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839.01
Electrical

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TEST REPORT

ACCORDING TO: FCC CFR 47 PART 15 Subpart C, section 15.209

FOR:

E.N.G.S. Systems Ltd.
Milk Control System
Sensomatic with internal antenna
Model number: FPSMTACIANT

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1 Applicant information

Client name:	E.N.G.S. Systems Ltd.
Address:	P.O.Box 77, Rosh Pina 12000, Israel
Telephone:	+972 4680 2257
Fax:	+972 4680 2258
E-mail:	meirs@engs-dairy.com
Contact name:	Mr. Meir Shtein

2 Equipment under test attributes

Product name:	Sensomatic with internal antenna
Product type:	Transmitter operating at 125 kHz
Model(s):	FPSMTACIANT
Hardware version:	VER-5
Software release:	2.0
Receipt date	8/13/2008

3 Manufacturer information

Manufacturer name:	E.N.G.S. Systems Ltd.
Address:	P.O.Box 77, Rosh Pina 12000, Israel
Telephone:	+972 4680 2257
Fax:	+972 4680 2258
E-Mail:	meirs@engs-dairy.com
Contact name:	Mr. Meir Shtein

4 Test details

Project ID:	18190
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	8/13/2008
Test completed:	1/01/2009
Test specification(s):	FCC Part 15, subpart C, §15.209

5 Tests summary

Test	Status
Transmitter characteristics	
Section 209, Field strength of emissions	Pass
Section 15.207(a), Conducted emission	Pass
Section 15.203, Antenna requirement	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 replaces the previously issued test report identified by Doc ID: ENGRAD_FCC.18190_sensomatic_int.

	Name and Title	Date	Signature
Tested by:	Mr. S. Samokha, test engineer Mr. L. Markel, test engineer	December 2, 2008	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	January 29, 2009	
Approved by:	Mr. M. Nikishin, EMC and radio group manager	January 30, 2009	

6 EUT description

6.1 General information

The EUT is a milk meter operating at 125 kHz. The EUT has an internal antenna and is powered from 24 VAC via AC transformer.

6.2 Ports and lines

Port type	Port description	Connected		Qty.	Cable type	Cable length	Indoor / outdoor
		From	To				
Power	24 VAC	EUT	Transformer	1	Unshielded	3.5 m	Outdoor
Power	AC mains	Transformer	AC mains	1	Unshielded	1.5 m	Outdoor
RF	Optional antenna	EUT	Open circuit	1	Unshielded	5 m	Indoor
Signal	RS 485	EUT	Sensomatic 1 (with external antenna)	1	Shielded	5 m	Outdoor
Signal	RS 485	EUT	I/O card	1	Shielded	5 m	Outdoor
Signal	Sensor	EUT	Sensor	1	Unshielded	5 m	Indoor

6.3 EUT system parts

Description	Manufacturer	Model number	Serial number
AC/AC transformer	Unknown	TRNS 230V 24V 3A	NA
COM Card	E.N.G.S. Systems	FPCOMCARD	NA
AC/AC adapter	Unknown	TRNS 230V 24V	NA
PC	Fujitsu Siemens	Scenic	YBEM383922
Monitor	Proview	786n	feyn290197886
Keyboard	Microsoft	NA	5167711501423
Mouse	Fujitsu Siemens	953348-0000	HCA15034961
Sensomatic 1	E.N.G.S. Systems	FPSMTACEANT	NA
Sensomatic 2	E.N.G.S. Systems	FPSMTACIANT	NA
I/O card	E.N.G.S. Systems	FPOCONTROLLER	NA
Sensor	E.N.G.S. Systems	ASS-SENSOR10FW	NA
Receiver	E.N.G.S. Systems	FPRECEIVER	NA
Watch ID	E.N.G.S. Systems	FPWATCHID	NA
Active tag	E.N.G.S. Systems	FPCOWTAGA	NA

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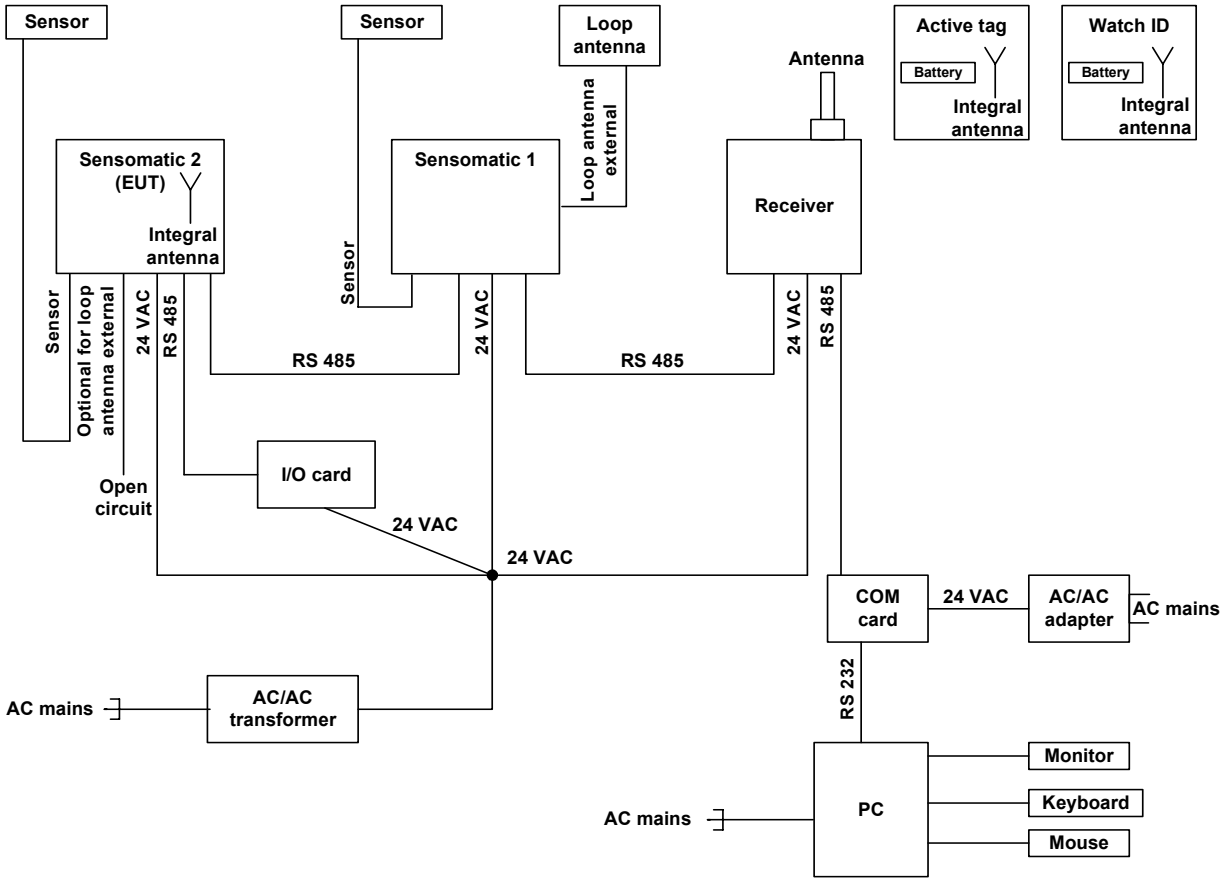
6.4 Test configuration



6.5 Transmitter characteristics

Type of equipment						
X	Stand-alone (Equipment with or without its own control provisions)					
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)					
	Plug-in card (Equipment intended for a variety of host systems)					

Intended use		**Condition of use**
	fixed	Always at a distance more than 2 m from all people
X	mobile	Always at a distance more than 20 cm from all people
	portable	May operate at a distance closer than 20 cm to human body

Operating frequency	125 kHz

Is transmitter output power variable?	X	No			
		Yes		continuous variable	
				stepped variable with stepsize	dB
			minimum RF power		dBm
			maximum RF power		-3.9 dBm

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

Type of modulation	OOK

Transmitter power source			
	Battery	**Nominal rated voltage**	VDC
	DC	**Nominal rated voltage**	VDC
X	AC power	**Nominal rated voltage**	24 VAC

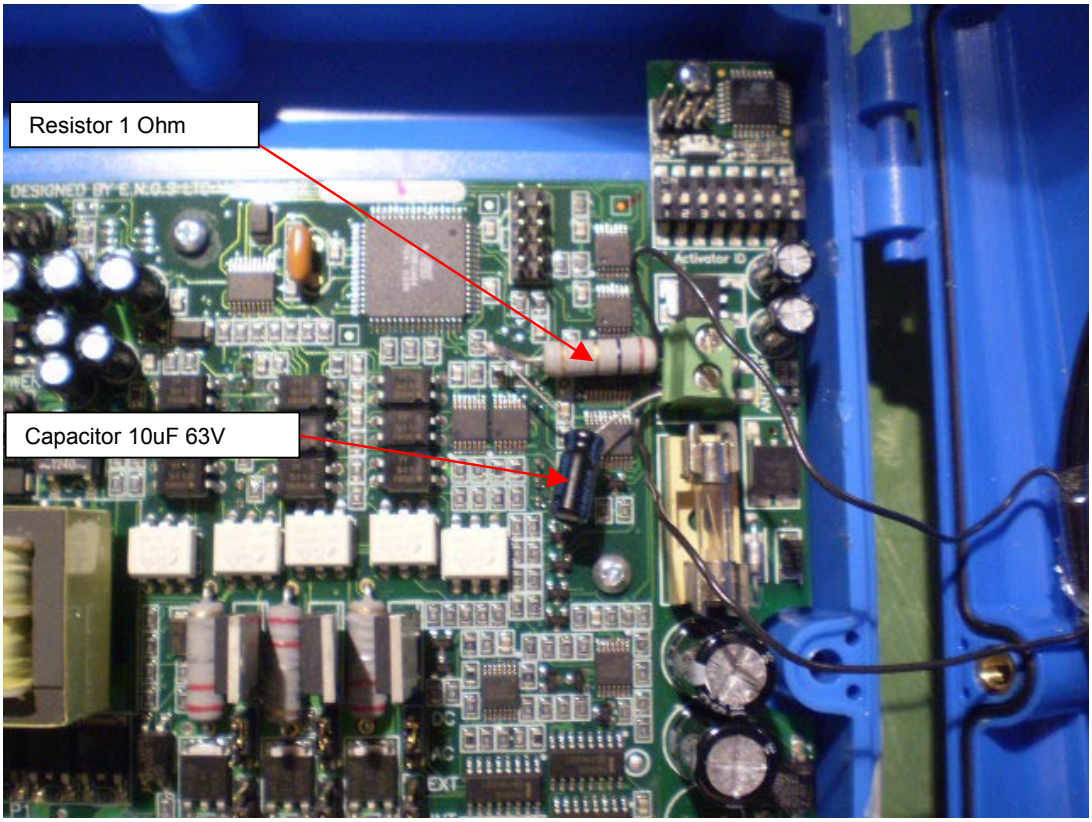
6.6 Changes made in EUT

To withstand the standard requirements, the following changes were made in the EUT during the testing.

An RC filter (resistor of 1 Ohm with capacitor of 10uF / 63V) was installed parallel to antenna output as shown in Photograph 6.6.1.

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 6.6.1 Changes made in the EUT



Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

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

7.1 Field strength of emissions

7.1.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.1.1 and Table 7.1.2.

Table 7.1.1 Radiated fundamental emission limits

Fundamental frequency, kHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
125.7	125.7	105.7

Table 7.1.2 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)		
	Within restricted bands		
	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	
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:

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

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

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

Note 1: The fundamental emission limit in dB(μV/m) was calculated as follows:

$$Lim_{AVR} = 20 \times \log(56.81818 \times F - 6136.3636)$$ - within 130 – 174 MHz band;

$$Lim_{AVR} = 20 \times \log(41.6667 \times F - 7083.3333)$$ - within 260 – 470 MHz band,

where F is the carrier frequency in MHz.

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:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

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

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

7.1.2.2 The specified frequency range was investigated with loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.

7.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.3 and shown in the associated plots.

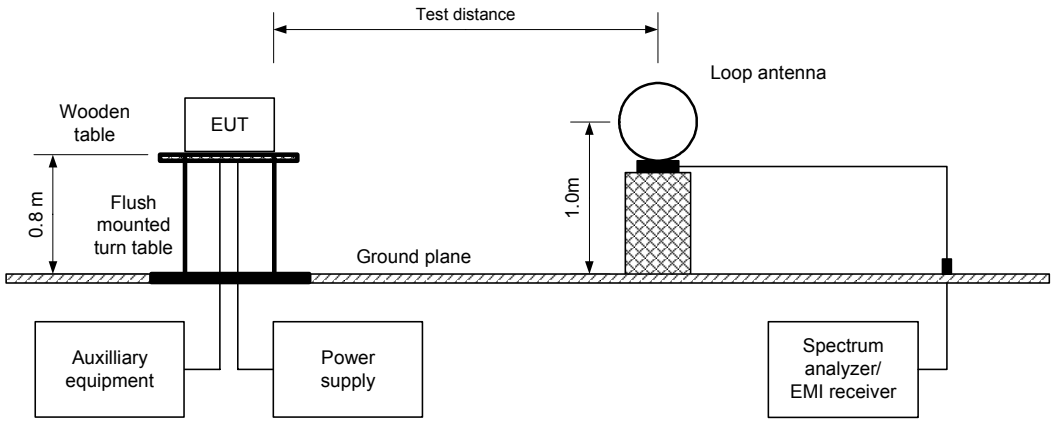
7.1.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.1.3.1 The EUT was set up as shown in Figure 7.1.2, energized and the performance check was conducted.

7.1.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.1.3.3 The worst test results (the lowest margins) were recorded in Table 7.1.3 and shown in the associated plots.

Figure 7.1.1 Setup for spurious emission field strength measurements below 30 MHz



Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

Photograph 7.1.1 Setup for spurious emission field strength measurements below 30 MHz

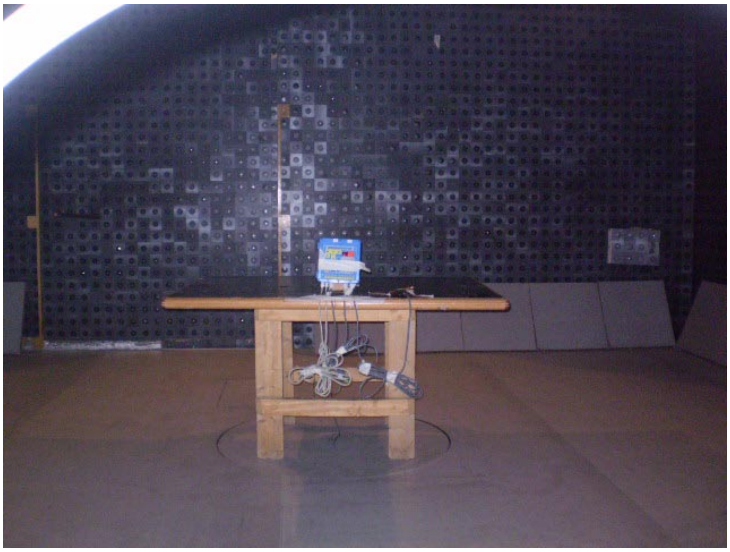
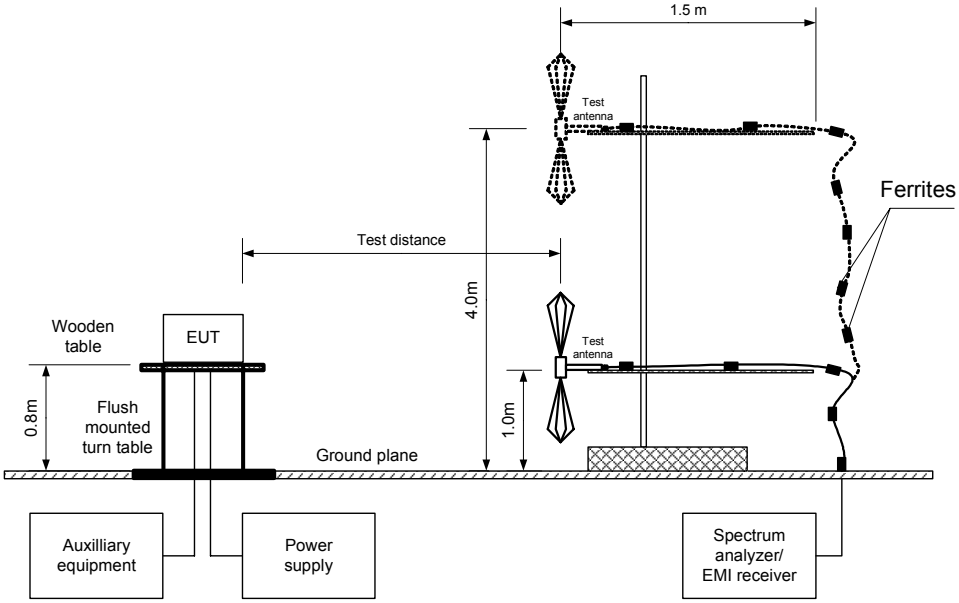
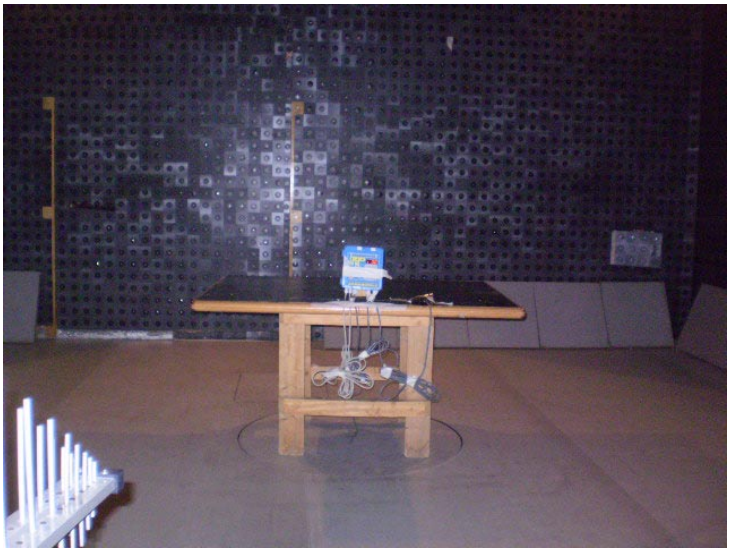


Figure 7.1.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 15.209, Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	**Air Pressure:** 1017 hPa	**Relative Humidity:** 37 %	**Power Supply:** 24 VAC
Remarks:			

Photograph 7.1.2 Setup for spurious emission field strength measurements from 30 to 1000 MHz



Test specification:	**Section 15.209, Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	**Air Pressure:** 1017 hPa	**Relative Humidity:** 37 %	**Power Supply:** 24 VAC
Remarks:			

Table 7.1.3 Field strength of fundamental emission and spurious emissions

TEST DISTANCE:	3 m
EUT POSITION:	Typical (Verticall)
MODULATION:	OOK
MODULATING SIGNAL	ID code
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 - 1000 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)
VIDEO BANDWIDTH:	≥ Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconilog (30 MHz – 1000 MHz

F, kHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength			Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Calculated*** dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental										
125.375	Vert	1.0	0	91.37	125.66	-34.29	75.97	105.66	-29.69	Pass
Spurious emissions										
251.650	Vert	1.0	0	76.84	119.60	-42.76	61.44	99.60	-38.16	
377.200	Vert	1.0	0	79.35	116.08	-36.73	63.95	96.08	-21.33	

The fundamental emission results at U nom±15% are shown in Plots 7.1.2 and 7.1.3.

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin = dB below (negative if above) specification limit.
*** - Calculated – Peak field strength – average factor****
**** - Average factor = -15.4 dB

1. The total transmission burst consist of 2 pulses of preamble and 32 bits of data.
2. Preamble consists of 2 pulses 0.5 ms duration and 2.5 ms period.
3. Total “OFF” time between preamble and data transmission is 17 ms
4. Data transmission consists of maximum 32 bits with 0.5 ms pulse duration and 1 ms pulse period.
5. Transmission pulse train consists of 3 bursts with 200 ms “OFF” time between the bursts

The total maximum transmission time is: (3+17+32*1+200)*3 = 756 ms
The maximum transmission "ON" within 100 ms time window could be calculated as follows:
T_{xON} = 2*0.5+32*0.5 = 17 ms and the next burst will occure after 200 ms.
The average factor: AF = 20 log (17/100) = -15.4 dB.

Reference numbers of test equipment used

HL 0446	HL 0521	HL 0604	HL 1947	HL 3123			

Full description is given in Appendix A.

Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

Table 7.1.3 Field strength of spurious emissions (continued)

Spurious emissions

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*				
0.5021	70.90	65.70	73.59	-7.89	Vertical	1.0	0	Pass
0.6285	67.00	60.20	71.64	-11.44	Vertical	1.0	0	
0.7517	65.60	60.00	70.09	-10.09	Vertical	1.0	0	
0.8794	53.50	44.00	68.73	-24.73	Vertical	1.0	0	
1.00300	62.40	56.10	67.60	-11.50	Vertical	1.0	0	
1.12900	53.90	48.20	66.57	-18.37	Vertical	1.0	0	
1.25400	57.10	49.80	65.66	-15.86	Vertical	1.0	0	
35.30000	32.20	17.50	40.00	-22.50	Vertical	1.0	0	
47.85000	28.90	22.30	40.00	-17.70	Vertical	1.0	250	
87.08750	35.00	17.60	40.00	-22.40	Vertical	1.0	0	
110.39980	38.30	34.30	43.50	-9.20	Vertical	1.0	0	
117.75705	38.10	35.10	43.50	-8.40	Vertical	1.0	60	
122.50000	35.80	20.80	43.50	-22.70	Vertical	1.0	0	
139.82245	37.00	35.70	43.50	-7.80	Vertical	1.0	0	

Reference numbers of test equipment used

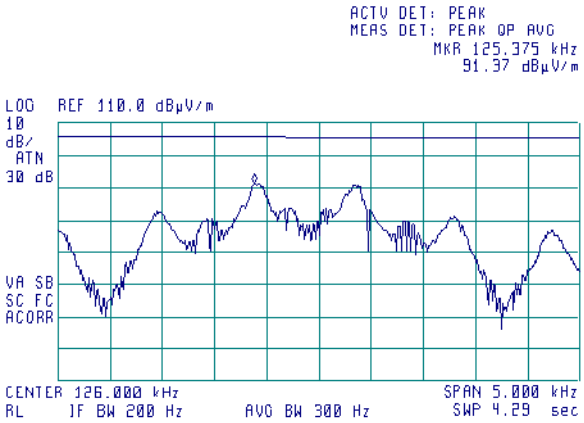
HL 0446	HL 0521	HL 0604	HL 1947	HL 3123			

Full description is given in Appendix A.

Test specification:	**Section 15.209, Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	**Air Pressure:** 1017 hPa	**Relative Humidity:** 37 %	**Power Supply:** 24 VAC
Remarks:			

Plot 7.1.1 Radiated emission measurements at the fundamental frequency

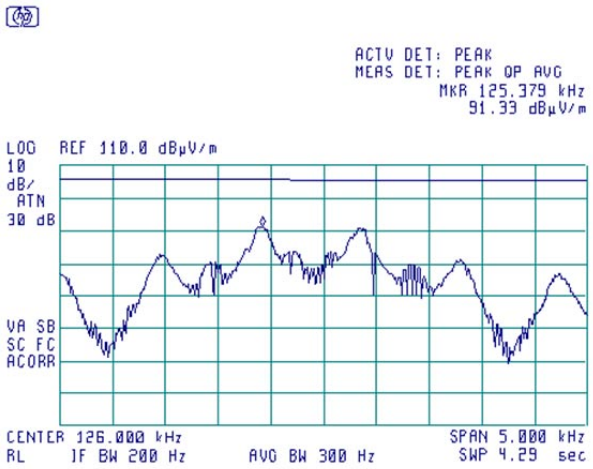
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Typical (Vertical)
DETECTOR:	Peak
VOLTAGE:	Nominal



Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

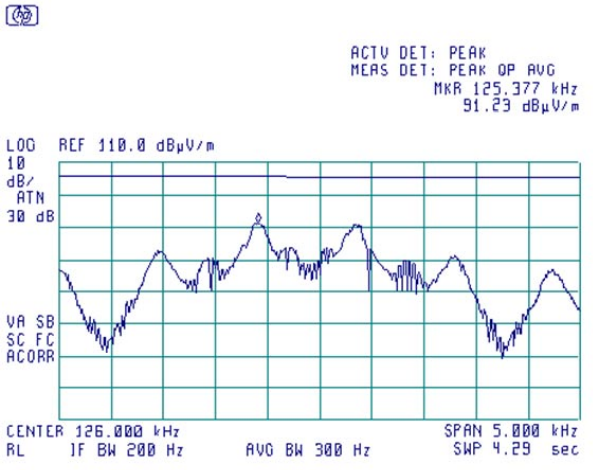
Plot 7.1.2 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)
DETECTOR: Peak
VOLTAGE: Unom + 15%



Plot 7.1.3 Radiated emission measurements at the fundamental frequency

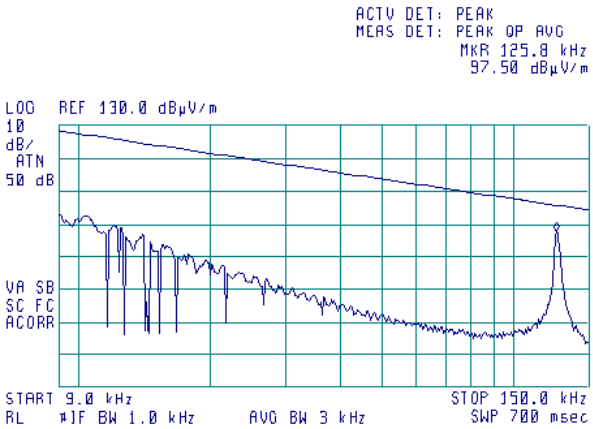
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)
DETECTOR: Peak
VOLTAGE: Unom - 15%



Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

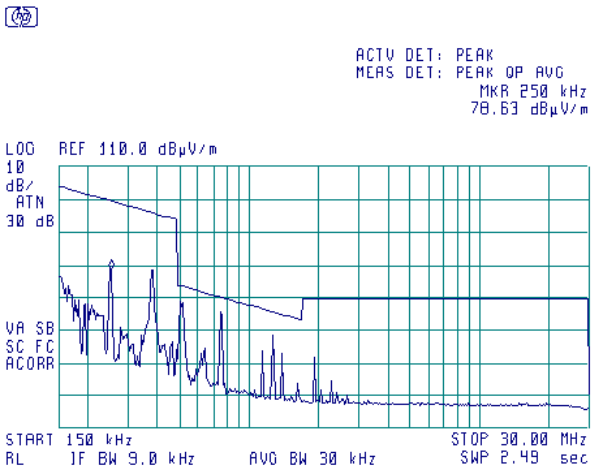
Plot 7.1.4 Radiated emission measurements from 9 to 150 kHz

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



Plot 7.1.5 Radiated emission measurements from 0.15 to 30 MHz

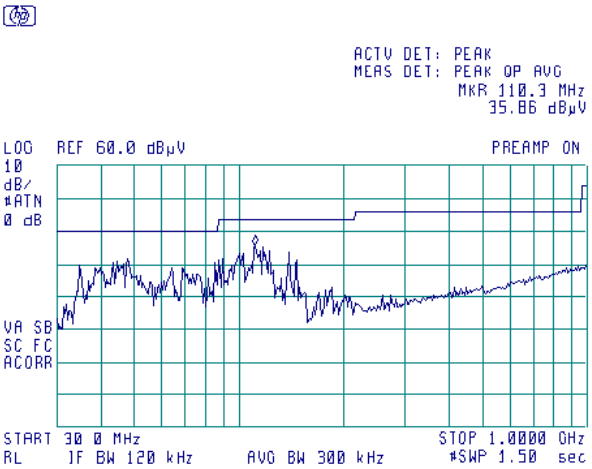
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

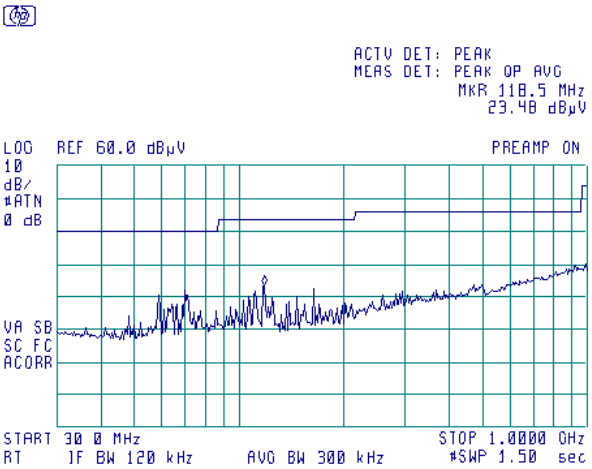
Plot 7.1.6 Radiated emission measurements from 30 to 1000 MHz

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



Plot 7.1.7 Radiated emission measurements from 30 to 1000 MHz

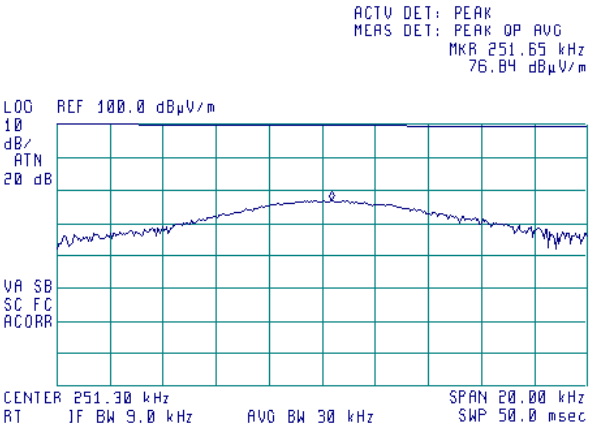
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal



Test specification:	**Section 15.209, Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	**Air Pressure:** 1017 hPa	**Relative Humidity:** 37 %	**Power Supply:** 24 VAC
Remarks:			

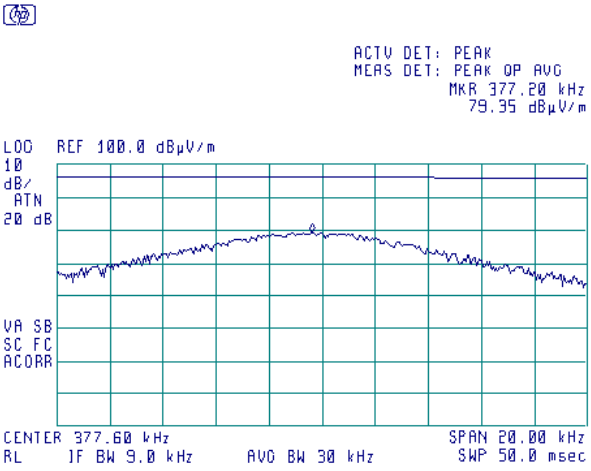
Plot 7.1.8 Radiated emission measurements at the second harmonic frequency

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



Plot 7.1.9 Radiated emission measurements at the third harmonic frequency

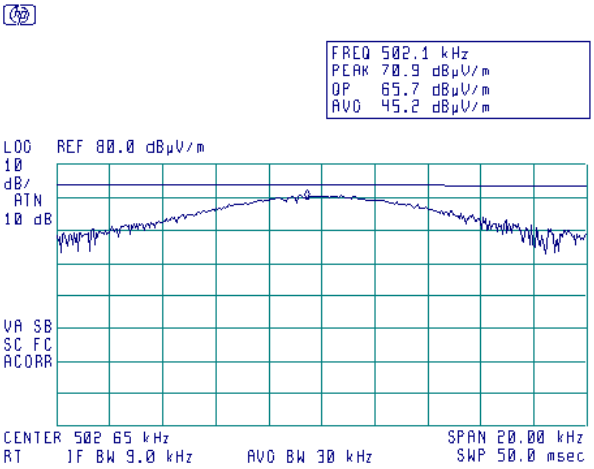
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)
DETECTOR Peak



Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

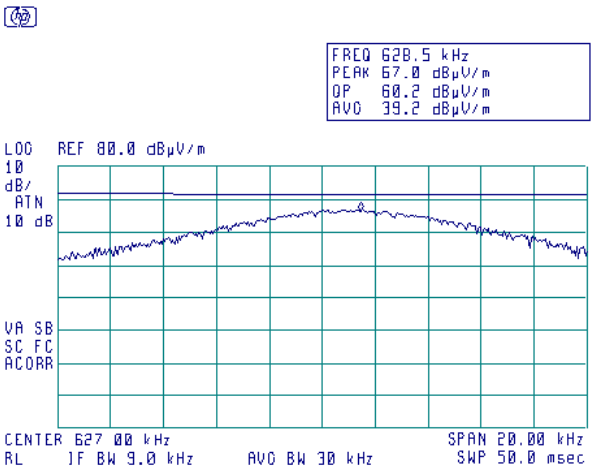
Plot 7.1.10 Radiated emission measurements at the fourth harmonic frequency

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



Plot 7.1.11 Radiated emission measurements at the fifth harmonic frequency

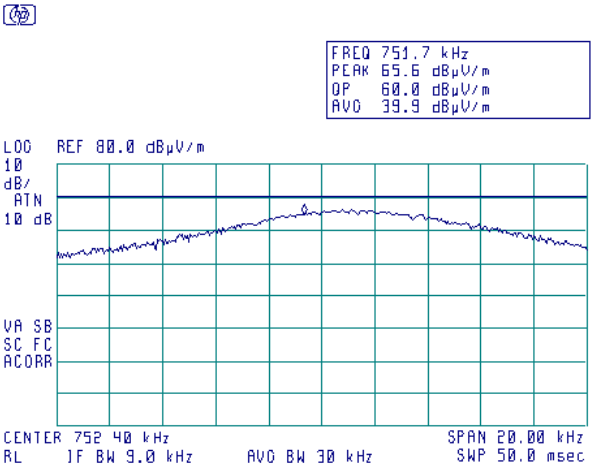
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

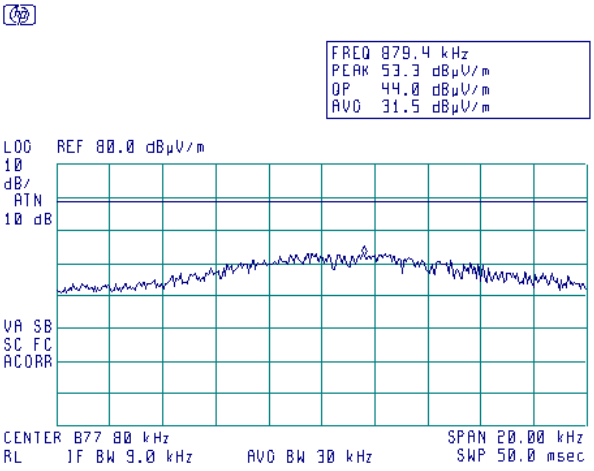
Plot 7.1.12 Radiated emission measurements at the sixth harmonic frequency

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



Plot 7.1.13 Radiated emission measurements at the seventh harmonic frequency

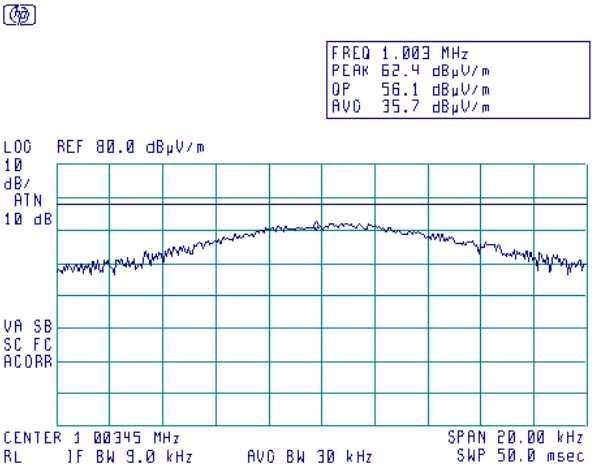
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

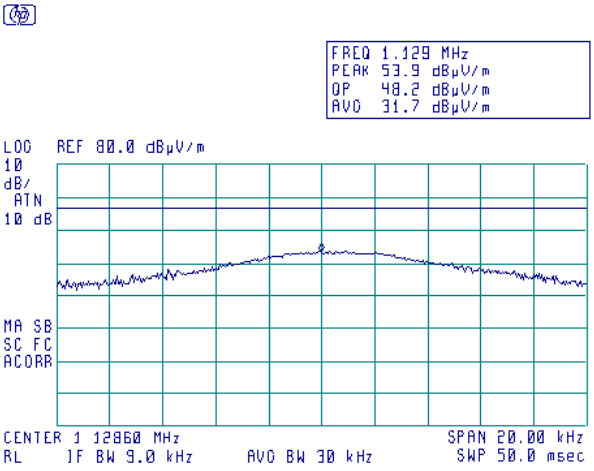
Plot 7.1.14 Radiated emission measurements at the eighth harmonic frequency

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



Plot 7.1.15 Radiated emission measurements at the ninth harmonic frequency

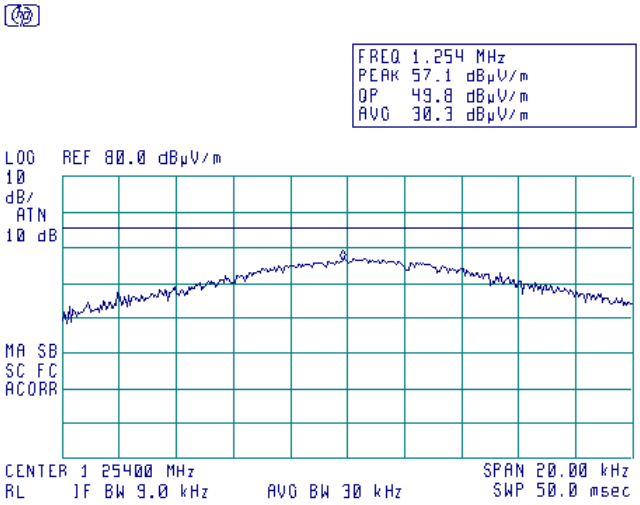
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical)



Test specification:	**Section 15.209, Field strength of emissions**		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	**Air Pressure:** 1017 hPa	**Relative Humidity:** 37 %	**Power Supply:** 24 VAC
Remarks:			

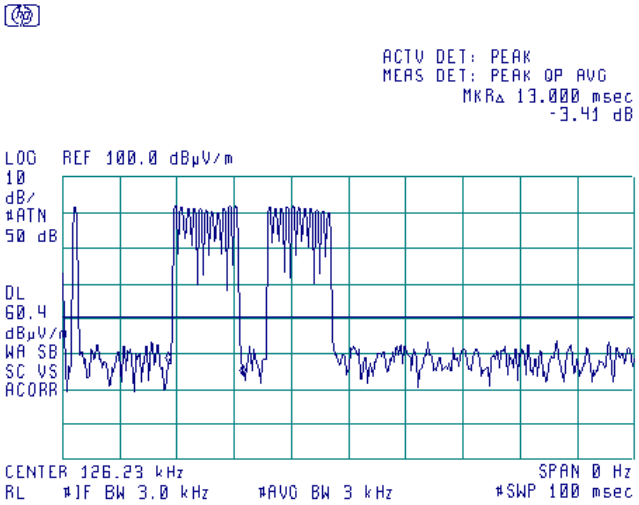
Plot 7.1.16 Radiated emission measurements at the tenth harmonic frequency

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

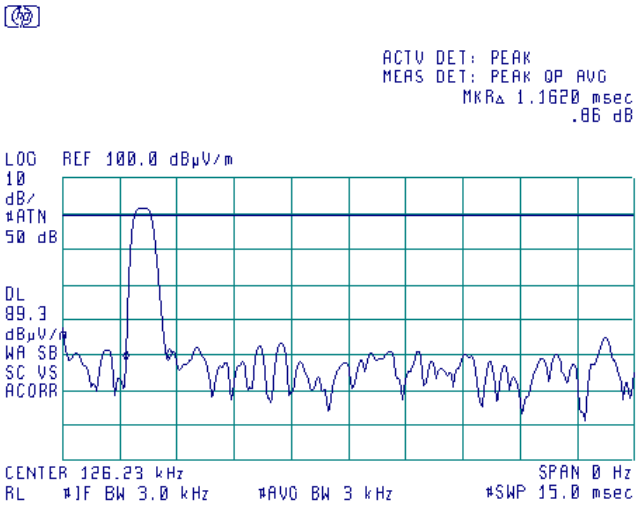


Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

Plot 7.1.17 Transmission pulse duration

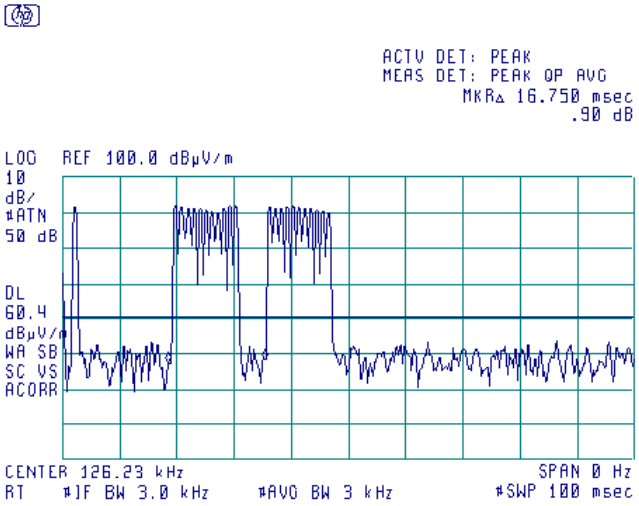


Plot 7.1.18 Transmission pulse duration

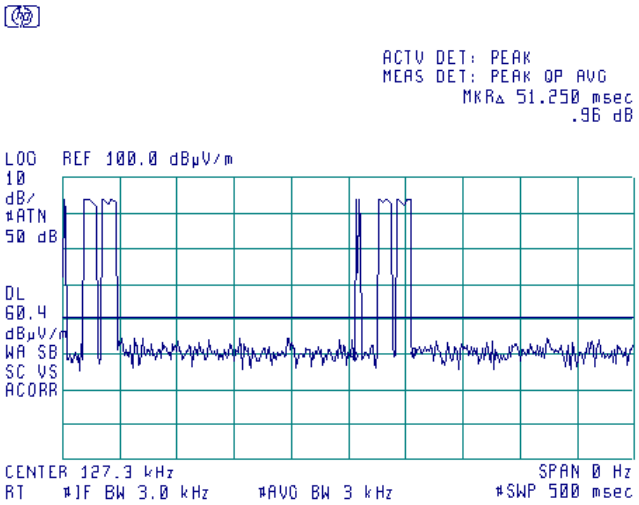


Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

Plot 7.1.19 Transmission pulse period

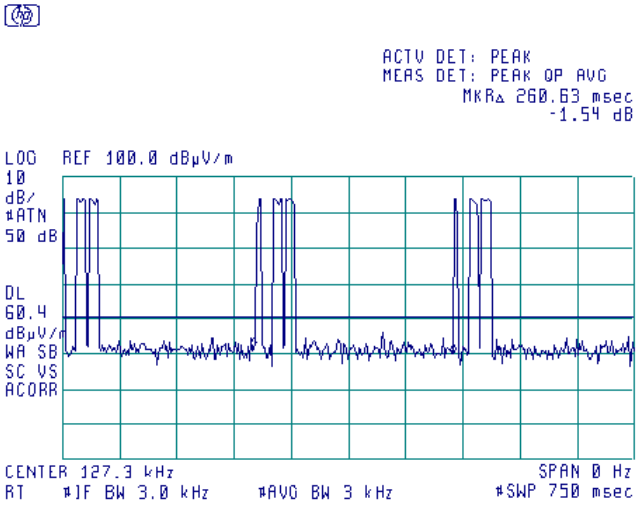


Plot 7.1.20 Transmission burst duration

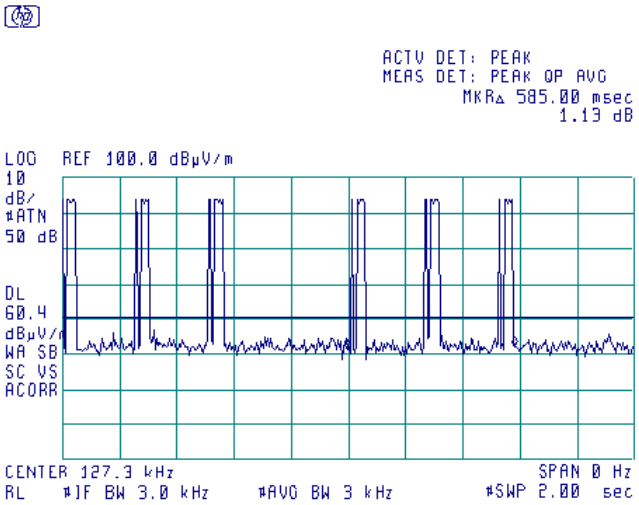


Test specification:	Section 15.209, Field strength of emissions		
Test procedure:	ANSI C63.4, Section 13.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/12/2008 9:24:14 AM		
Temperature: 24ºC	Air Pressure: 1017 hPa	Relative Humidity: 37 %	Power Supply: 24 VAC
Remarks:			

Plot 7.1.21 Transmission burst period



Plot 7.1.22 Transmission train duration



Test specification:	**Section 15.203, Antenna requirement**		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	1/1/2009 1:40:12 PM		
Temperature: 22ºC	**Air Pressure:** 1008 hPa	**Relative Humidity:** 42%	**Power Supply:** 24 VAC
Remarks:			

7.2 Antenna requirements

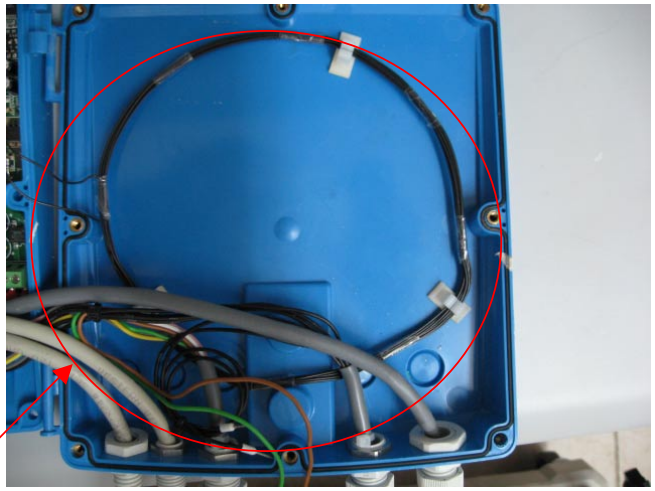
The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed 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 7.2.1.

Table 7.2.1 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	

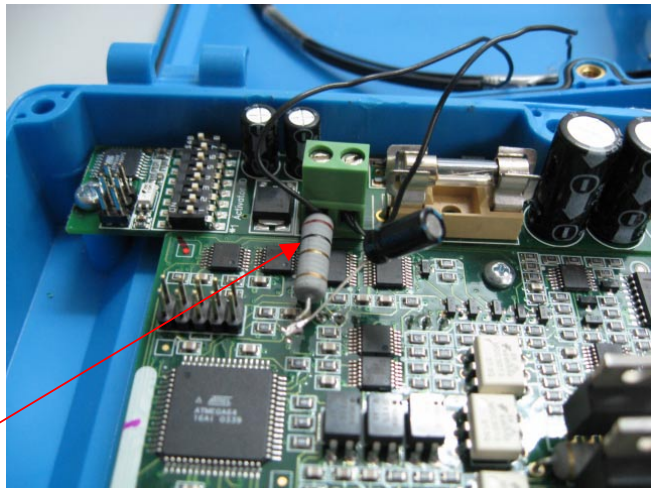
Test specification:	**Section 15.203, Antenna requirement**		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	1/1/2009 1:40:12 PM		
Temperature: 22ºC	**Air Pressure:** 1008 hPa	**Relative Humidity:** 42%	**Power Supply:** 24 VAC
Remarks:			

Photograph 7.2.1 Antenna assembly



Antenna loop

Photograph 7.2.2 Antenna assembly



Antenna connector

Test specification:	Section 15.207(a), Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	10/19/2008 3:32:21 PM		
Temperature: 23ºC	Air Pressure: 1010 hPa	Relative Humidity: 42%	Power Supply: 120 VAC
Remarks:			

7.3 Conducted emissions

7.3.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.3.1.

Table 7.3.1 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.

7.3.2 Test procedure

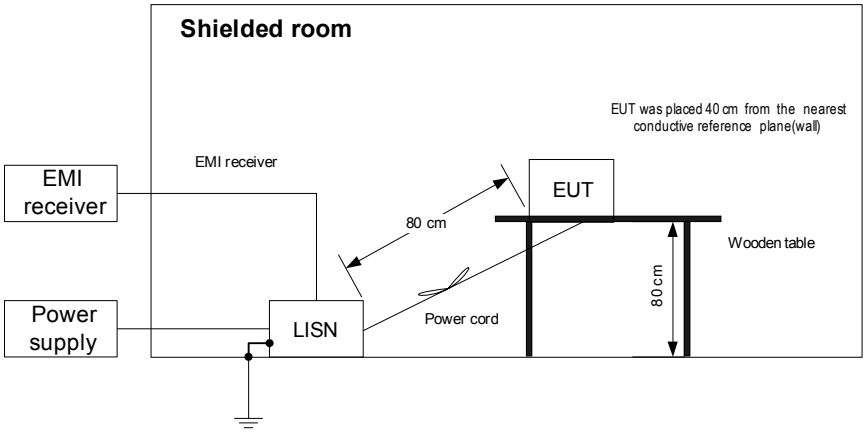
7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and the performance check was conducted.

7.3.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.3.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

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

7.3.2.4 The worst test results (the lowest margins) were recorded in Table 7.3.2 and shown in the associated plots.

Figure 7.3.1 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 & Time:	10/19/2008 3:32:21 PM		
Temperature: 23ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 42%	**Power Supply:** 120 VAC
Remarks:			

Table 7.3.2 Conducted emission test results

LINE: AC mains 120 VAC before transformer
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*		
0.158100	43.40	30.40	65.60	-35.2.	5.68	55.60	-49.92	L1	Pass
0.247250	62.90	54.27	61.87	-7.60	27.73	51.87	-24.14		
0.369375	56.95	48.66	58.56	-9.90	13.23	48.56	-35.33		
0.620500	48.81	33.96	56.00	-22.04	11.61	46.00	-34.39		
0.744288	50.25	35.26	56.00	-20.74	14.07	46.00	-31.93		
14.255000	57.34	42.5	56.00	-13.5	17.15	46.00	-28.85		
16.365000	60.48	43.37	56.00	-12.63	12.86	46.00	-33.14		
0.150150	45.29	32.44	65.99	-33.55	7.10	55.99	-48.89	L2	Pass
0.252000	60.60	54.90	61.73	-6.83	29.10	51.73	-22.63		
0.373098	53.06	45.90	58.47	-12.57	16.94	48.47	-31.53		
0.504875	39.37	34.63	56.00	-21.37	9.64	46.00	-36.36		
3.523625	40.52	31.10	56.00	-24.90	2.51	46.00	-43.49		
10.556000	52.82	41.04	56.00	-14.96	8.72	46.00	-37.28		
12.823478	55.14	46.70	56.00	-9.3	11.38	46.00	-34.62		
16.677575	59.99	40.64	56.00	-15.36	13.59	46.00	-32.41		
23.706750	48.72	32.68	56.00	-23.32	4.46	46.00	-41.54		

Reference numbers of test equipment used

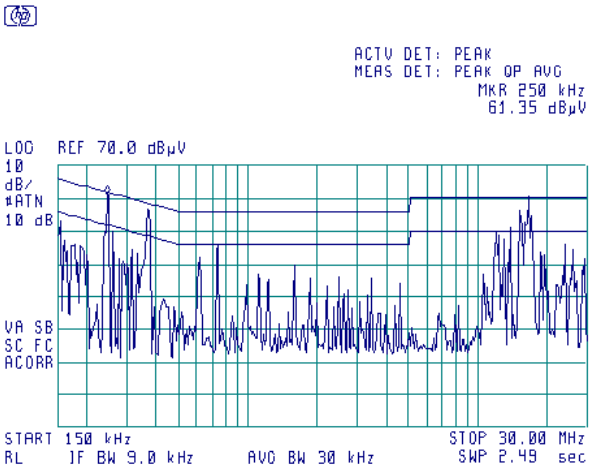
HL 0495	HL 0787	HL 1430	HL 1502	HL 1503	HL 2888		

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 & Time:	10/19/2008 3:32:21 PM		
Temperature: 23ºC	Air Pressure: 1010 hPa	Relative Humidity: 42%	Power Supply: 120 VAC
Remarks:			

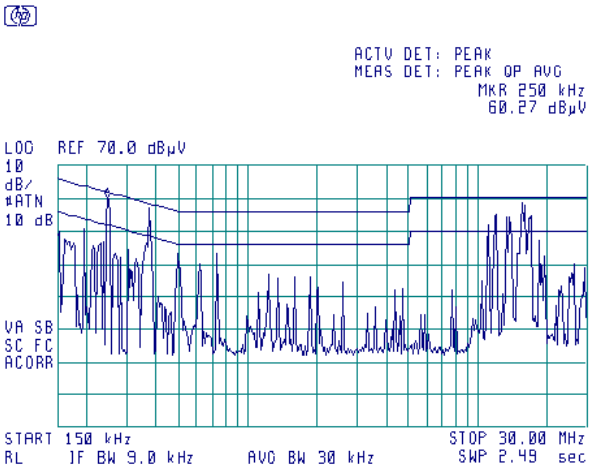
Plot 7.3.1 Conducted emission measurements

LINE:	L1
LIMIT:	QUASI-PEAK, AVERAGE
DETECTOR:	PEAK
EUT unit	120 VAC before transformer
Mode	Transmit



Plot 7.3.2 Conducted emission measurements

LINE:	L2
LIMIT:	QUASI-PEAK, AVERAGE
DETECTOR:	PEAK
EUT unit	120 VAC before transformer
Mode	Transmit



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal.	Due Cal.
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	29-Jun-08	29-Jun-09
0495	Autotransformer 0-255V, 10A	Variac	EMPL01	495	14-Aug-08	14-Aug-09
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard Co	8546A	3617A 00319, 3448A002 53	29-Aug-08	29-Aug-09
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	11-Jan-09	11-Jan-10
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard Co	11947A	3107A018 77	16-Oct-08	16-Oct-09
1430	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL1432	Agilent Technologies	8542E	3807A002 62,3705A0 0217	31-Aug-08	31-Aug-09
1502	Cable RF, 6 m, BNC/BNC	Belden	M17/167 MIL-C-17	1502	30-Dec-08	30-Dec-09
1503	Cable RF, 6 m, BNC/BNC	Belden	M17/167 MIL-C-17	1503	30-Dec-08	30-Dec-09
1947	Cable 18GHz, 6.5 m, blue	Rhophase Microwave Limited	NPS-1803A-6500-NPS	T4974	30-Dec-08	30-Dec-09
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	09-Jul-08	09-Jul-09
3123	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-9155-00	3123	30-Dec-08	30-Dec-09

9 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Radiated emissions at 10 m measuring distance Horizontal polarization 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 with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 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.

10 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.
Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file numbers IC 2186A-1 for OATS and IC 2186A-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site), 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).

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website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

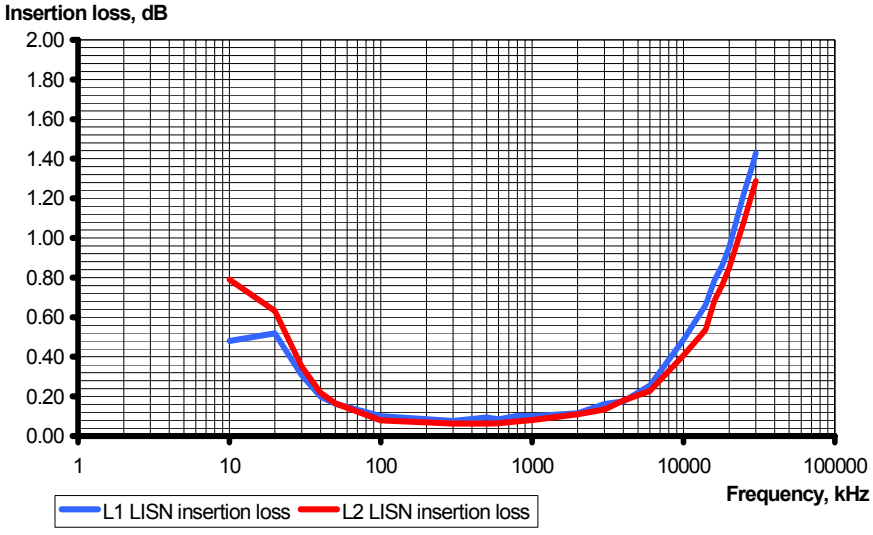
11 APPENDIX D Specification references

47CFR part 15: 2007	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.

12 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(μV) to convert it into field intensity in dB(μV/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(μV) to convert it into field intensity in dB(μV/m).

Cable loss
Cable coaxial, 6 m, model: M17/167 MIL-C-17, HL 1502

Frequency, MHz	Cable loss, dB
0.1	0.02
1	0.07
3	0.15
5	0.17
10	0.26
30	0.43
50	0.57
80	0.72
100	0.81
300	1.48
500	2.00
800	2.70
1000	3.09

Cable loss
Cable coaxial, 6 m, model: M17/167 MIL-C-17, HL 1503

Frequency, MHz	Cable loss, dB
0.15	0.043
1	0.077
3	0.139
5	0.169
10	0.248
30	0.430
50	0.561
75	0.697
100	0.822
300	1.446
500	1.901
800	2.663
1000	2.829
1500	3.569
2000	4.179

Cable loss
Cable 18 GHz, 6.5 m, blue, model: NPS-1803A-6500-NPS, S/N T4974, HL 1947

Frequency, GHz	Cable loss, dB
0.03	0.30
0.05	0.38
0.10	0.53
0.20	0.74
0.30	0.91
0.40	1.05
0.50	1.18
0.60	1.29
0.70	1.40
0.80	1.50
0.90	1.59
1.00	1.68
1.10	1.77
1.20	1.86
1.30	1.94
1.40	2.01
1.50	2.08
1.60	2.16
1.70	2.22
1.80	2.29
1.90	2.36
2.00	2.42
2.10	2.48
2.20	2.54
2.30	2.60
2.40	2.66
2.50	2.71
2.60	2.77
2.70	2.83
2.80	2.89
2.90	2.95
3.10	3.06
3.30	3.17
3.50	3.28
3.70	3.39
3.90	3.51
4.10	3.62
4.30	3.76
4.50	3.87
4.70	4.01
4.90	4.10
5.10	4.21
5.30	4.31
5.50	4.43
5.70	4.56
5.90	4.71

Frequency, GHz	Cable loss, dB
6.10	4.87
6.30	4.95
6.50	4.94
6.70	4.88
6.90	4.87
7.10	4.83
7.30	4.85
7.50	4.86
7.70	4.91
7.90	4.96
8.10	5.03
8.30	5.08
8.50	5.13
8.70	5.21
8.90	5.22
9.10	5.34
9.30	5.35
9.50	5.52
9.70	5.51
9.90	5.66
10.10	5.70
10.30	5.78
10.50	5.79
10.70	5.82
10.90	5.86
11.10	5.94
11.30	6.06
11.50	6.21
11.70	6.44
11.90	6.61
12.10	6.76
12.40	6.68
13.00	6.66
13.50	6.81
14.00	6.90
14.50	6.90
15.00	6.97
15.50	7.17
16.00	7.28
16.50	7.27
17.00	7.38
17.50	7.68
18.00	7.92

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		

13 APPENDIX F Abbreviations and acronyms

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

END OF DOCUMENT