – 63.0**	NA		
1.705 – 30.0*		69.5			
30 – 88		40.0			
88 – 216		43.5			
216 – 960		46.0			
960 - 1000		54.0			
Above 1000	74.0	NA	54.0		

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

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

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

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

The limit for spurious emissions was 20 dB lower than fundamental emission limit.

The above limits provided in terms of average values, peak limit was 20 dB above the average limit.

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

Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

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

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

7.2.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.2.2.3 The worst test results (the lowest margins) were recorded in Table 7.2.3, Table 7.2.5 and shown in the associated plots.

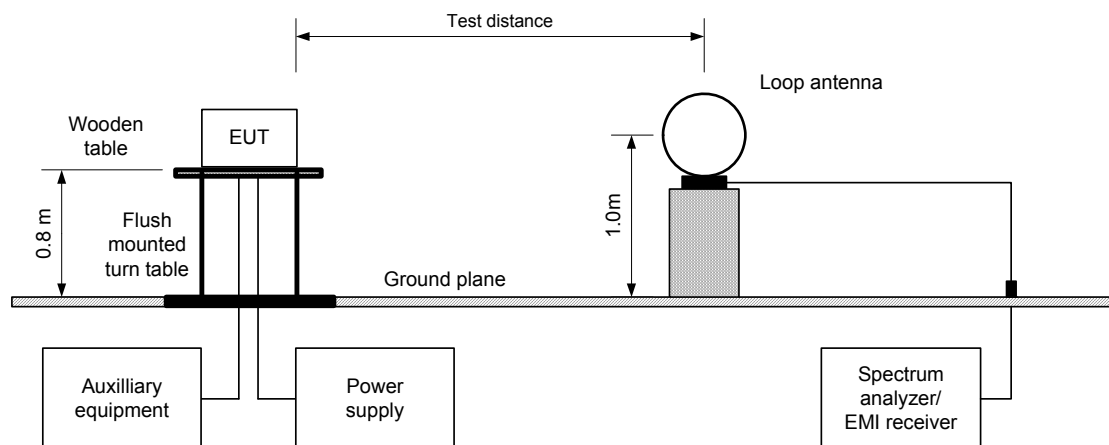
7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

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

7.2.3.2 The 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.

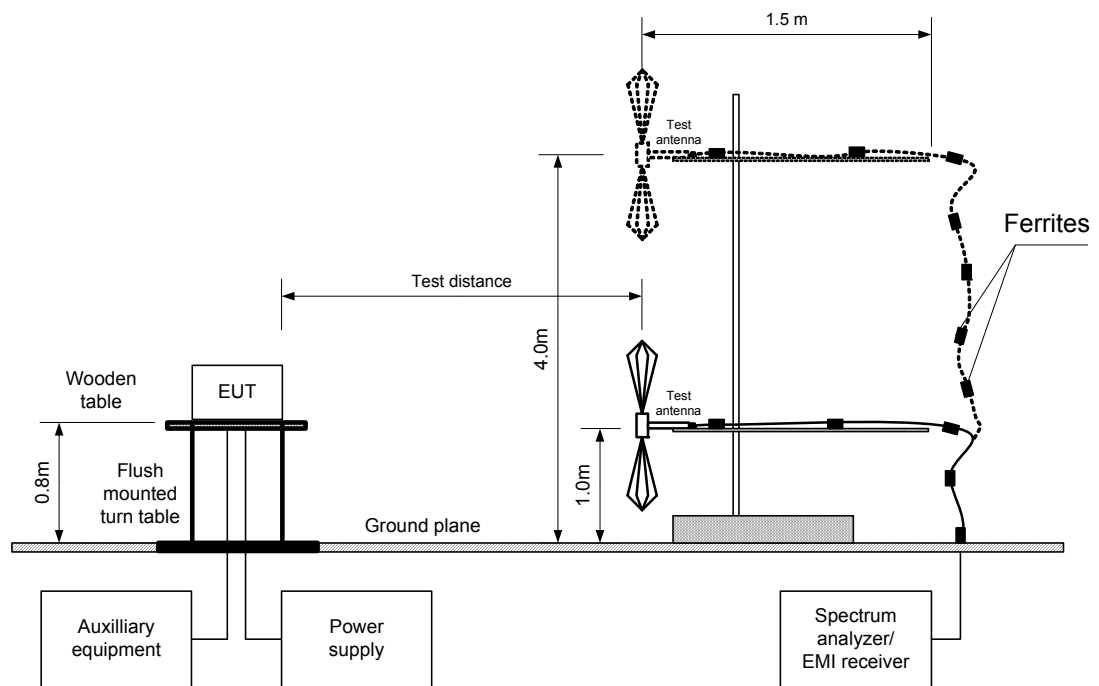
7.2.3.3 The worst test results (the lowest margins) were recorded in Table 7.2.3, Table 7.2.5 and shown in the associated plots.

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



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict: PASS	
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

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





Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions				
Test procedure:	ANSI C63.4, Section 13.1.4				
Test mode:	Compliance		Verdict: PASS		
Date(s):	3/17/2013				
Temperature: 23.2 °C	Air Pressure: 1018 hPa		Relative Humidity: 41 %		Power Supply: 12 VDC
Remarks:					

Table 7.2.3 Field strength of fundamental emission, spurious emissions outside restricted bands and within restricted bands at frequencies above 1 GHz

TEST DISTANCE:	3 m
EUT POSITION:	Typical (Horizontal)
MODULATION:	FSK
MODULATING SIGNAL:	PRBS
BIT RATE:	19.2 kbps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 - 4500 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	1.0 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz) 1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH:	≥ Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconilog (30 MHz – 1000 MHz) Double ridged guide (above 1000 MHz)

F, MHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength				Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission***											
433.7950	Hor	1.0	229	59.87	92.9	-33.03	59.87	49.63	72.9	-23.27	Pass
434.1575	Hor	1.0	152	59.99	92.9	-32.91	59.99	49.75	72.9	-23.15	Pass
Spurious emissions											
Low frequency 433.75 MHz											
867.4050	Hor	1.0	114	48.45	72.9	-24.45	48.45	38.21	52.9	-14.69	Pass
1301.100	Hor	1.3	225	52.77	74.0	-21.23	52.77	42.53	54.0	-11.47	
High frequency 434.20 MHz											
868.3075	Hor	1.0	114	48.65	72.9	-24.25	48.65	38.41	52.9	-14.49	Pass
1302.487	Vert	1.3	122	52.88	74.0	-21.12	52.88	42.64	54.0	-11.36	

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin = dB below (negative if above) specification limit.

Table 7.2.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
30.0	97.5	528	18.01	NA	- 10.24

*- Average factor was calculated as follows
for pulse train shorter than 100 ms:

$$\text{Average factor} = 20 \times \log_{10} \left(\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{Burst duration}}{\text{Train duration}} \times \text{Number of bursts within pulse train} \right)$$

for pulse train longer than 100 ms:

$$\text{Average factor} = 20 \times \log_{10} \left(\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{Burst duration}}{100 \text{ ms}} \times \text{Number of bursts within 100 ms} \right)$$

Reference numbers of test equipment used

HL 0446	HL 0604	HL 1984	HL 2780	HL 2871	HL 4353		
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Full description is given in Appendix A.



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

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

TEST DISTANCE: 3 m
 EUT POSITION: Typical (Horizontal)
 MODULATION: FSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 19.2 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 120 kHz (30 MHz – 1000 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)

Discontinues (50 MHz – 1500 MHz)								
Frequency, MHz	Peak emission, dB(μV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
No emissions were found								
Pass								

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

HL 0604	HL 1984	HL 2909	HL 4347	HL 4351			
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Full description is given in Appendix A.



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions			
Test procedure:	ANSI C63.4, Section 13.1.4			
Test mode:	Compliance	Verdict: PASS		
Date(s):	3/17/2013			
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC	
Remarks:				

Table 7.2.6 Restricted bands according to FCC 15, Section 205

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.290 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.420 - 16.423	156.7 - 156.9	1660 - 1710	5350 - 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 - 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

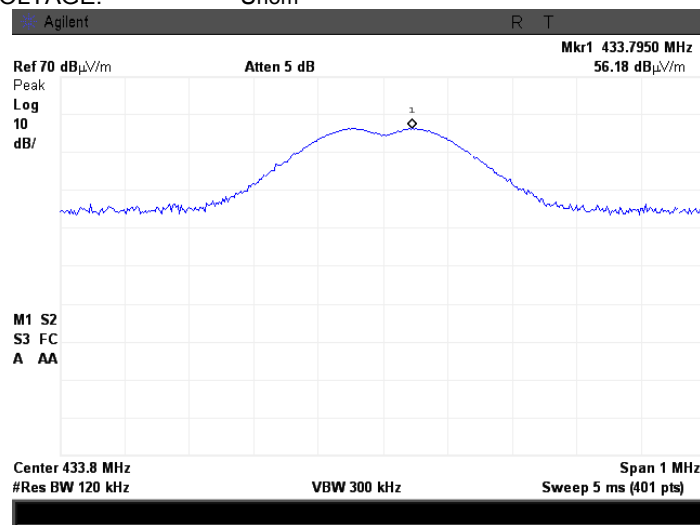
Table 7.2.7 Restricted bands according to RSS-Gen

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

Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/17/2013	
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

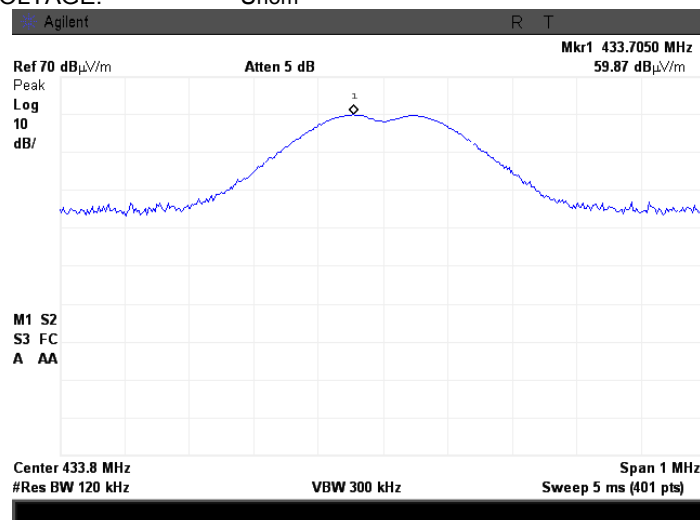
Plot 7.2.1 Radiated emission measurements at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Horizontal)
INPUT VOLTAGE: Unom



Plot 7.2.2 Radiated emission measurements at the low carrier frequency

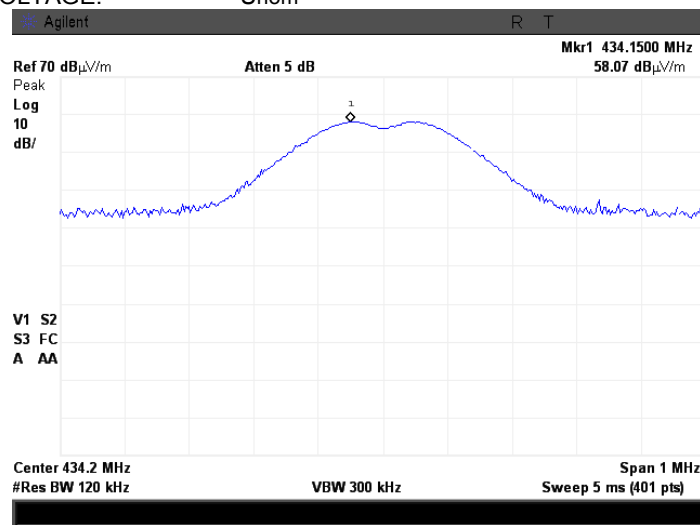
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical (Horizontal)
INPUT VOLTAGE: Unom



Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/17/2013	
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

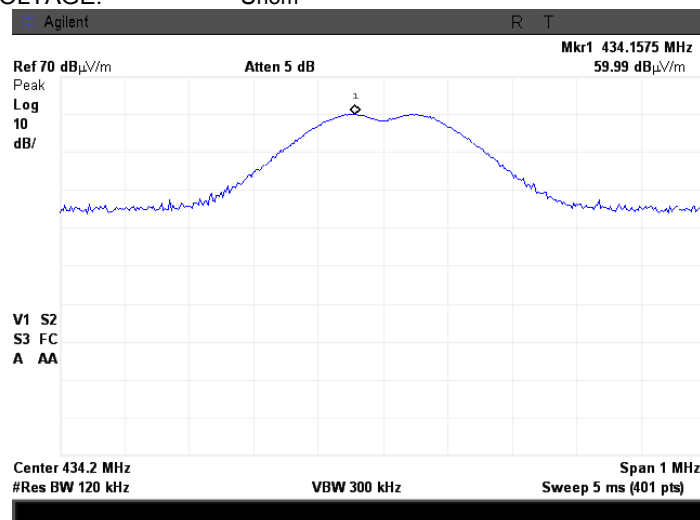
Plot 7.2.3 Radiated emission measurements at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Horizontal)
INPUT VOLTAGE: Unom



Plot 7.2.4 Radiated emission measurements at the high carrier frequency

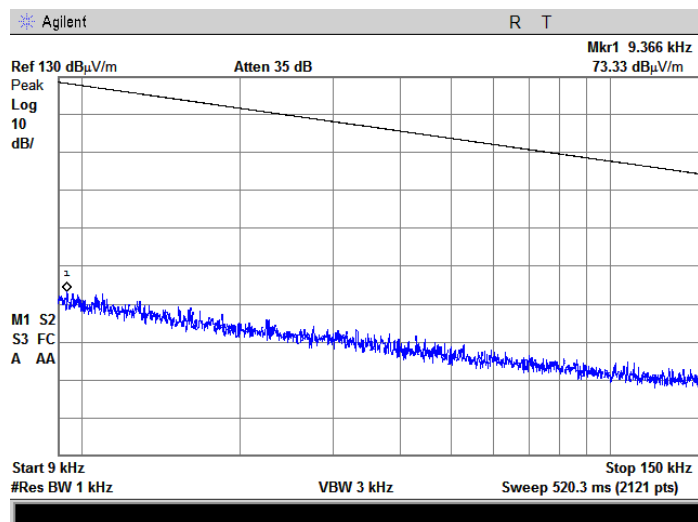
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: Typical (Horizontal)
INPUT VOLTAGE: Unom



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

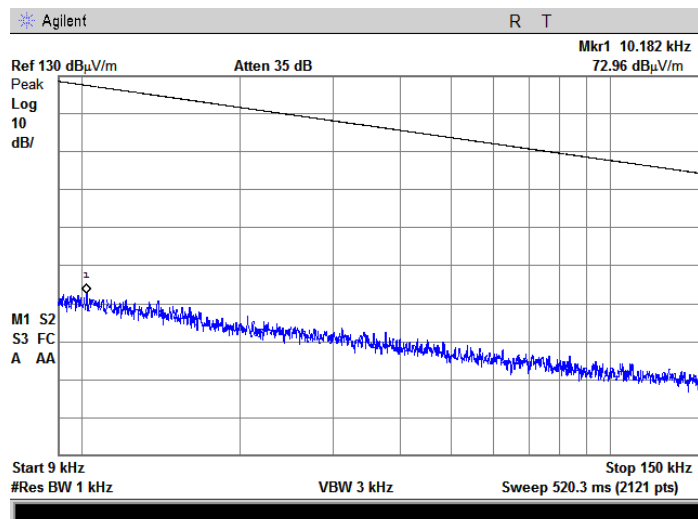
Plot 7.2.5 Radiated emission measurements from 9 to 150 kHz at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Horizontal)



Plot 7.2.6 Radiated emission measurements from 9 to 150 kHz at the high carrier frequency

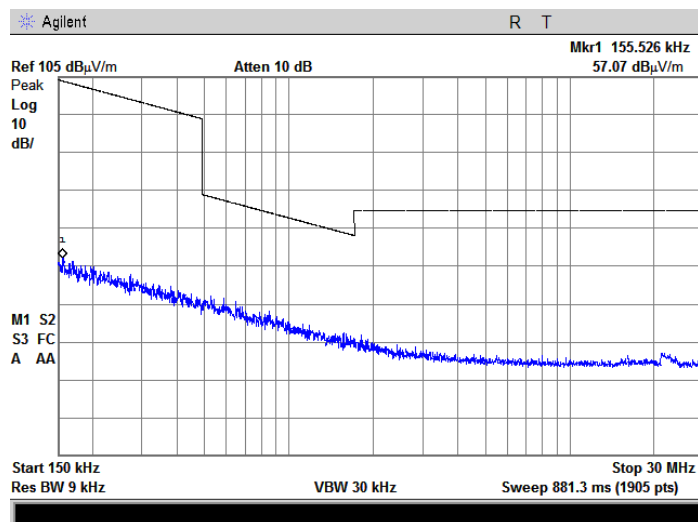
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Horizontal)



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

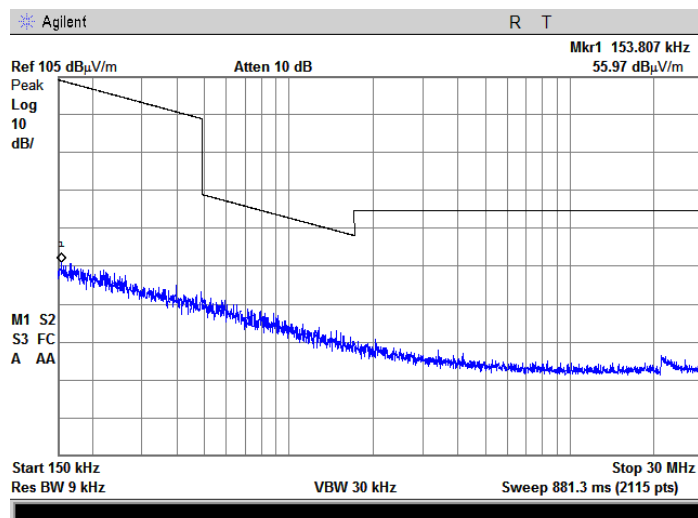
Plot 7.2.7 Radiated emission measurements from 0.15 to 30 MHz at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Horizontal)



Plot 7.2.8 Radiated emission measurements from 0.15 to 30 MHz at the high carrier frequency

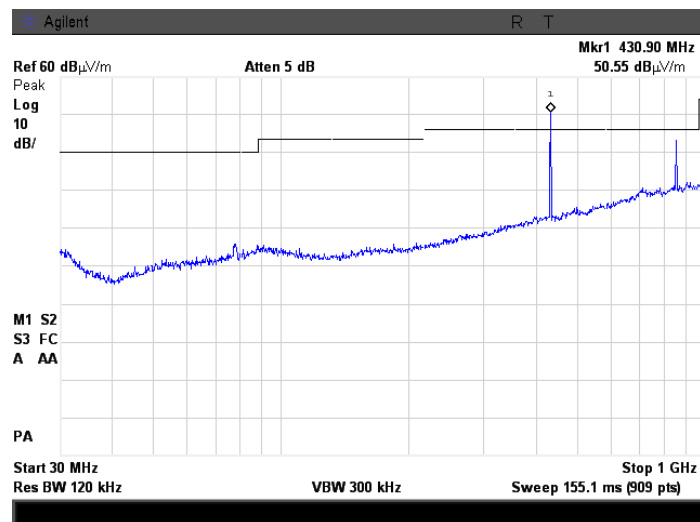
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Horizontal)



Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/17/2013	
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

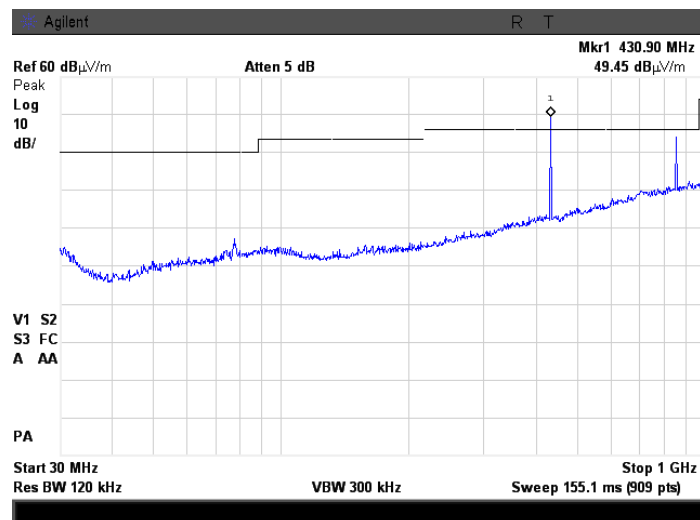
Plot 7.2.9 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Horizontal)



Plot 7.2.10 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

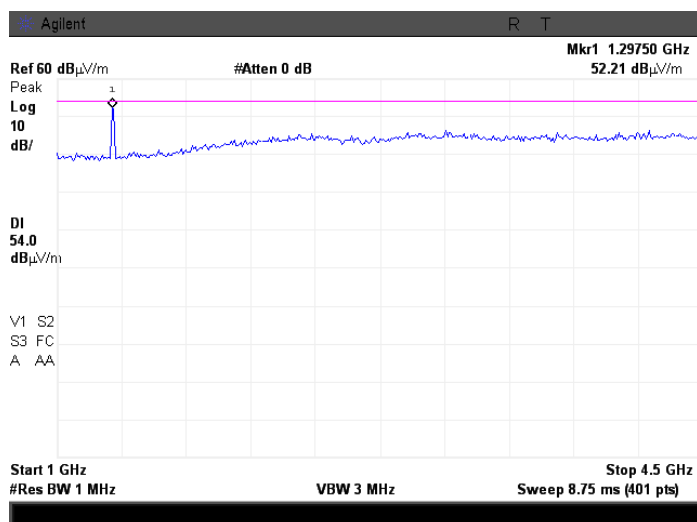
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Horizontal)



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

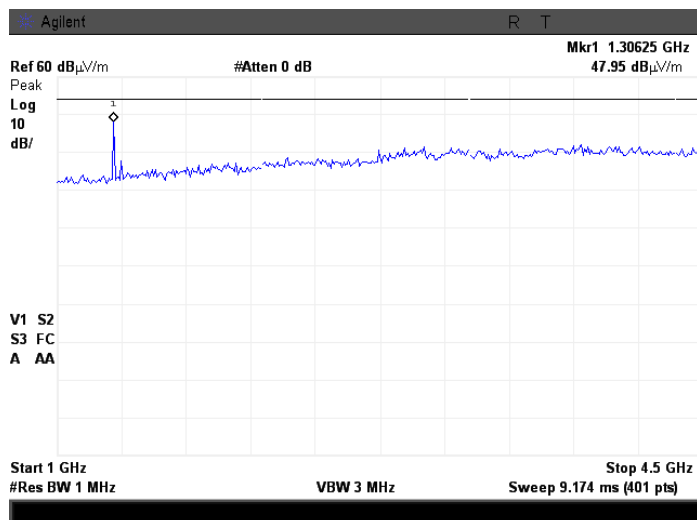
Plot 7.2.11 Radiated emission measurements from 1000 to 4500 MHz at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Horizontal)



Plot 7.2.12 Radiated emission measurements from 1000 to 4500 MHz at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Horizontal)



Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/17/2013	
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

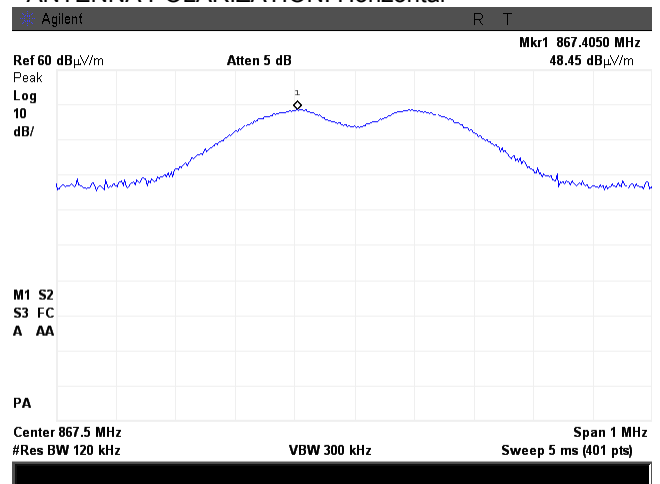
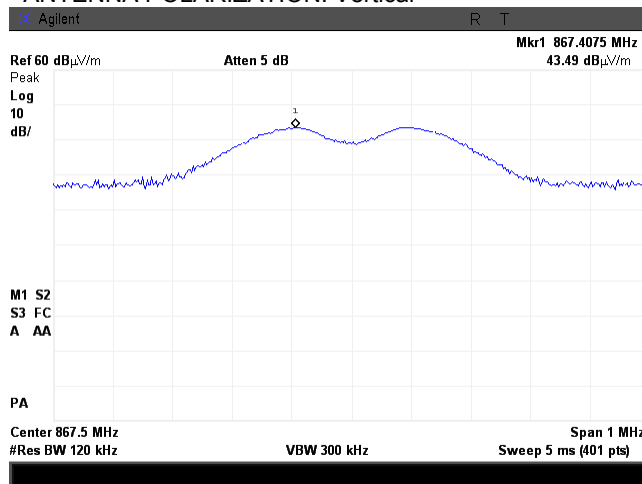
Plot 7.2.13 Radiated emission measurements at the second harmonic frequency at the low carrier frequency

TEST SITE:
TEST DISTANCE:

Semi anechoic chamber
3 m

EUT POSITION:
ANTENNA POLARIZATION: Vertical

Typical (Horizontal)
ANTENNA POLARIZATION: Horizontal



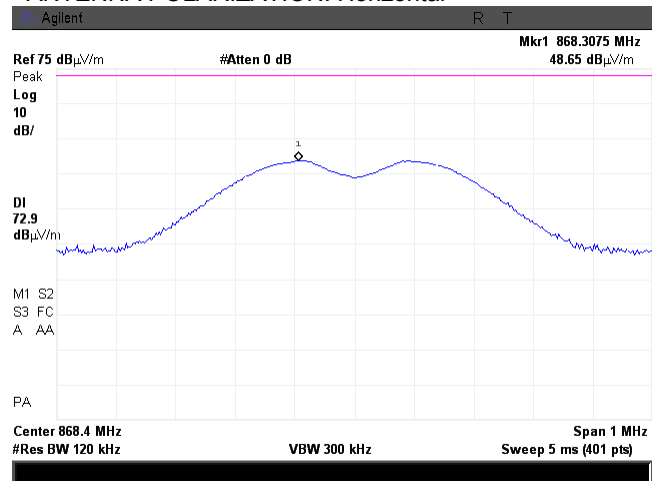
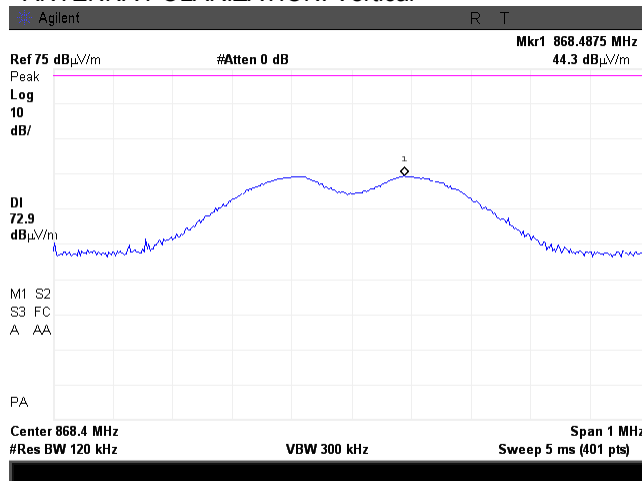
Plot 7.2.14 Radiated emission measurements at the second harmonic frequency at the high carrier frequency

TEST SITE:
TEST DISTANCE:

Semi anechoic chamber
3 m

EUT POSITION:
ANTENNA POLARIZATION: Vertical

Typical (Horizontal)
ANTENNA POLARIZATION: Horizontal

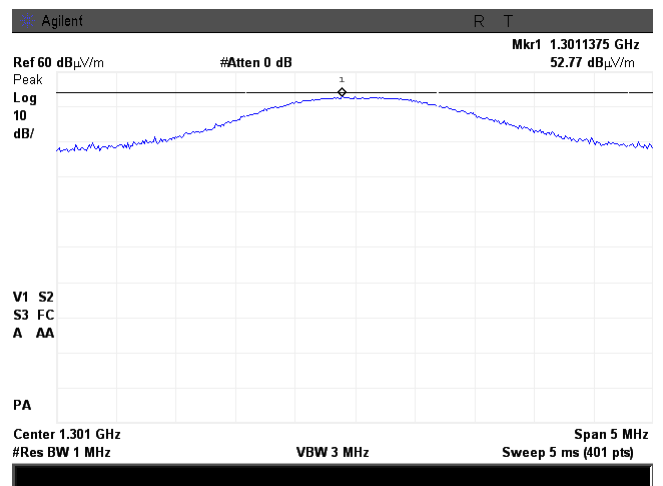
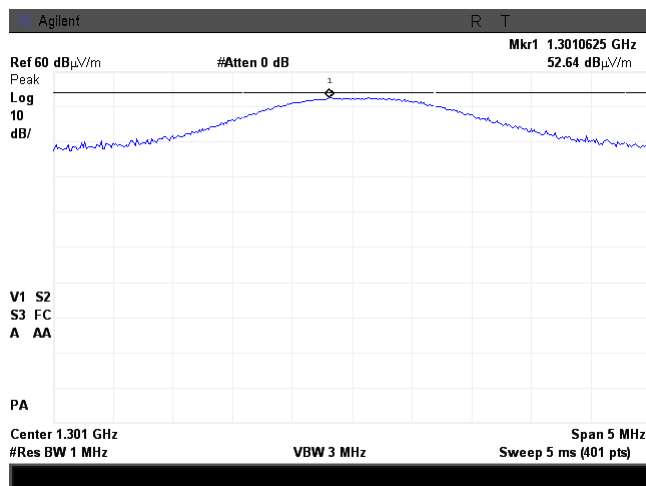


Test specification:		FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/17/2013	
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

Plot 7.2.15 Radiated emission measurements at the third harmonic frequency at the low carrier frequency

TEST SITE:
TEST DISTANCE:
EUT POSITION:
ANTENNA POLARIZATION: Vertical

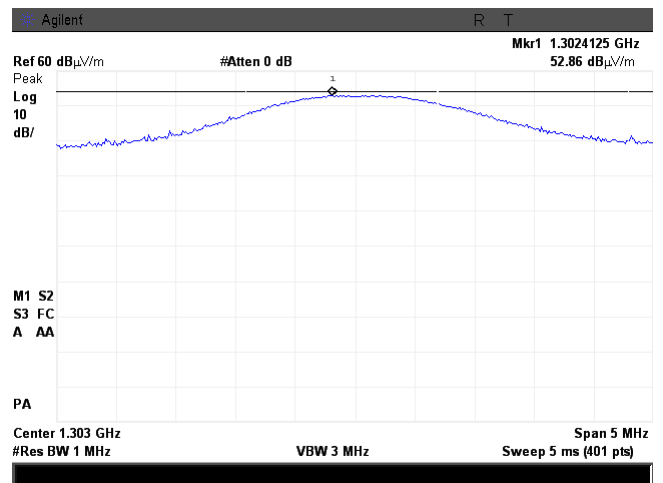
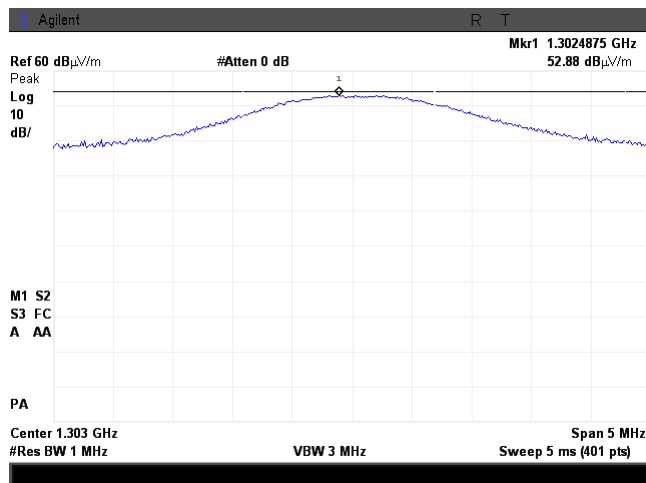
Semi anechoic chamber
3 m
Typical (Horizontal)
ANTENNA POLARIZATION: Horizontal



Plot 7.2.16 Radiated emission measurements at the third harmonic frequency at the high carrier frequency

TEST SITE:
TEST DISTANCE:
EUT POSITION:
ANTENNA POLARIZATION: Vertical

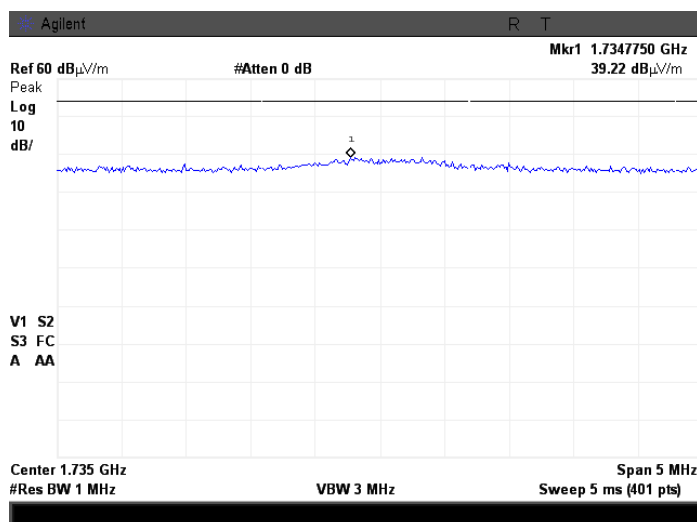
Semi anechoic chamber
3 m
Typical (Horizontal)
ANTENNA POLARIZATION: Horizontal



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

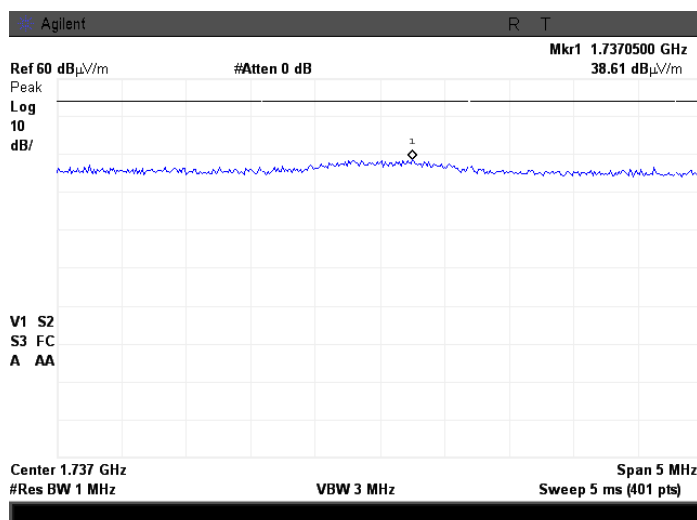
Plot 7.2.17 Radiated emission measurements at the fourth harmonic frequency at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
EUT POSITION: Typical (Horizontal)
ANTENNA POLARIZATION: Vertical and Horizontal:



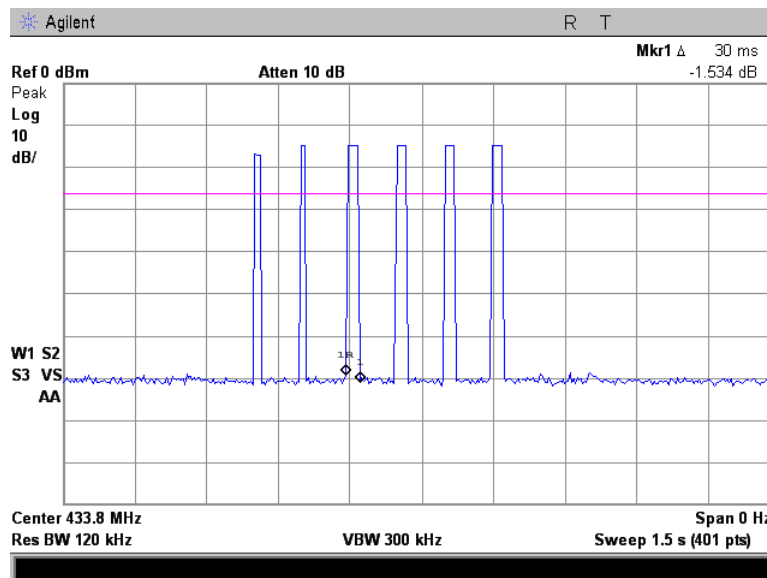
Plot 7.2.18 Radiated emission measurements at the fourth harmonic frequency at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
EUT POSITION: Typical (Horizontal)
ANTENNA POLARIZATION: Vertical and Horizontal:

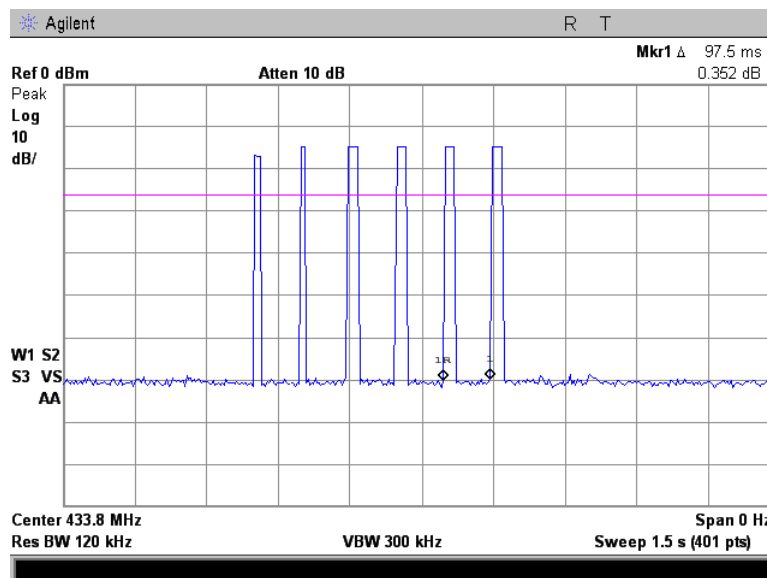


Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

Plot 7.2.19 Transmitter pulse duration



Plot 7.2.20 Transmission pulse period



Test specification:	FCC Part 15, Section 231(e) / RSS-210, Section A1.1.5, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

Plot 7.2.21 Transmission burst duration

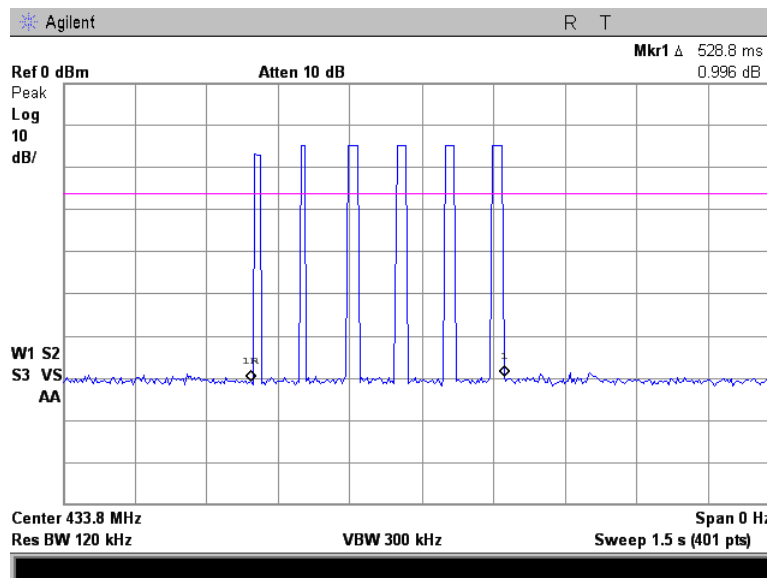
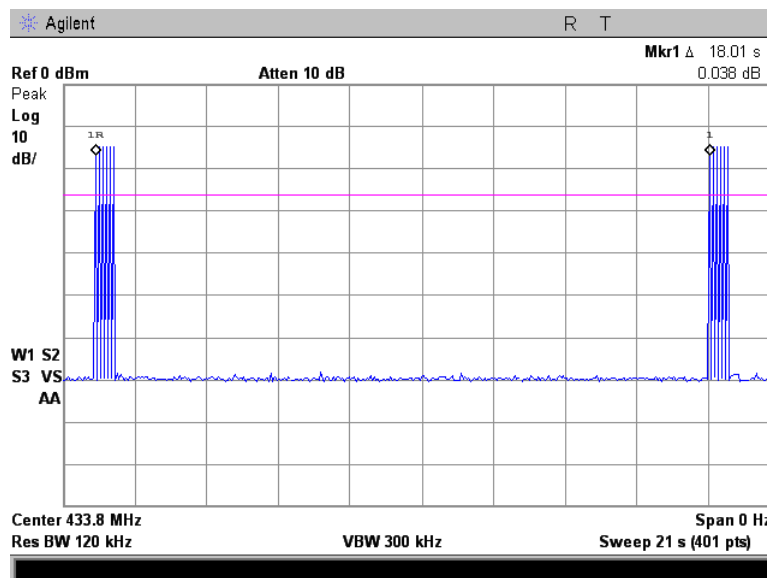


Table 7.2.8 Transmission burst period





Test specification: FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth			
Test procedure: ANSI C63.4, Section 13.1.7			
Test mode:	Compliance	Verdict: PASS	
Date(s):	3/14/2013		
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

7.3 Occupied bandwidth test

7.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, % of the carrier frequency
70 - 900	20.0	0.25
Above 900		0.50

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

7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The EUT was set to transmit modulated carrier.

7.3.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.3.2 and the associated plots.

Figure 7.3.1 Occupied bandwidth test setup





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Test specification:		FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/14/2013		
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 10 kHz
 VIDEO BANDWIDTH: 30 kHz
 MODULATION: FSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 19.2 kbps

MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
433.75	198.75	0.25	1084	-885.25	Pass
434.20	198.70	0.25	1085	-886.30	Pass

MODULATION ENVELOPE REFERENCE POINTS: 99% power

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
433.75	234.75	0.25	1084	-849.25	Pass
434.20	234.70	0.25	1085	-850.30	Pass

Reference numbers of test equipment used

HL 0337	HL 3818							
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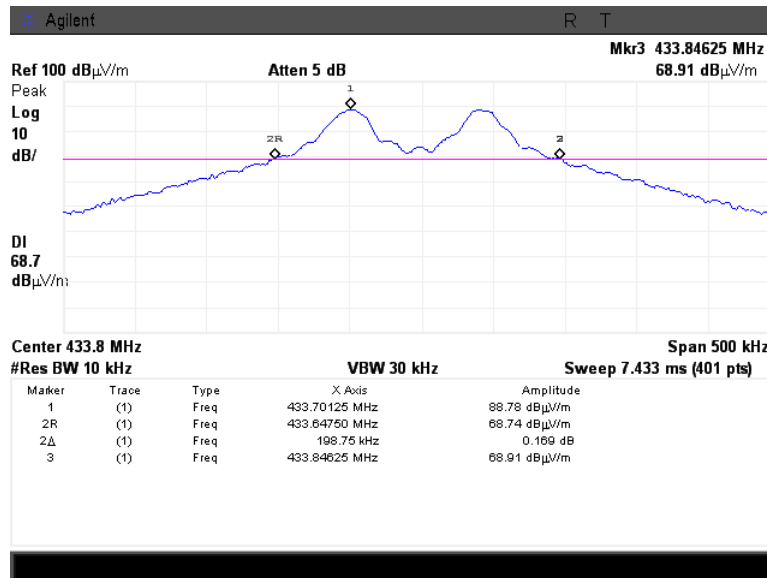
Full description is given in Appendix A.



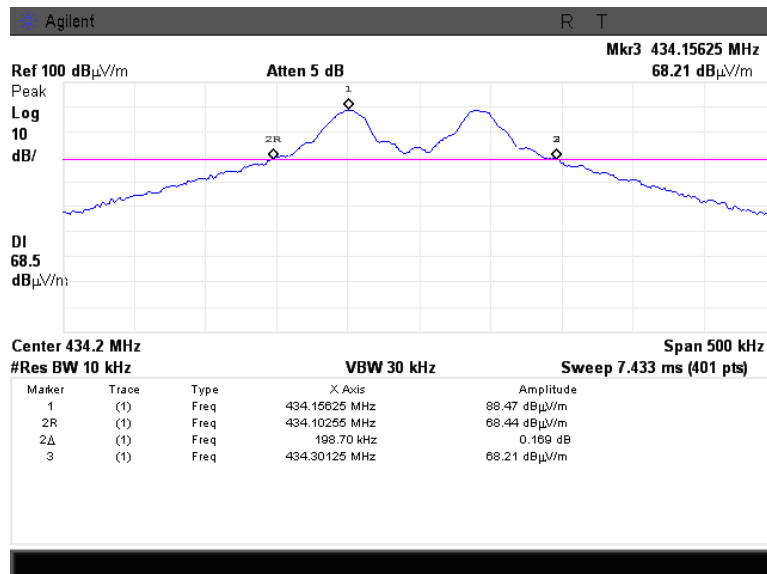
HERMON LABORATORIES

Test specification:		FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/14/2013	
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

Plot 7.3.1 Occupied bandwidth test result at the low frequency, 20 dBc



Plot 7.3.2 Occupied bandwidth test result at the high frequency, 20 dBc

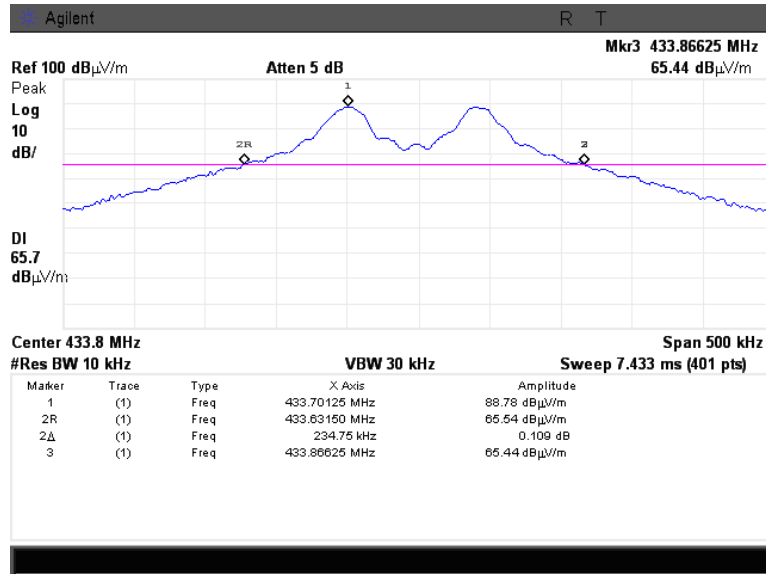




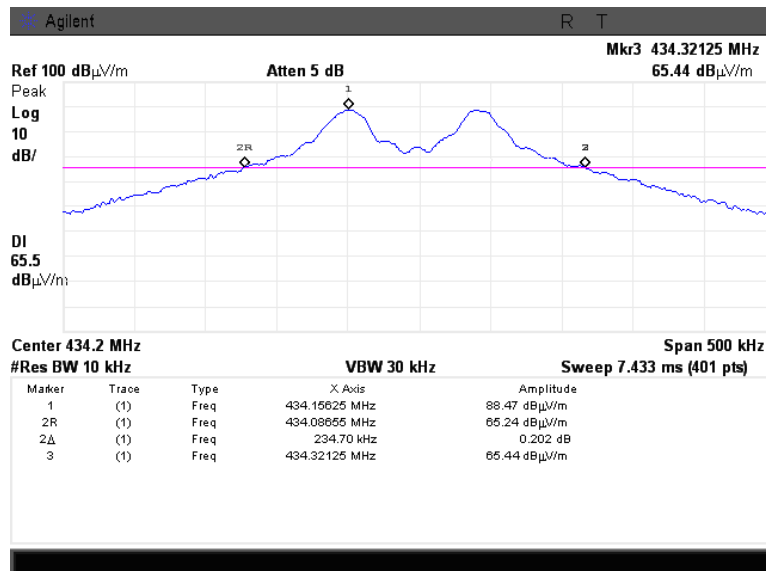
HERMON LABORATORIES

Test specification:		FCC Part 15, Section 231(c) / RSS-210, Section A1.1.3, Occupied bandwidth	
Test procedure:		ANSI C63.4, Section 13.1.7	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/14/2013	
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 12 VDC
Remarks:			

Plot 7.3.3 Occupied bandwidth test result at the low frequency, 99% power



Plot 7.3.4 Occupied bandwidth test result at the high frequency, 99% power



Test specification:		FCC Part 15, Section 207 / RSS-Gen, Section 7.2.2, Conducted emission	
Test procedure:		ANSI C63.4, Section 13.1.3	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/14/2013	
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	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

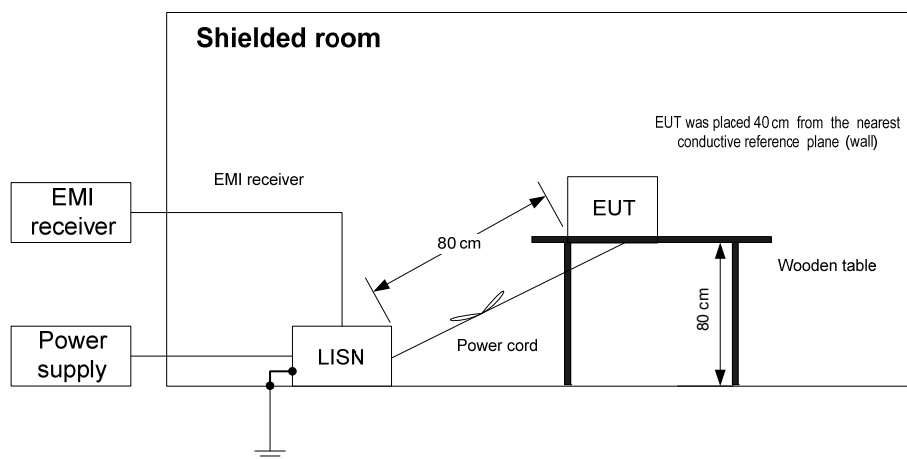
7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and the performance check was conducted.

7.4.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer while unused coaxial connector of the LISN was terminated with 50 Ohm.

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





HERMON LABORATORIES

Test specification:		FCC Part 15, Section 207 / RSS-Gen, Section 7.2.2, Conducted emission	
Test procedure:		ANSI C63.4, Section 13.1.3	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/14/2013	
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	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
 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*		
0.204650	52.00	50.80	63.48	-12.68	50.56	53.48	-2.92	L1	Pass
0.408763	30.57	29.59	57.71	-28.12	29.27	47.71	-18.44		
1.054445	32.46	26.78	56.00	-29.22	13.02	46.00	-32.98		
0.204050	52.24	50.97	63.50	-12.53	50.83	53.50	-2.67	L2	Pass
0.409025	30.99	30.04	57.70	-27.66	29.77	47.70	-17.93		
1.062630	30.16	23.66	56.00	-32.34	15.21	46.00	-30.79		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

HL 0163	HL 0787	HL 1425	HL 1513	HL 3612			
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Full description is given in Appendix A.



HERMON LABORATORIES

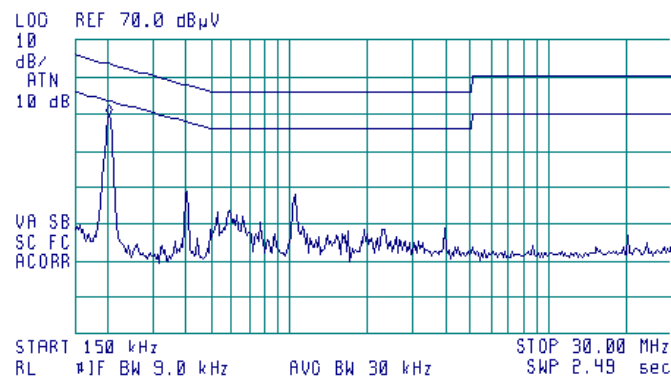
Test specification:		FCC Part 15, Section 207 / RSS-Gen, Section 7.2.2, Conducted emission	
Test procedure:		ANSI C63.4, Section 13.1.3	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/14/2013	
Temperature: 23.8 °C	Air Pressure: 1009 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

Plot 7.4.1 Conducted emission measurements

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



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 200 kHz
49.60 dBμV

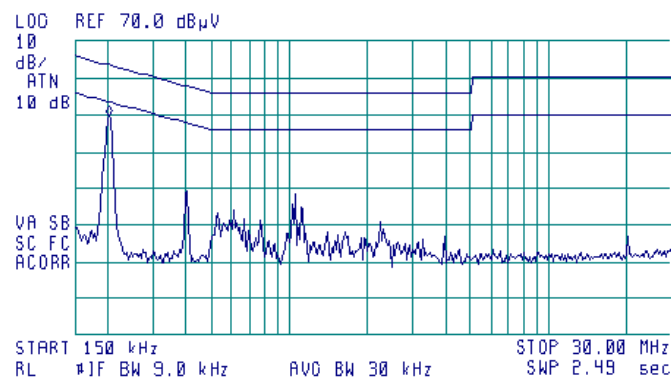


Plot 7.4.2 Conducted emission measurements

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



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 200 kHz
49.72 dBμV





Test specification:	FCC Part 15, Section 203 / RSS-Gen, Section 7.1.4, Antenna requirements		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

7.5 Antenna requirements

The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed for use with the EUT. This requirement does not apply to professionally installed transmitters.

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

Table 7.5.1 Antenna requirements

Requirement	Rationale	Verdict
The transmitter antenna is permanently attached	Visual inspection	Comply
The transmitter employs a unique antenna connector	NA	
The transmitter requires professional installation	NA	



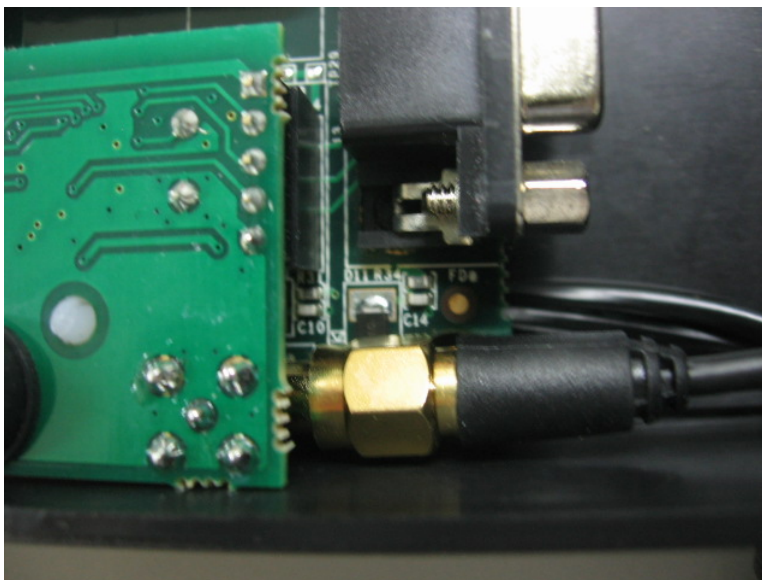
HERMON LABORATORIES

Test specification:	FCC Part 15, Section 203 / RSS-Gen, Section 7.1.4, Antenna requirements		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/17/2013		
Temperature: 23.2 °C	Air Pressure: 1018 hPa	Relative Humidity: 41 %	Power Supply: 12 VDC
Remarks:			

Photograph 7.5.1 Antenna assembly



Photograph 7.5.2 Antenna assembly





Test specification:		FCC Section 15.107/ICES-003 Section 6.1 Class B, AC power lines conducted emissions	
Test procedure:		ANSI C63.4, Section 11.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/21/2013	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 41 %	Power Supply: 120 VAC
Remarks:			

8 Emissions tests according to 47CFR part 15 subpart B and ICES-003 requirements

8.1 Conducted emissions

8.1.1 General

This test was performed to measure 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

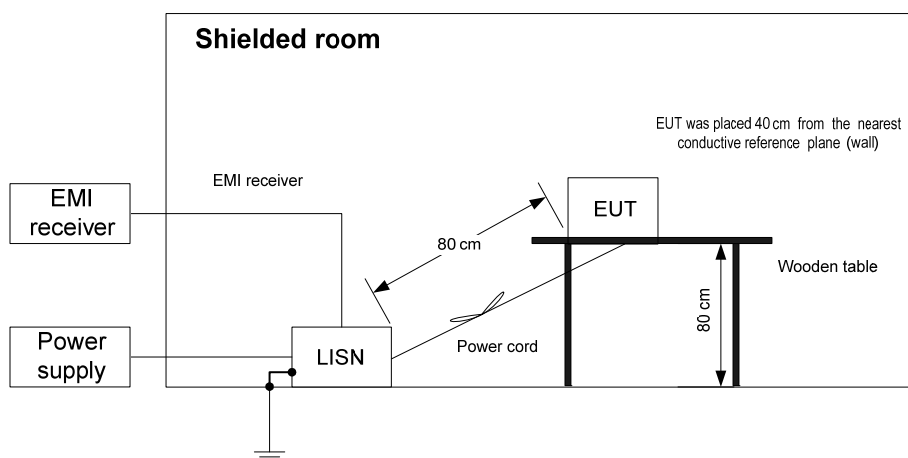
8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and the associated photographs, energized and the EUT performance was checked.

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

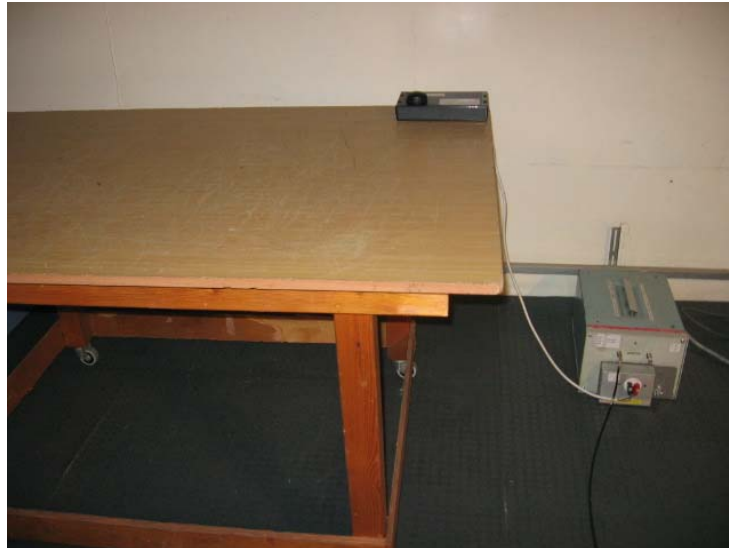




HERMON LABORATORIES

Test specification:		FCC Section 15.107/ICES-003 Section 6.1 Class B, AC power lines conducted emissions	
Test procedure:		ANSI C63.4, Section 11.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/21/2013	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 41 %	Power Supply: 120 VAC
Remarks:			

Photograph 8.1.1 Setup for conducted emissions measurements



Photograph 8.1.2 Setup for conducted emissions measurements





HERMON LABORATORIES

Test specification:		FCC Section 15.107/ICES-003 Section 6.1 Class B, AC power lines conducted emissions	
Test procedure:		ANSI C63.4, Section 11.5	
Test mode:		Verdict: PASS	
Date(s):		3/21/2013	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 41 %	Power Supply: 120 VAC
Remarks:			

Table 8.1.2 Conducted emission test results

LINE: AC mains
 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*		
0.204650	52.00	50.80	63.48	-12.68	50.56	53.48	-2.92	L1	Pass
0.408763	30.57	29.59	57.71	-28.12	29.27	47.71	-18.44		
1.054445	32.46	26.78	56.00	-29.22	13.02	46.00	-32.98		
0.204050	52.24	50.97	63.50	-12.53	50.83	53.50	-2.67	L2	Pass
0.409025	30.99	30.04	57.70	-27.66	29.77	47.70	-17.93		
1.062630	30.16	23.66	56.00	-32.34	15.21	46.00	-30.79		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

HL 0163	HL 0787	HL 1425	HL 1513	HL 3612			
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Full description is given in Appendix A.

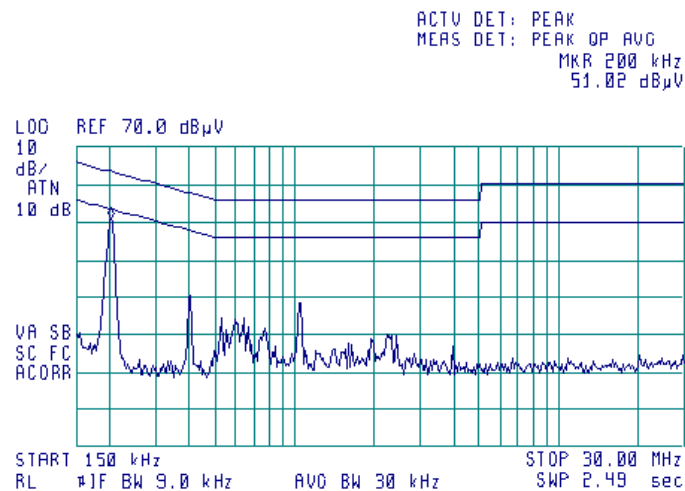


HERMON LABORATORIES

Test specification:		FCC Section 15.107/ICES-003 Section 6.1 Class B, AC power lines conducted emissions	
Test procedure:		ANSI C63.4, Section 11.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/21/2013	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 41 %	Power Supply: 120 VAC
Remarks:			

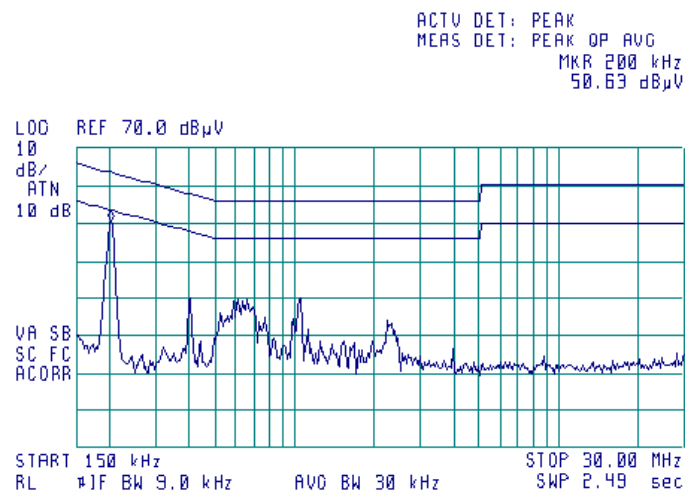
Plot 8.1.1 Conducted emission measurements

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:		FCC Section 15.109/ ICES-003 Section 6.2 Class B, Radiated emission	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/21/2013		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 43 %	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 test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $\text{Lim}_{S2} = \text{Lim}_{S1} + 20 \log (S_1/S_2)$, 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 the associated photographs, 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.

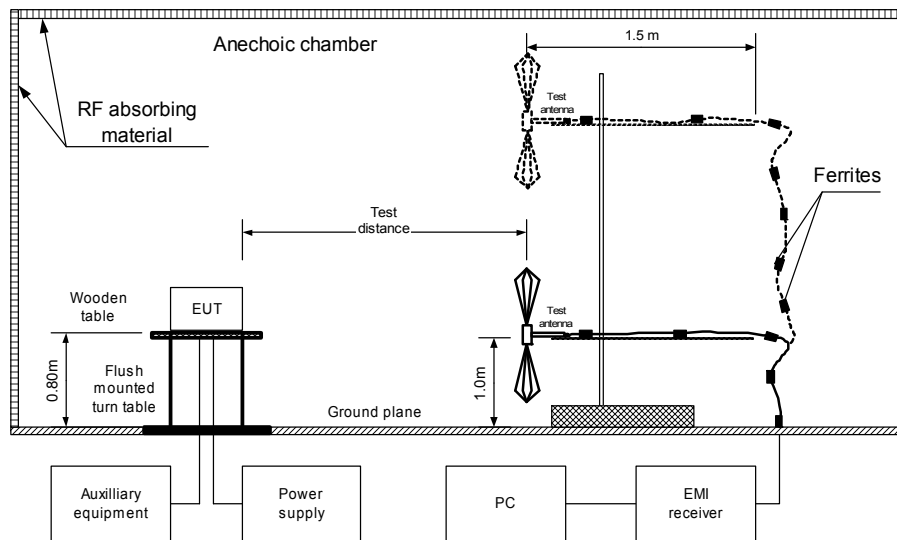
8.2.2.3 The worst test results with respect to the limits were recorded in Table 8.2.2 and shown in the associated plots.



HERMON LABORATORIES

Test specification:		FCC Section 15.109/ ICES-003 Section 6.2 Class B, Radiated emission	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/21/2013	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

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



Photograph 8.2.1 Setup for radiated emission measurements





HERMON LABORATORIES

Test specification:		FCC Section 15.109/ ICES-003 Section 6.2 Class B, Radiated emission	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/21/2013	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Photograph 8.2.2 Setup for radiated emission measurements, EUT close view





HERMON LABORATORIES

Test specification: FCC Section 15.109/ ICES-003 Section 6.2 Class B, Radiated emission			
Test procedure: ANSI C63.4, Section 11.6			
Test mode:	Compliance	Verdict: PASS	
Date(s):	3/21/2013		
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

Table 8.2.2 Radiated emission test results

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

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*				
179.28	34.23	31.56	43.50	-11.94	Vertical	1.0	246	Pass
812.46	41.44	38.78	46.00	-7.22	Horizontal	1.1	43	

FREQUENCY RANGE: 1000 MHz – 6000 MHz
 DETECTORS USED: PEAK
 RESOLUTION BANDWIDTH: 1000 kHz
 TEST SITE: SEMI ANECHOIC CHAMBER
 TEST DISTANCE: 3 m

Frequency, MHz	Peak emission, dB(μV/m)	Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
No emissions were found								Pass

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

HL 0604	HL 0684	HL 0788	HL 0812	HL 0813	HL 1425	HL 1554	HL 1984
HL 2780	HL 2871	HL 4353					

Full description is given in Appendix A.

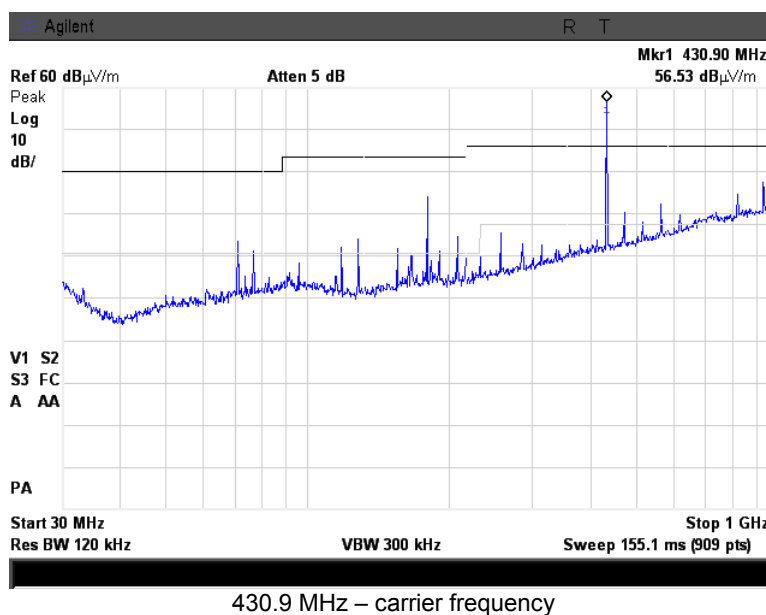


HERMON LABORATORIES

Test specification:		FCC Section 15.109/ ICES-003 Section 6.2 Class B, Radiated emission	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		3/21/2013	
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

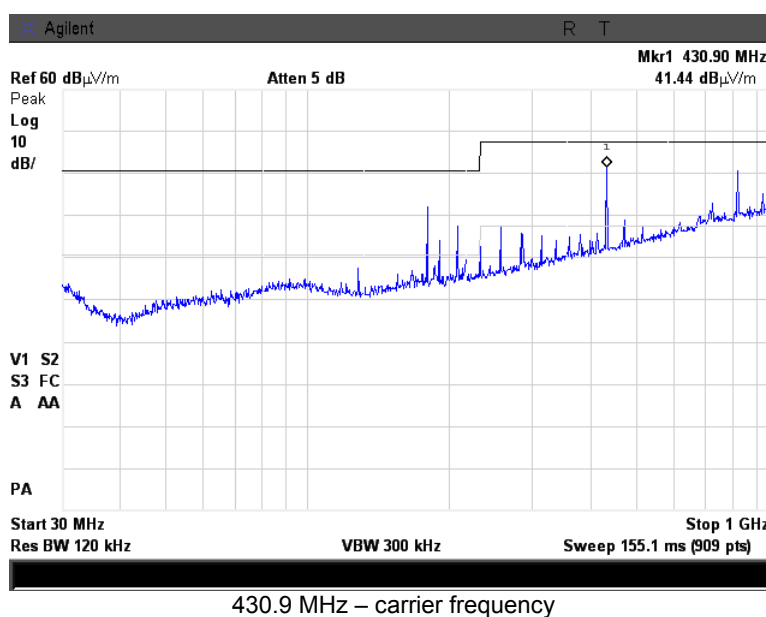
Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

TEST SITE: Semi-anechoic chamber
TEST DISTANCE: 3 m



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

TEST SITE: Semi-anechoic chamber
TEST DISTANCE: 3 m



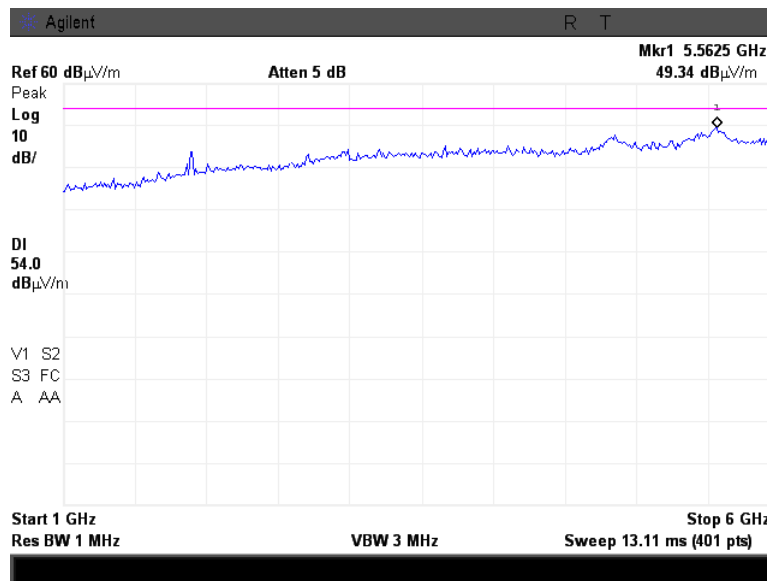


HERMON LABORATORIES

Test specification:		FCC Section 15.109/ ICES-003 Section 6.2 Class B, Radiated emission	
Test procedure:		ANSI C63.4, Section 11.6	
Test mode:		Verdict: PASS	
Date(s):			
3/21/2013			
Temperature: 23 °C	Air Pressure: 1015 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks:			

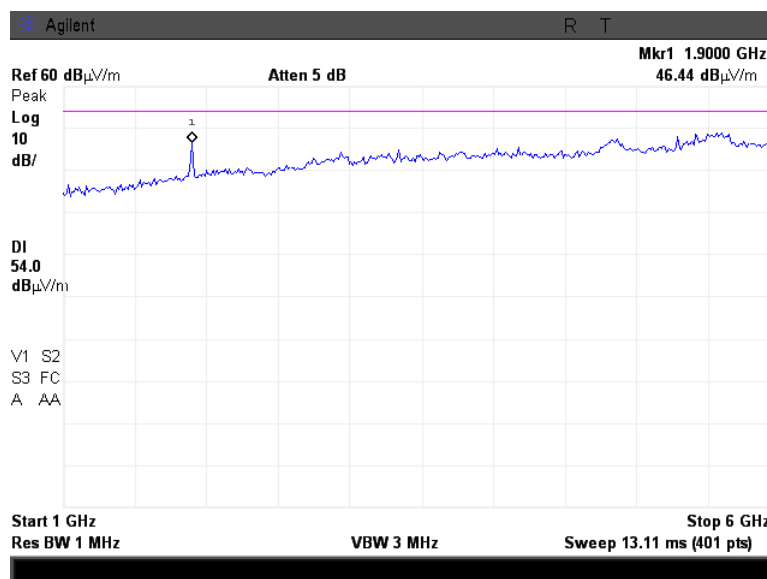
Plot 8.2.3 Radiated emission measurements in 1000 – 6000 MHz range, vertical antenna polarization

TEST SITE: Semi-anechoic chamber
TEST DISTANCE: 3 m



Plot 8.2.4 Radiated emission measurements in 1000 – 6000 MHz range, horizontal antenna polarization

TEST SITE: Semi-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
0163	LISN FCC/VDE/50 Ohm/50 uH + 5 Ohm, MIL-STD-461E, CISPR 16-1	Electro-Metrics	ANS 25/2	1314	15-Jan-13	15-Jan-14
0337	Probe Set, Hand held, 5 probes	Electro-Metrics	EHFP-30	238	06-Jun-12	06-Jun-13
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	03-Jul-12	03-Jul-13
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	20-May-12	20-May-14
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A018 77	15-Oct-12	15-Oct-13
1425	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427	Agilent Technologies	8542E	3710A002 22, 3705A002 04	26-Aug-12	26-Aug-13
1513	Cable RF, 8 m, BNC/BNC	Belden	M17/167 MIL-C-17	1513	02-Sep-12	02-Sep-13
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	07-Dec-12	07-Dec-13
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY451024 62	09-Jul-12	09-Jul-13
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	04-Dec-12	04-Dec-13
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	20-Dec-12	20-Dec-13
3612	Cable RF, 17.5 m, N type-N type	Teldor	RG-214/U	NA	02-Dec-12	02-Dec-13
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	24-Apr-13	24-Apr-14
4347	Low Loss Armored Test Cable, DC - 18 GHz, 2.0 m, N type-M/N type-M	MegaPhase	NC29-N1N1-79	12025103 001	06-Mar-13	06-Mar-14
4351	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 001	06-Mar-13	06-Mar-14
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 003	06-Mar-13	06-Mar-14

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
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Occupied bandwidth	± 8.0 %

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

11 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.

Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file 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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Person for contact: Mr. Alex Usoskin, CEO.

12 APPENDIX D Specification references

FCC 47CFR part 15: 2012	Radio Frequency Devices
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications
ANSI C63.4: 2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
RSS-210 Issue 8: 2010	Low Power Licence- Exempt Radiocommunication Devices
RSS-Gen Issue 3: 2010	General Requirements and Information for the Certification of Radiocommunication Equipment
ICES-003: 2012, Issue 5	Spectrum Management and Telecommunications Policy. Interference-Causing Equipment Standard. Information Technology Equipment (ITE) – Limits and methods of measurement

13 APPENDIX E Test equipment correction factors

Correction factor
Line impedance stabilization network
Model ANS-25/2, Electro-Metrics, HL 0163

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
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
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).

Antenna factor
Double-ridged wave guide horn antenna
Model 3115, S/N 9911-5964, HL1984

Frequency, MHz	Antenna factor, dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.6
2500.0	28.9
3000.0	31.2
3500.0	32.0
4000.0	32.5
4500.0	32.7
5000.0	33.6
5500.0	35.1
6000.0	35.4
6500.0	34.9
7000.0	36.1
7500.0	37.8
8000.0	38.0
8500.0	38.1
9000.0	39.1
9500.0	38.3
10000.0	38.6
10500.0	38.2
11000.0	38.7
11500.0	39.5
12000.0	40.0
12500.0	40.4
13000.0	40.5
13500.0	41.1
14000.0	41.6
14500.0	41.7
15000.0	38.7
15500.0	38.2
16000.0	38.8
16500.0	40.5
17000.0	42.5
17500.0	45.9
18000.0	49.4

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

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, 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
Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,
NC29-N1N1-244S/N 12025101 001,
HL 4351

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.21	9000	2.86
100	0.28	9500	2.96
300	0.49	10000	3.05
500	0.63	10500	3.12
1000	0.90	11000	3.18
1500	1.10	11500	3.24
2000	1.29	12000	3.30
2500	1.44	12500	3.37
3000	1.58	13000	3.45
3500	1.71	13500	3.53
4000	1.84	14000	3.58
4500	1.95	14500	3.66
5000	2.05	15000	3.73
5500	2.17	15500	3.79
6000	2.29	16000	3.87
6500	2.39	16500	3.94
7000	2.47	17000	3.98
7500	2.56	17500	4.07
8000	2.70	18000	4.14
8500	2.77		

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

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

14 APPENDIX F Abbreviations and acronyms

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

END OF DOCUMENT