HERMON LABORATORIES

Electrical

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ELECTROMAGNETIC EMISSION TEST REPORT

ACCORDING TO 47CFR PART 15, SUBPART C § 15.225, § 15.249 and SUBPART B

for

On Track Innovations Ltd.

EQUIPMENT UNDER TEST:

VST/PST system controller

This report is in conformity with EN 45001 and ISO/IEC 17025. The A2LA logo endorsement applies only to the test methods and the standards that are listed in the scope of Hermon Laboratories accreditation.
The test results relate only to the items tested. **This test report must not be reproduced in any form except in full with the approval of Hermon Laboratories Ltd.**

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1 Project information

Description of equipment under test

Test items	:VST/PST system
Manufacturer	:On Track Innovations Ltd.
Types (Models)	:MCI2-3 QSR
Equipment FCC code[1]	:DXX

Applicant information

Applicant's responsible person	:Mr. Hemi Itay, project manager
Company	: On Track Innovations Ltd.
Address	:Zahar industrial zone,
Postal code	:12000
City	:Rosh Pina
Country	:Israel
Telephone number	:+972 4 6868000
Telefax number	:+972 4 6938887

Test performance

Project Number:	:14915
Location	:Hermon Laboratories
Receipt date	:December 12, 2001
Test started	:December 12, 2001
Test completed	:December 17, 2001
Purpose of test	Apparatus compliance verification in accordance with emission requirements
Test specification(s)	47CFR Part 15, §15.225, §15.249 and subpart B

[1] FCC Equipment codes – see Appendix D

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2 Summary of tests

The tests listed in the table below were performed. The EUT was found complying with the limits of 47CFR Part 15, §15.225, §15.249 and subpart B.

Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
Transmitter characteristics, §15.225								
Field strength of emission within the assigned band	(a)	**C**				Mrs. E Pitt, test engineer	Dec-11-2001	
Out of band spurious emissions (radiated)	(b)	**C**				Mrs. E Pitt, test engineer	Dec-11-2001	
Frequency tolerance of carrier signal	(c)	**C**				Mrs. E Pitt, test engineer	Dec-17-2001	
Transmitter characteristics, §15.249								
Field strength of fundamental	(a)	**C**				Mrs. E Pitt, test engineer	Dec-11-2001	
Field strength of harmonics	(a)	**C**				Mrs. E Pitt, test engineer	Dec-11-2001	
Out of band spurious emissions (radiated)	(c)	**C**				Mrs. E Pitt, test engineer	Dec-11-12-2001	
Unintentional radiation, §15.107, §15.109								
Conducted emissions	15.107	**C**				Mrs. E Pitt, test engineer	Dec-12-2001	
Radiated emissions	15.109	**C**				Mrs. E Pitt, test engineer	Dec-11-2001	
Receiver characteristics, §15.109								
Spurious radiated emissions	15.109	**C**				Mrs. E Pitt, test engineer	Dec-11-2001	
General conditions under Part 15								
The Intentional radiator operates at 13.56 MHz and 916.5 MHz frequency.	15.225, 15.249	**C**						
The intentional radiator has permanently attached antenna or antenna that uses a unique coupling to the intentional radiator.	15.203				**NA**			

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Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
The intentional radiator has a standard connector and must be professionally installed. To demonstrate that professional installation is required, the following three points must be addressed: (a) the application (or intended use) of the EUT; (b) the installation requirements of the EUT, and (c) the method by which the EUT will be marketed.	15.203	**C**						
No antenna other than that furnished by the responsible party can be used with the device.	15.203					Responsibility of the end user		
Antenna technical characteristics, as referred to in "Transmitter description" table in the test report	15.204	**C**						
NOTE: C: The parameter is compliant with the requirements. NC: The parameter is not compliant with the requirements. NT: The parameter is not tested. NA: The test of this parameter is not applicable.								

Tests performed by: Mrs. E. Pitt, test engineer

Test report prepared by: Mrs. V. Mednikov, certification engineer

Test report approved by: Mr. M. Nikishin, EMC group leader

Mr. A. Usoskin, QA manager

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3 EUT description

3.1 General description

The VST/PST system comprises three elements:

- VST/PST Controller
- VST (Vehicle Smart Tag) tag
- PST (Portable Smart Tag) tag

The VST portion of the system supports communication between the VST tag and the controller over distances of up to few tens of meters, utilizing 915MHz communication frequency.
The PST portion of the system supports communication of the PST tag and the controller over distances of up to 10cm, utilizing 13.56MHz frequency.
The Controller supports one VST communication channel and two PST communication channels.
It also supports RS232 communication to host channel and one signaling channel comprising two indication signals.
The system is used to perform “transaction” of data between the VST or PST tags and the controller for various applications.

The controller is powered from 110 V AC mains. The VST tag is powered from 3.6 V battery. The PST tag has no independent power source. It receives its power from the controller’s antenna transmitted power.

3.2 EUT test configuration

The EUT ports and lines description is given in Table 3.2.1, test configuration is provided in Figure 3.2.1.

Table 3.2.1 EUT ports and lines

Port type	Port description	Connector type	Quantity	Cable type description	Cable length, m	Connected to
Power	AC power	Gland	1	unshielded	1.5	Mains
Antenna	Antenna	SMA	1	coax	4	Antenna 915 MHz
Antenna	Antenna	Gland	2	coax	7	Antenna 13.56 MHz
Signal	Signal	Gland	1	shielded	1.7*	terminated
Control	Control	Gland	1	unshielded	2*	lamp

*** May be longer than 3 m**

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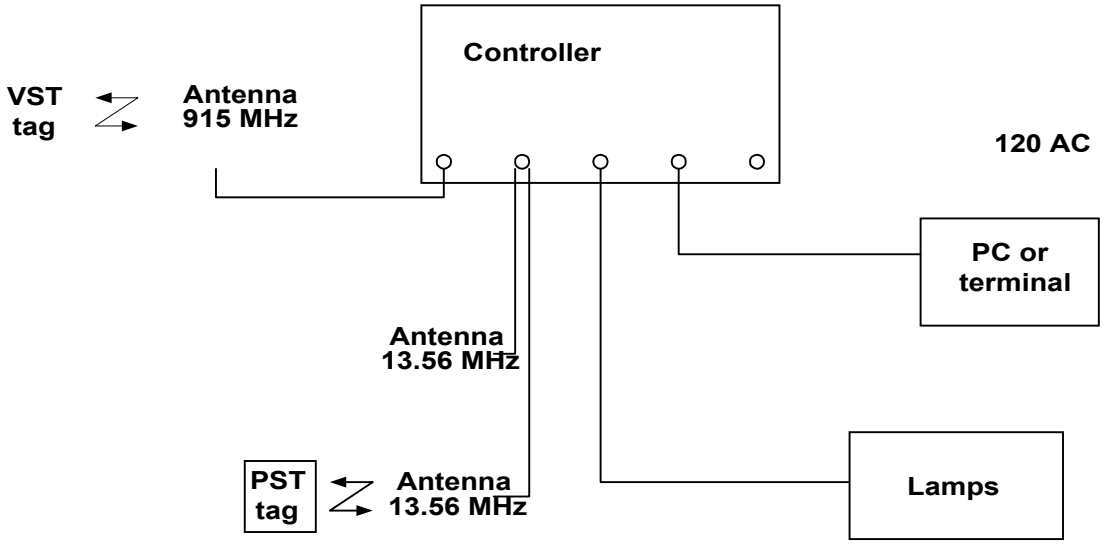
Figure 3.2.1



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3.3 Transmitter description

VST/PST controller

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)
	Other:

Operating frequency	VST channel – 915 MHz PST channel – 13.56 MHz
Transmitter aggregate data rate (bits per second)	4.8kb/s
Normal test signal	normal send-message/get-response sequence in a repetitive mode

Maximum rated output power	
At transmitter permanent external 50 Ω rf output connector (dBm)	VST channel: -15 dBm
Effective radiated power (for equipment with integral antenna) (dBm)	PST channel: 250 mW (24 dBm)

Is transmitter output power variable?	**X**	No		
		Yes		continuous variable
				stepped variable
				stepsize (dB):.....
				minimum RF power (dBm):.....
				maximum RF power (dBm):.....

Transmitter power source			
	Battery	**Nominal rated voltage (VDC)**	
	Nickel Cadmium		
	Lithium		
	Other		
	DC	**Nominal rated voltage (VDC)**	
X	**AC mains**	**Nominal rated voltage (VAC)**	120 V / 60 Hz

Is there common power source for transmitter and receiver	**X**	yes		no

Antenna technical characteristics

Controller, VST channel

			Type	**Manufacturer**	**Model number**	**Gain**
Integral		with temporary RF connector				
		without temporary RF connector				
External			**directional**	**Mars + RF Systems LTD**	**MA9158V-OTI**	**9 dBi**

External antenna connection

X	standard connector SMA		unique coupling

Controller, PST channel

			Type	**Manufacturer**	**Model number**	**Gain**
Integral		with temporary RF connector				
		without temporary RF connector				
External			**loop**	**OTI**		**-----**

External antenna connection

X	standard connector – Terminal Block		unique coupling

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VST tag

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)
	Other:

Operating frequency	915 MHz
Transmitter aggregate data rate (bits per second)	4.8kb/s
Normal test signal	normal send-message/get-response sequence in a repetitive mode

Maximum rated output power	
At transmitter permanent external 50 Ω rf output connector (dBm)	
Effective radiated power (for equipment with integral antenna) (dBm)	-10 dBm

Is transmitter output power variable?		No		
	X	Yes		continuous variable
			X	stepped variable
			X	stepsize (dB): 5dB
			X	minimum RF power (dBm):-.20dBm
			X	maximum RF power (dBm): -10dBm

Transmitter power source			
X	**Battery**	**Nominal rated voltage (VDC)**	**3.6**
	Nickel Cadmium		
X	Lithium		
	Other		
	DC	**Nominal rated voltage (VDC)**	
	AC mains	**Nominal rated voltage (VAC)**	60 Hz

Is there common power source for transmitter and receiver	**X**	yes		no

Antenna technical characteristics						
			Type	**Manufacturer**	**Model number**	**Gain**
Integral		with temporary RF connector	**"L"** Shape PCB Trace	--------	---------	------
	X	without temporary RF connector				
External						

External antenna connection – NA			
	standard connector		unique coupling

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PST tag

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)
	Other:

Operating frequency	13.56 MHz
Transmitter aggregate data rate (bits per second)	4.8kb/s
Normal test signal	normal send-message/get-response sequence in a repetitive mode

Maximum rated output power	
At transmitter permanent external 50 Ω rf output connector (dBm)	
Effective radiated power (for equipment with integral antenna) (dBm)	not relevant (load modulation)

Is transmitter output power variable?		No		
		Yes		continuous variable
				stepped variable
				stepsize (dB):.....
				minimum RF power (dBm):.....
				maximum RF power (dBm):.....

Transmitter power source – no independent power source			
	Battery	**Nominal rated voltage (VDC)**	
	Nickel Cadmium		
	Lithium		
	Other		
	DC	**Nominal rated voltage (VDC)**	
	AC mains	**Nominal rated voltage (VAC)**	60 Hz

Is there common power source for transmitter and receiver		yes		no

Antenna technical characteristics						
			Type	**Manufacturer**	**Model number**	**Gain**
Integral		with temporary RF connector	**Loop** PCB Trace	--------	--------	------
	X	without temporary RF connector				
External						

External antenna connection – NA			
	standard connector		unique coupling

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4 Tests results

4.1 Field strength of emission within the assigned band according to § 15.225 (a)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4
EQUIPMENT UNDER TEST	VST/PST Controller + PST tag
DATE:	December 11, 2001
RELATIVE HUMIDITY:	57 %
AMBIENT TEMPERATURE:	23 °C
OPERATING FREQUENCY RANGE	13.553-13.567 MHz
TEST DISTANCE	3 m

Peak detector

Frequency, MHz	Field strength, dB(μV/m)	Calculated limit*, dB (μV/m)	Margin, dB	Reference to Plots in Appendix A
13.562	89.46	120	30.54	A1
Measurement uncertainty, dB		± 2.36 dB		

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

$Lim_{3m} = Lim_{30m} + 40 \log (S_1/S_2)$, where $S_1 = 30$ m, $S_2 = 3$ m.

TEST EQUIPMENT USED:

HL 0446	HL 0521					

LIMIT

The field strength of any emissions within 13.553-13.567 MHz band shall not exceed 10000 μV/m at 30 m.

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4.2 Out of band radiated spurious emissions according to § 15.225 (b), §15.209

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4/ §13.1.5
EQUIPMENT UNDER TEST	VST/PST Controller + PST tag
MODE OF OPERATION	Tx+Rx
DATE:	December 11, 2001
RELATIVE HUMIDITY:	57 %
AMBIENT TEMPERATURE:	23 °C
RATED CARRIER FIELD STRENGTH	89.46 dB(µV/m)
TEST DISTANCE	3 m
OPERATING FREQUENCY	13.56 MHz
FREQUENCY RANGE	9 kHz to 900 MHz

Quasi-peak detector

Frequency, MHz	Radiated emission, dB (µV/m)	Limit*, dB (µV/m)	Margin, dB	Reference to Plots in Appendix A
0.009 – 0.15	No spurious emissions found			A2
0.15 – 30	No spurious emissions found			A3
13.500 – 13.600	All out of band emissions were found below the limit			A4, A5, A6
13.553	65.07	69.5	4.43	A5
13.567	54.57	69.5	14.93	A6
40.6970	28.57	40	11.43	A7
76.0221	24.46	40	15.54	A7
84.0257	29.26	40	10.74	A7
87.9948	24.83	40	15.17	A7
124.0516	28.84	43.5	14.66	A7
128.0245	26.85	43.5	16.65	A8
Measurement uncertainty, **dB**		± 2.36 dB		

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

$Lim_{3m} = Lim_{30m} + 40 \log (S_1/S_2)$, where $S_1 = 30$ m, $S_2 = 3$ m.

Table abbreviations:
Margin = dB below (negative if above) specification limit.

TEST EQUIPMENT USED:

HL 0446	HL 0521	HL 0539	HL 0554	HL 0589	HL 0604	HL 1004

LIMIT

The field strength of any emissions appearing outside of the assigned band shall not exceed the general radiated emission limits shown in Section15.209(a).

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4.3 Frequency tolerance of the carrier signal according to § 15.225 (c)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.6
EQUIPMENT UNDER TEST	VST/PST Controller + PST tag
DATE:	December 17, 2001
RELATIVE HUMIDITY:	57 %
AMBIENT TEMPERATURE:	23 °C
OPERATING FREQUENCY	13.56 MHz

Temperature, . °C	Supply voltage, V AC	Operating frequency, kHz	Frequency tolerance*, kHz	Reference to Plots in Appendix A
T_{nom} 23 °C	**V_{nom} 120 V**	**13563.2**	**Reference**	A9
	V_{min} 102 V	13563.2	0	A10
	V_{max} 138 V	13563.2	0	A11
T_{min} -20 °C	V_{min} .120 V	13562.8	-0.4	A12
T_{max} +50 °C	V_{max} .120 V	13562.8	-0.4	A13
Measurement uncertainty		± 0.21 ppm		

* Frequency tolerance of the carrier signal shall be within ± 1.35632 kHz

TEST EQUIPMENT USED:

HL 0026	HL 0493	HL 1412				

LIMIT

The frequency tolerance of the carrier signal shall be maintained within ± 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

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4.4 Field strength of fundamental according to § 15.249 (a), §15.209

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4
EQUIPMENT UNDER TEST	VST/PST Controller
MODE OF OPERATION	Tx+Rx
DATE:	December 11, 2001
RELATIVE HUMIDITY:	56 %
AMBIENT TEMPERATURE:	23 °C
OPERATING FREQUENCY RANGE	902-928 MHz

Peak detector

Carrier frequency, MHz	Field strength, dB(μV/m)	Quasi-peak limit, dB(μV/m)	Margin, dB	Reference to Plots in Appendix A
915.3	82.82	94	11.28	A14
Measurement uncertainty, dB		+5.73.dB / -5.57 dB		

TEST EQUIPMENT USED:

HL 0521	HL 0589	HL 0604	HL 1004			

LIMIT

Operating frequency range, MHz	Field strength of fundamental, dB(μV/m)
902-928	94
2400-2483.5	94
5275-5850	94
24000-24250	107.95

For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

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4.5 Field strength of harmonics according to § 15.249 (a), §15.209

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4
EQUIPMENT UNDER TEST	VST/PST Controller
MODE OF OPERATION	Tx+Rx
DATE:	December 11, 2001
RELATIVE HUMIDITY:	56 %
AMBIENT TEMPERATURE:	23 °C
FREQUENCY RANGE	1000 – 9500 MHz
CARRIER FREQUENCY	915.3 MHz

Peak detector

Harmonic, MHz	Field strength, dB(μV/m)	Average limit, dB(μV/m)	Margin, dB	Reference to Plots in Appendix A
1830	50.66	54	3.34	A15
2745	45.74	54	8.26	A16
Measurement uncertainty, dB		+5.73.dB / -5.57 dB		

Test results obtained using peak detector were found below average limit, therefore further measurements with average detector were considered unnecessary.

TEST EQUIPMENT USED:

HL 0041	HL 0521	HL 0589	HL 0604	HL 1004		

LIMIT

Operating frequency range, MHz	Field strength of harmonics, dB(μV/m)	
	Peak limit	Average limit
902-928	74	54
2400-2483.5	94	74
5275-5850	94	74
24000-24250	107.95	87.95

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4.6 Out of band spurious emissions

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4/ §13.1.5
EQUIPMENT UNDER TEST	VST/PST Controller + PST tag
MODE OF OPERATION	Tx+Rx
DATE:	December 11– 12, 2001
RELATIVE HUMIDITY:	59 %
AMBIENT TEMPERATURE:	23 °C
RATED CARRIER FIELD STRENGTH	82.82 dB(µV/m)
TEST DISTANCE	3 m
OPERATING FREQUENCY RANGE	902-928
FREQUENCY RANGE*	9 kHz – 9.5 GHz

Quasi-peak detector

Frequency, MHz	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB	Reference to Plots in Appendix A
0.009 - 900	Refer to paragraph 4.2 and Plots			A2 – A8
Measurement uncertainty, dB		+5.73.dB / -5.57 dB		

Peak detector

Frequency, MHz	Antenna polarization	Radiated emission, dB (µV/m)	Limit, dB(µV/m)	Margin, dB	Reference to Plots in Appendix A
901.88	V+H	43.63	46	2.37	A17
928.05	V+H	42.49	46	3.51	A18
928 – 1000	V	No spurious emissions were found			A19
928 – 1000	H	No spurious emissions were found			A20
1000 – 2000	V+H	No spurious emissions were found except harmonics			A21
2000 – 5000	V+H	No spurious emissions were found except harmonics			A22
5000 – 6500	V+H	No spurious emissions were found			A23
6500 – 9500	V+H	No spurious emissions were found			A24
Measurement uncertainty, dB		+5.73.dB / -5.57 dB			

Table abbreviations:
Margin = dB below (negative if above) specification limit.

TEST EQUIPMENT USED:

HL 0038	HL 0041	HL 0521	HL 0539	HL 0554	HL 0589	HL 0604
HL 1004	HL 1424	HL 1942				

LIMIT

Radiated emissions, which fall in the restricted bands, must comply with §15.209(a) limits.

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4.7 Receiver spurious emissions, according to §15.109

METHOD OF MEASUREMENT: ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
EQUIPMENT UNDER TEST VST/PST Controller + PST tag
TEST PERFROMED IN: ANECHOIC CHAMBER
DATE December 11, 2001
RELATIVE HUMIDITY 59 %
AMBIENT TEMPERATURE: 23 °C
DISTANCE BETWEEN ANTENNA AND EUT: 3 m
THE EUT WAS TESTED AS: TABLE-TOP
RECEIVER OPERATING FREQUENCIES 13.56 MHz, 915 MHz
FREQUECNY RANGE: 30 MHz – 5 GHz

	The EUT highest used frequency (not including operating frequency), MHz	Upper frequency of measurement range, MHz
	Below 1.705	30
	1.705 – 108	1000
	108 – 500	2000
	500 – 1000	5000
	Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

Frequency, MHz	Radiated emissions, dB (µV/m)	Limit, dB (µV/m)	Margin, dB	Reference to Plots in Appendix A
30-1000	All emissions were found more than 20 dB below the limit			A25, A26
1000-2000	All emissions were found more than 20 dB below the limit			A27
2000-5000	Tested in Rx + Tx mode. All emissions were found below the limit			A22
Measurement uncertainty, dB	+5.73.dB / -5.57 dB			

Table abbreviations:
Antenna polarization: V = vertical, H = horizontal
Turntable position: 0° = EUT front panel faces the receiving antenna

TEST EQUIPMENT USED:

HL 0038	HL 0041	HL 0521	HL 0539	HL 0554	HL 0589	HL 0604
HL 1004	HL 1424	HL 1942				

LIMIT

(§ 15.109)

Frequency, MHz	Class A equipment @ 10 m dB(µV/m)	Class B equipment @ 3 m dB(µV/m)
30 - 88	39.0	40
88 - 216	43.5	43.5
216 - 960	46.4	46
960 - 5000	49.5	54

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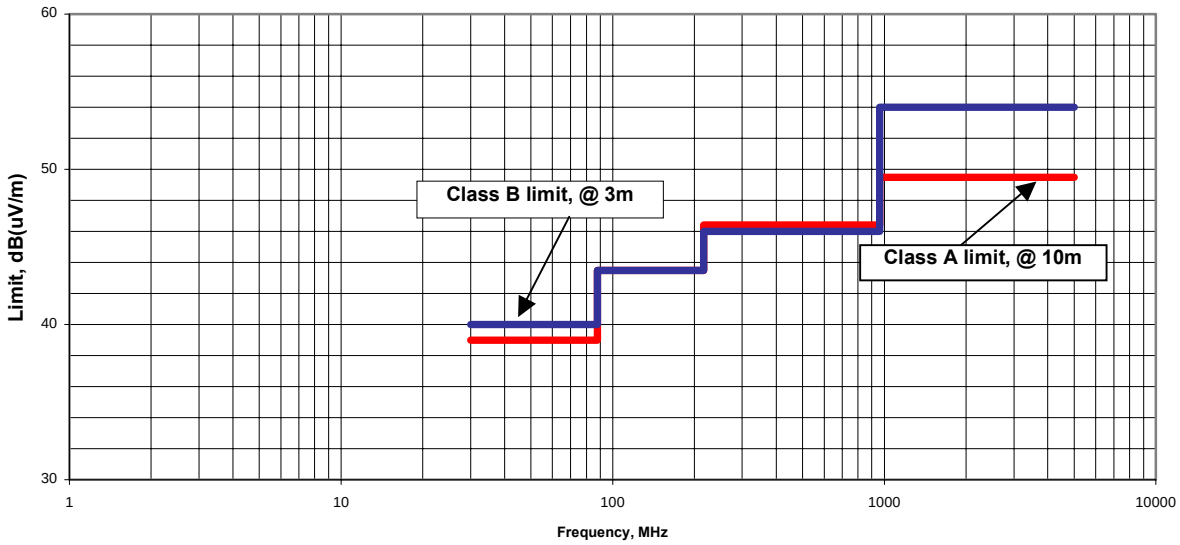
Unintentional radiated emissions test according to §15.109



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4.8 Unintentional conducted emissions test according to §15.107

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.3
DATE:	December 12, 2001
RELATIVE HUMIDITY:	54%
AMBIENT TEMPERATURE:	22 °C
THE EUT WAS TESTED AS:	TABLE-TOP
DETECTOR USED:	QUASI-PEAK
FREQUECNY RANGE:	450 kHz – 30 MHz
RESOLUTION BANDWIDTH:	9 kHz

Class B equipment

Frequency, MHz	Line identification	Measured emissions, dB (µV)	Specification limit, dB (µV)	Margin, dB	Reference to Plots in Appendix A
0.45 – 30	Phase	All emissions were found more than 20 dB below the limit			A28
0.45 – 30	Neutral	All emissions were found more than 20 dB below the limit			A29
Measurement uncertainty, dB		+2.43 dB / -2.22 dB			

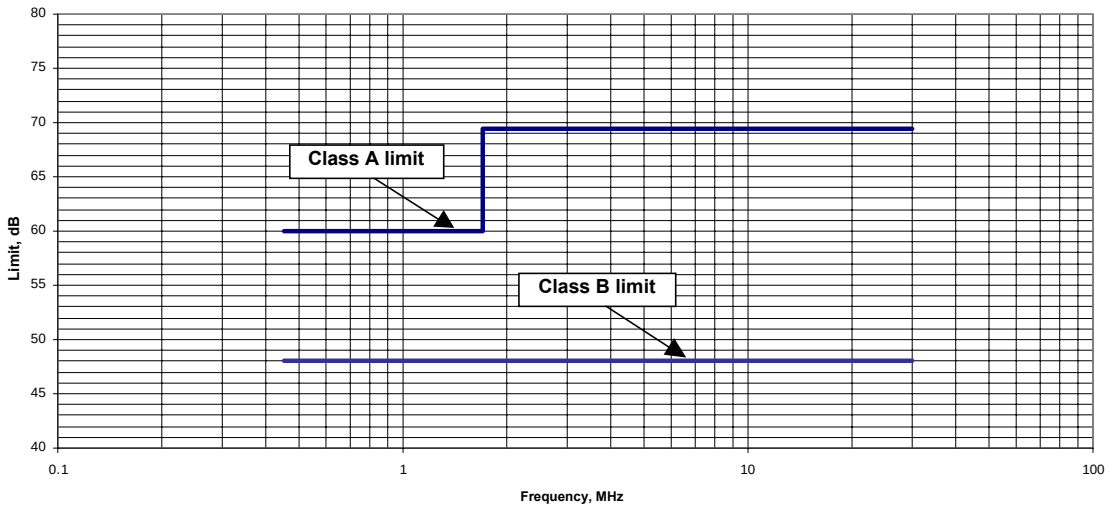
TEST EQUIPMENT USED:

HL 0447	HL 0787	HL 1425	HL 1503			

LIMIT

Frequency, MHz	Class A Equipment, dB(µV)	Class B equipment, dB(µV)
0.45 – 1.705	60.0	48
1.705 - 30	69.5	48

Unintentional conducted emissions limit according to §15.107



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4.9 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT:	ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
TEST PERFROMED IN:	ANECHOIC CHAMBER
DATE	December 11, 2001
RELATIVE HUMIDITY	59%
AMBIENT TEMPERATURE:	23 °C
DISTANCE BETWEEN ANTENNA AND EUT:	3 m
THE EUT WAS TESTED AS:	TABLE-TOP
FREQUECNY RANGE:	30 MHz – 1 GHz
DETECTOR TYPE:	QUASI-PEAK
RESOLUTION BANDWIDTH:	120 kHz

	The EUT highest used frequency (not including operating frequency), MHz	Upper frequency of measurement range, MHz
	Below 1.705	30
	1.705 – 108	1000
	108 – 500	2000
	500 – 1000	5000
	Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

The limits for class B unintentional radiated emissions were used while testing the equipment in Rx mode, refer to paragraph 4.7 and Plots A22, A25 – A27.

LIMIT (§ 15.109)

Frequency, MHz	Class A equipment @ 10 m dB(µV/m)	Class B equipment @ 3 m dB(µV/m)
30 - 88	39.0	40
88 - 216	43.5	43.5
216 - 960	46.4	46
960 - 5000	49.5	54

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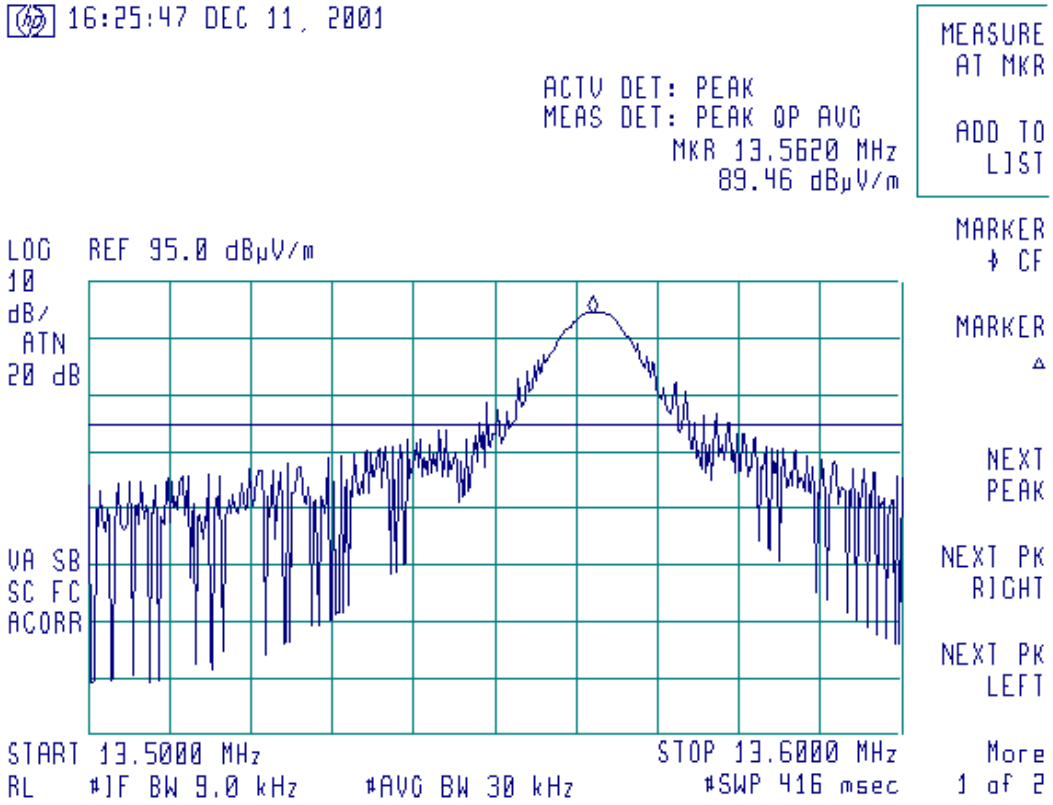
Appendix A Plots

Plot A1 Field strength of emission within the assigned band



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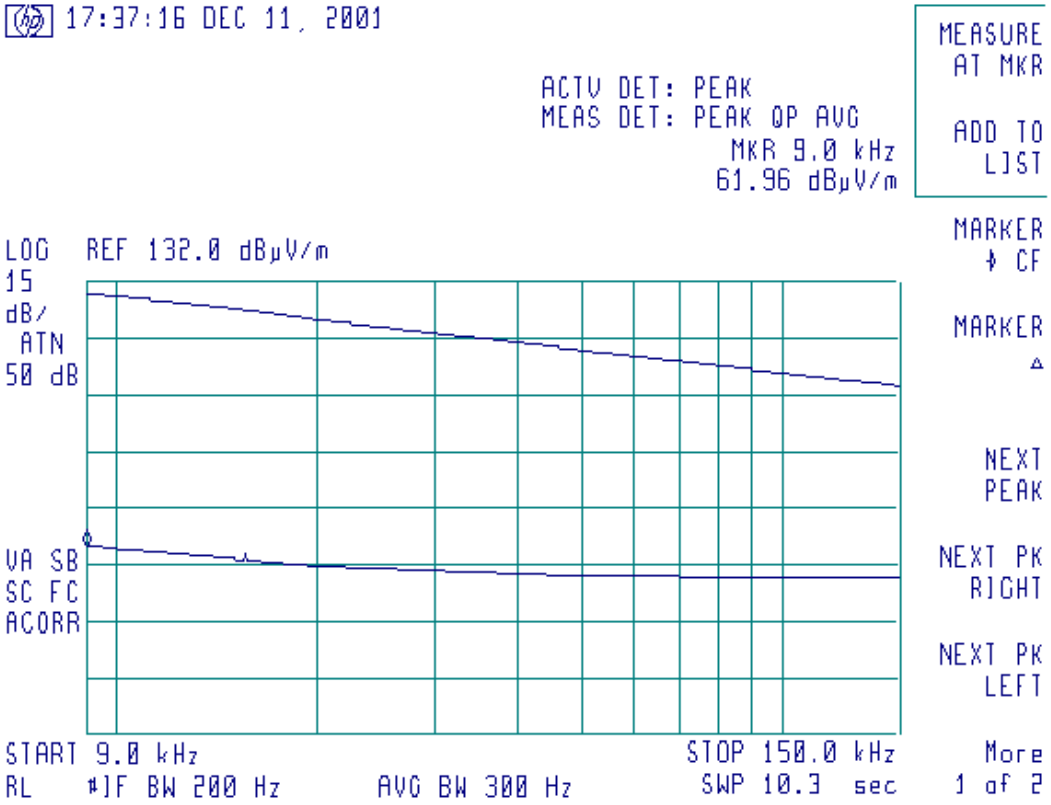
Plot A2 Field strength of out of band emissions,
9 kHz – 150 kHz frequency range



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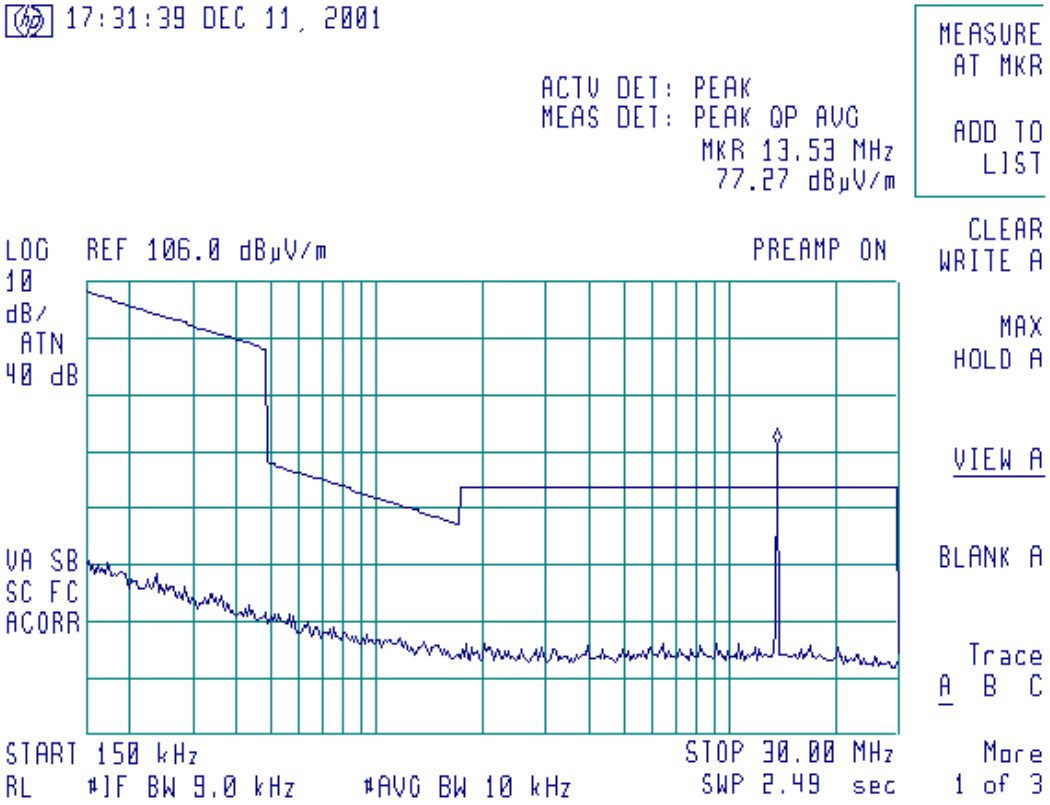
Plot A3 Field strength of out of band emissions,
150 kHz – 30 MHz frequency range



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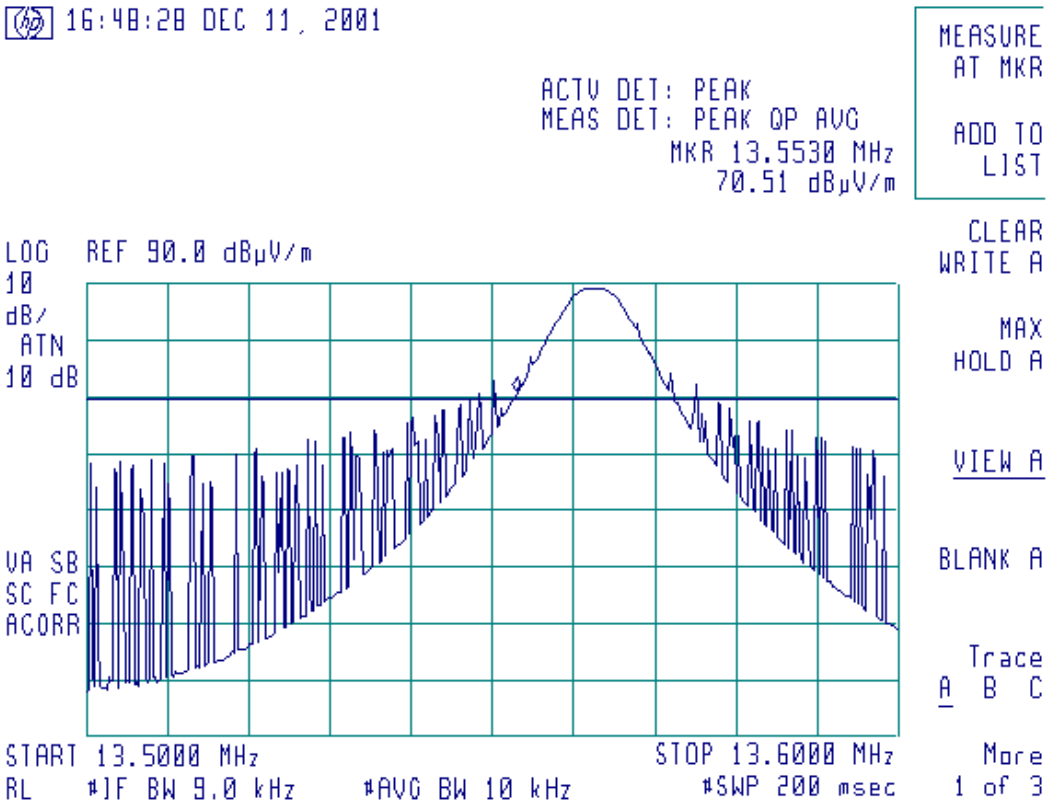
Plot A4 Field strength of out of band emissions,
13.500 – 13.600 MHz frequency range



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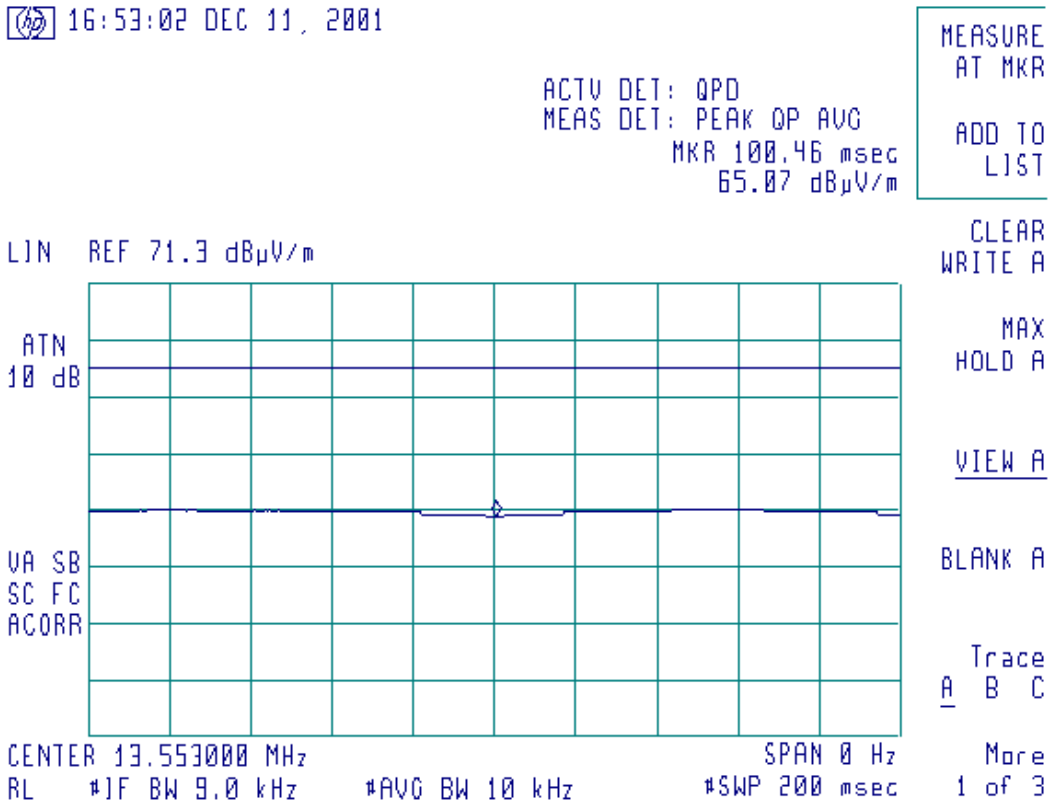
**Plot A5 Field strength of out of band emissions,
lower edge of the assigned band**



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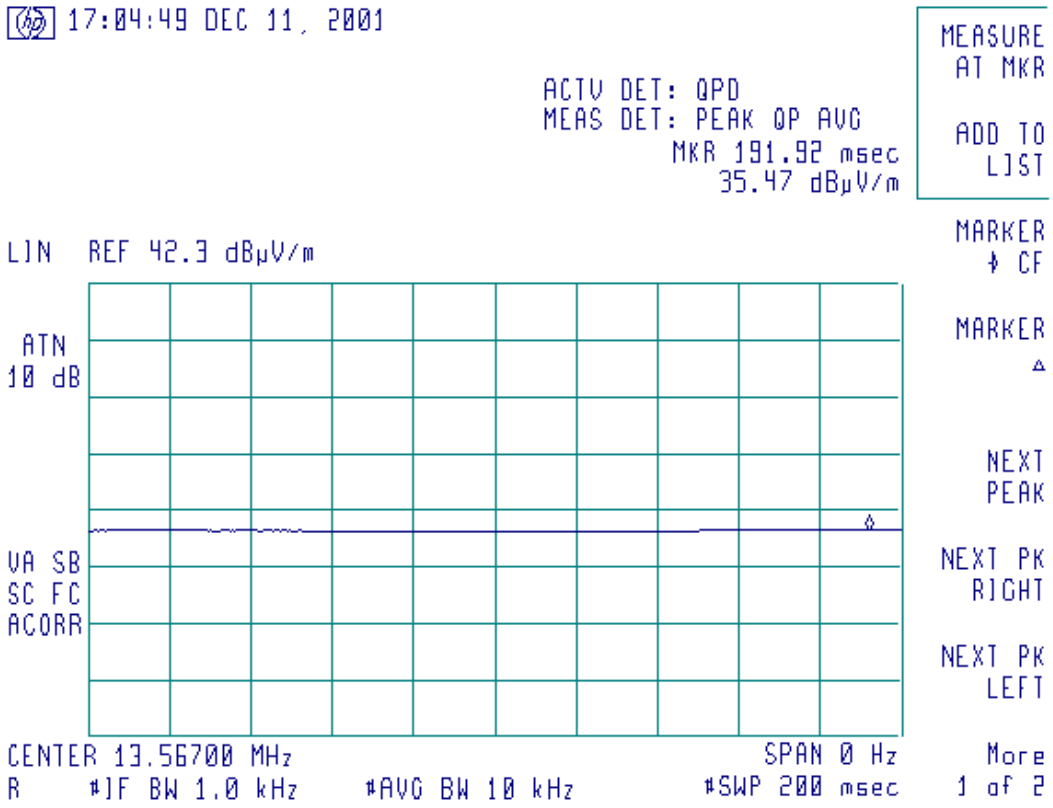
**Plot A6 Field strength of out of band emissions,
upper edge of the assigned band**



Correction factor = 20 log RBstd/RBmeas. = 20 log 9/1 = 19.1 dB
E = Emeas + Corr.Factor = 35.47 + 19.1 = 54.57 dB(µV/m)

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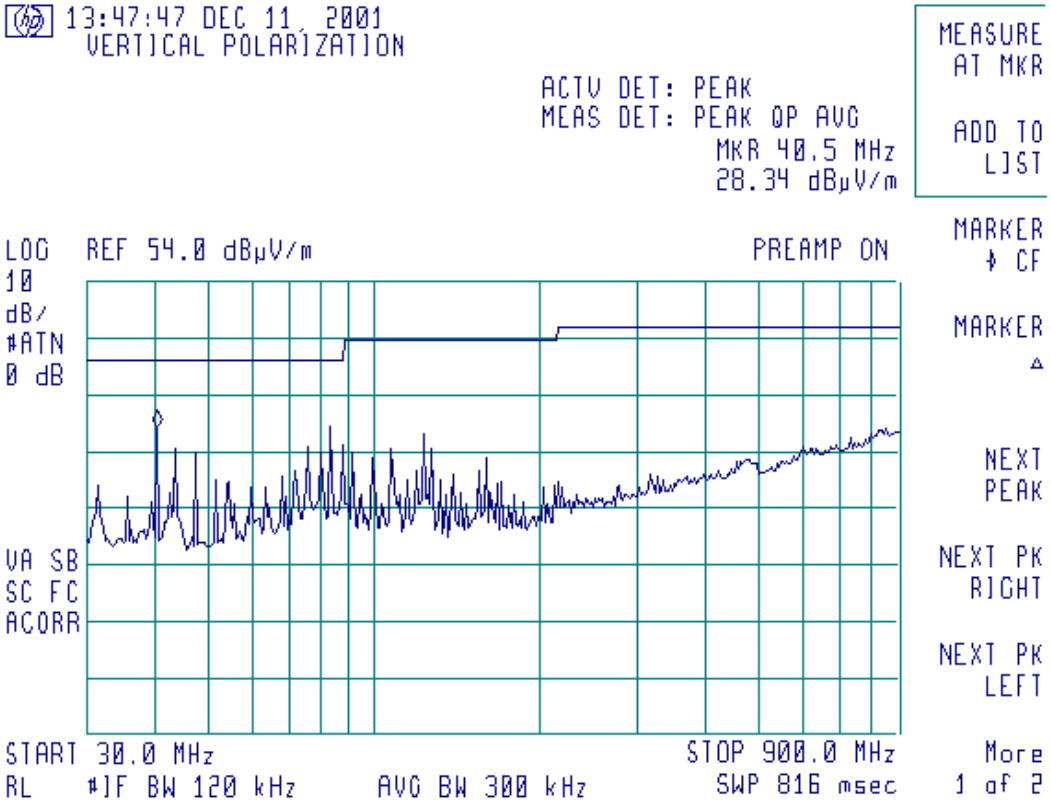
Plot A 7 Field strength of spurious emissions,
30 – 900 MHz frequency range, vertical polarization



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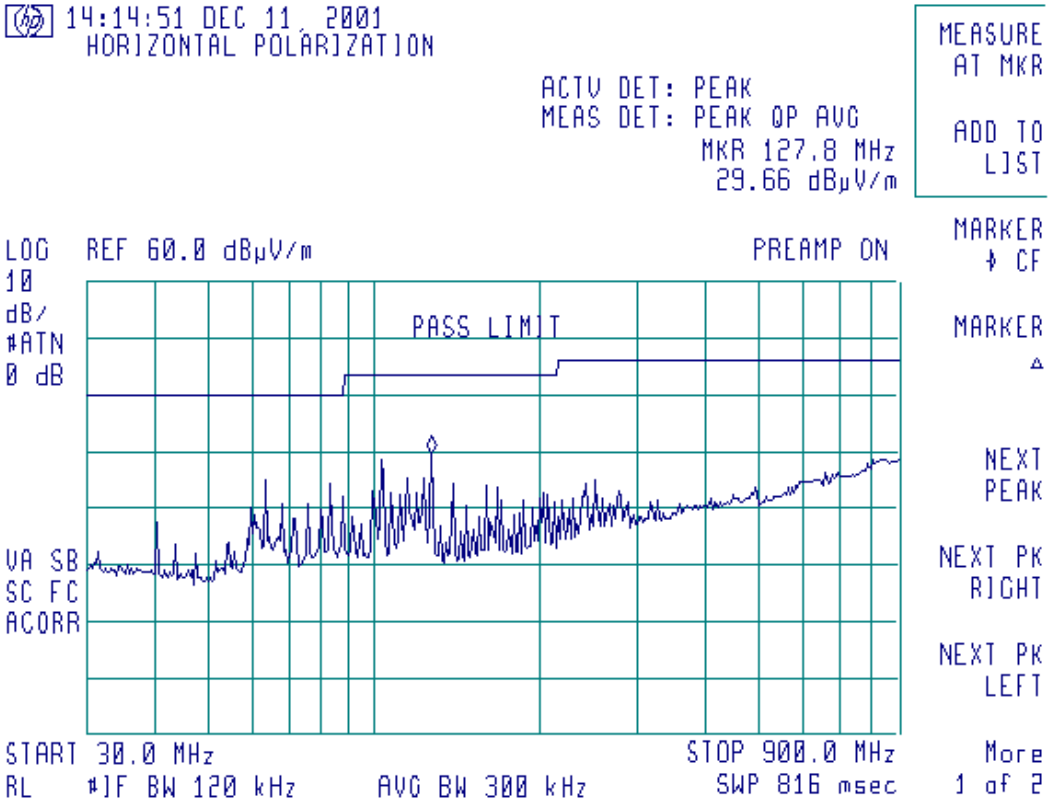
Plot A8 Field strength of spurious emissions,
30 – 900 MHz frequency range, horizontal polarization



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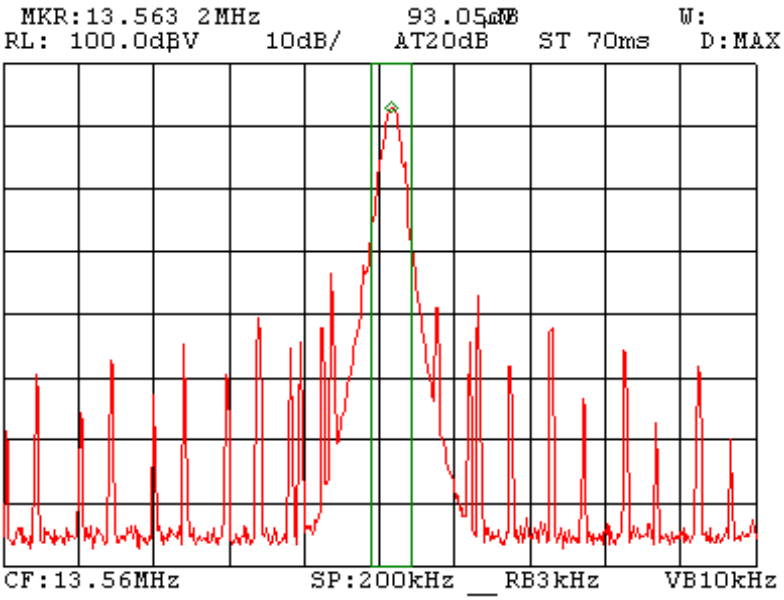
Plot A9 Frequency tolerance,
temperature 23°C, supply voltage 120 V (reference)



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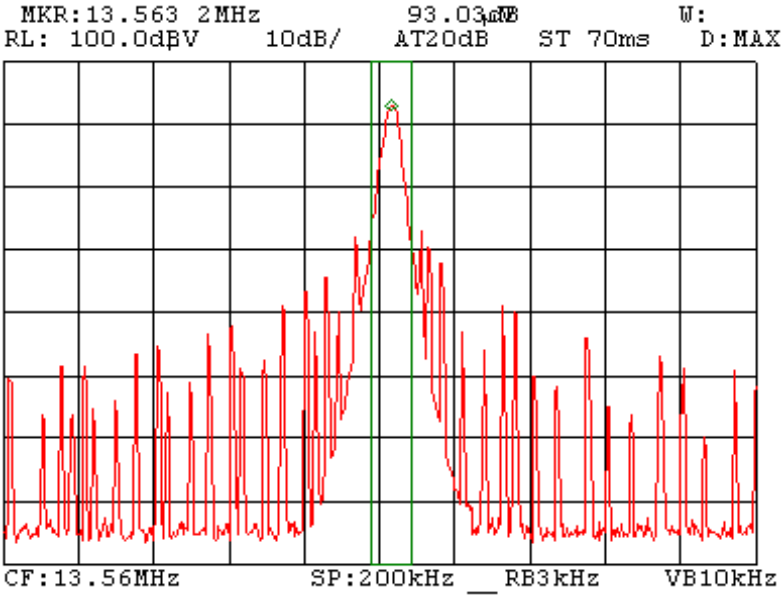
Plot A10 Frequency tolerance,
temperature 23°C, supply voltage 102 V



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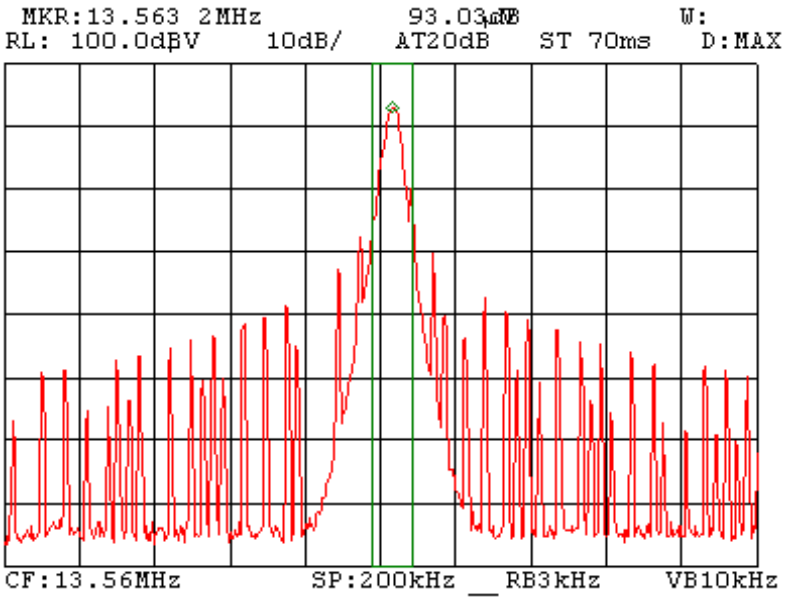
Plot A11 Frequency tolerance,
temperature 23°C, supply voltage 138 V



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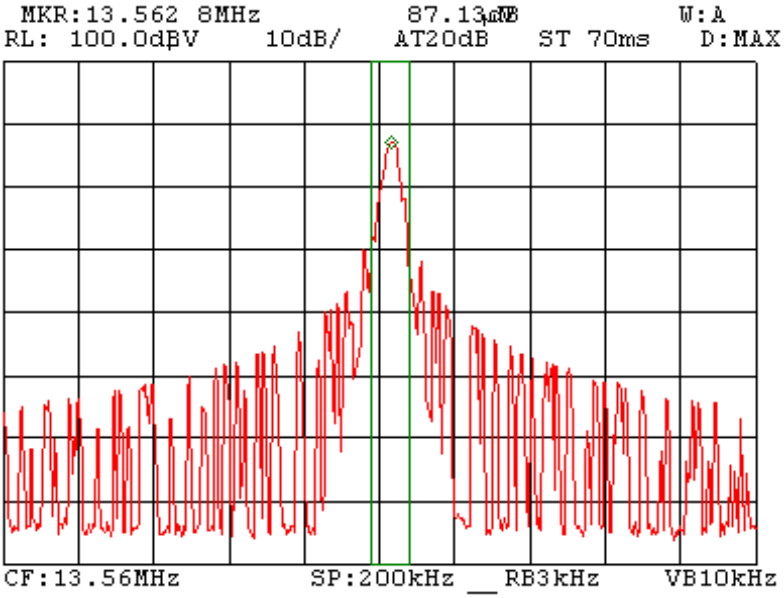
Plot A12 Frequency tolerance,
temperature -20ºC, supply voltage 120 V (reference)



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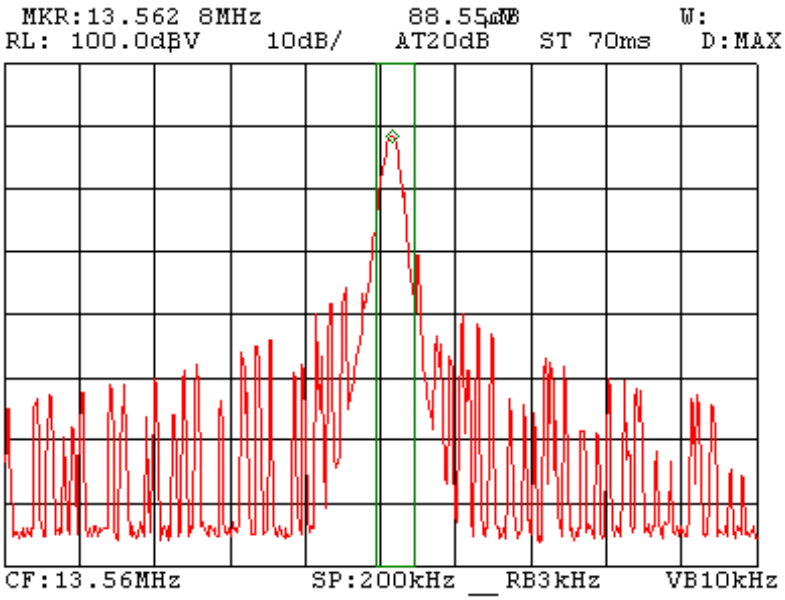
Plot A13 Frequency tolerance,
temperature +50ºC, supply voltage 120 V (reference)



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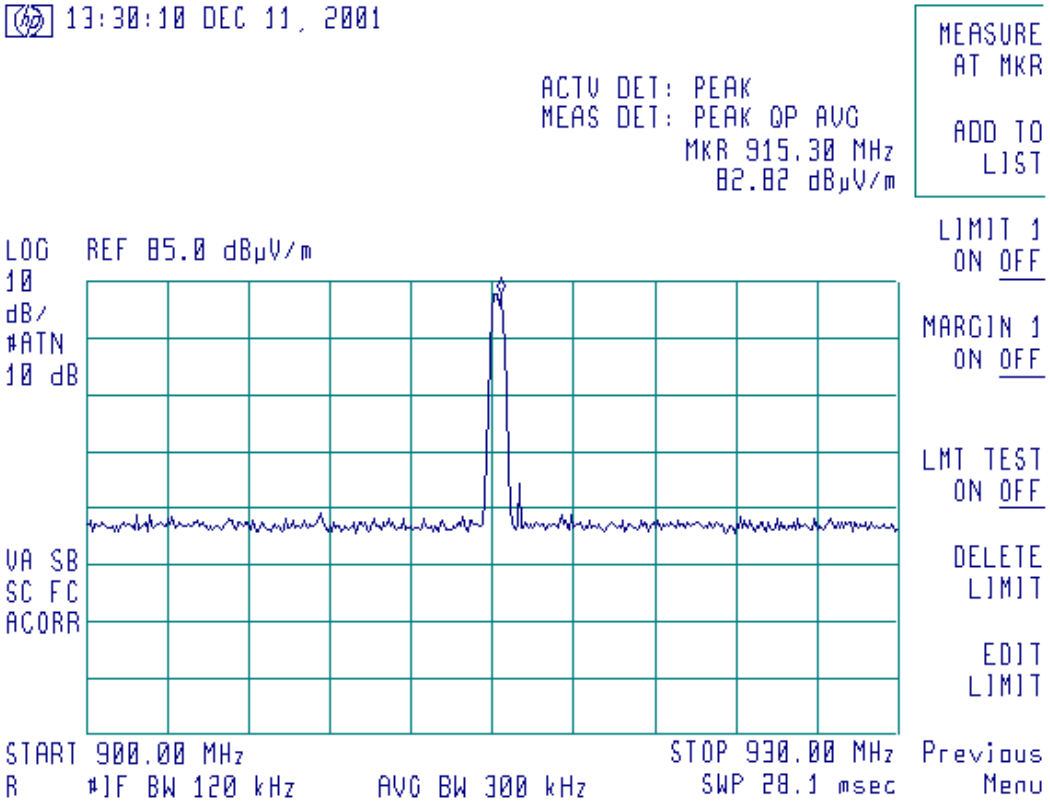
Plot A14 Field strength of 915 MHz carrier



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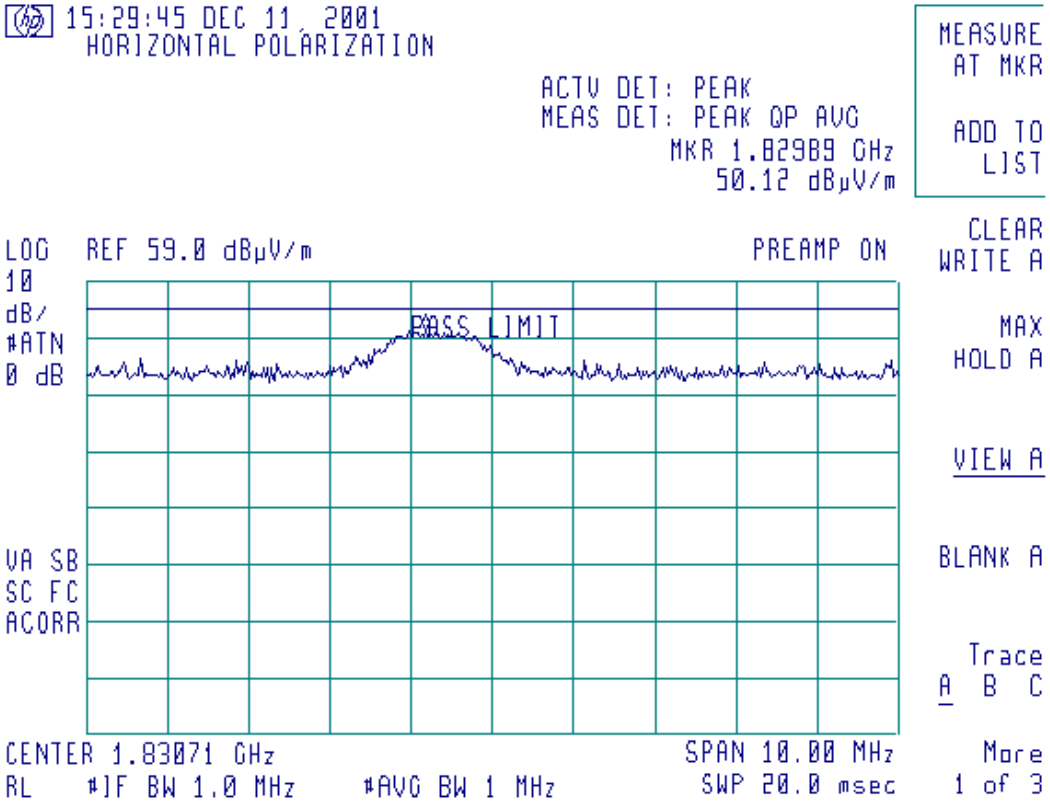
Plot A15 Field strength of harmonics,
2nd harmonic



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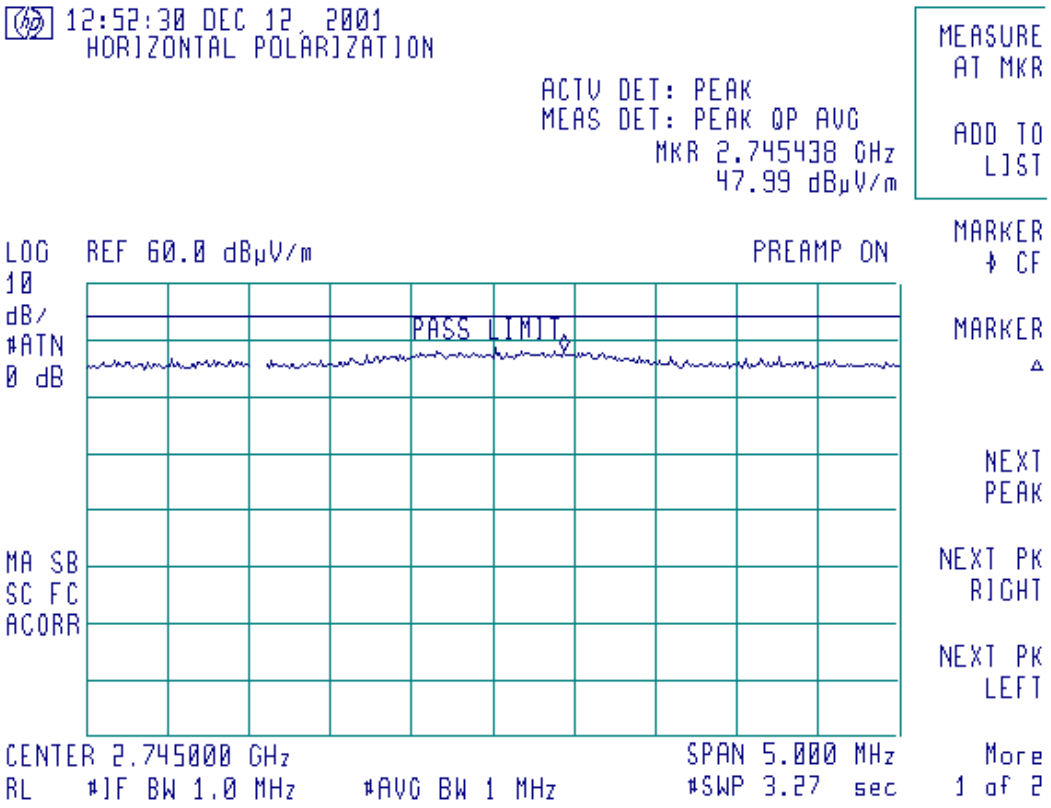
Plot A16 Field strength of harmonics,
3rd harmonic



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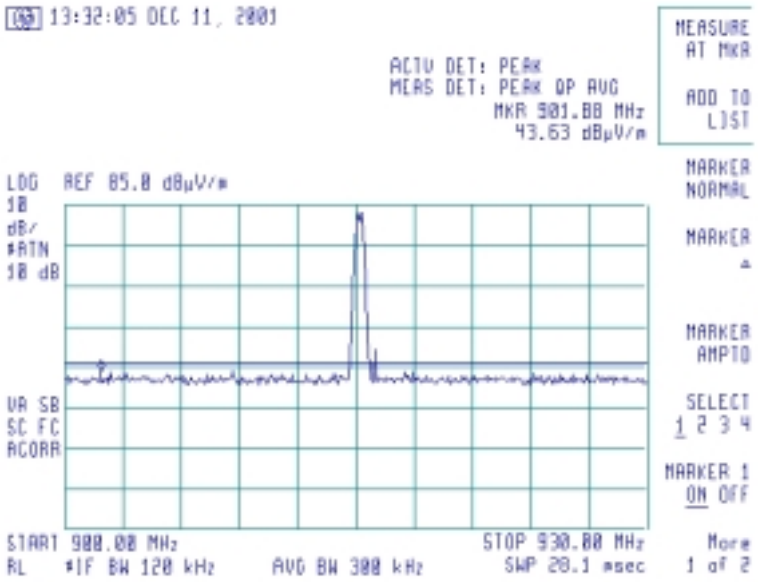
**Plot A17 Field strength of spurious emissions,
900 – 930 MHz frequency range, lower band edge**



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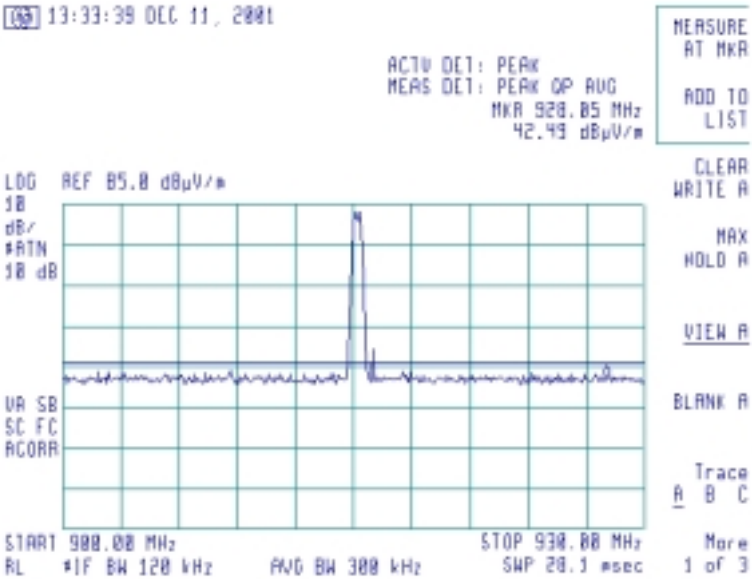
Plot A18 Field strength of spurious emissions,
900 – 930 MHz frequency range, upper band edge



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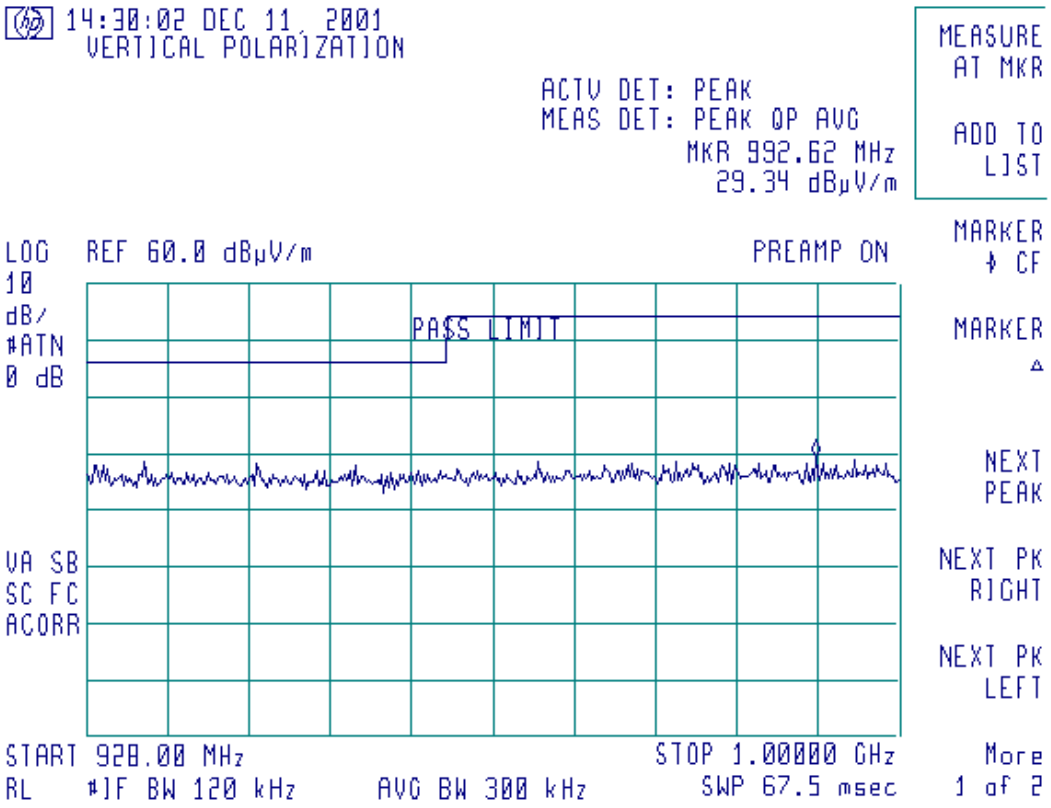
Plot A19 Field strength of spurious emissions,
928 – 1000 MHz frequency range, vertical polarization



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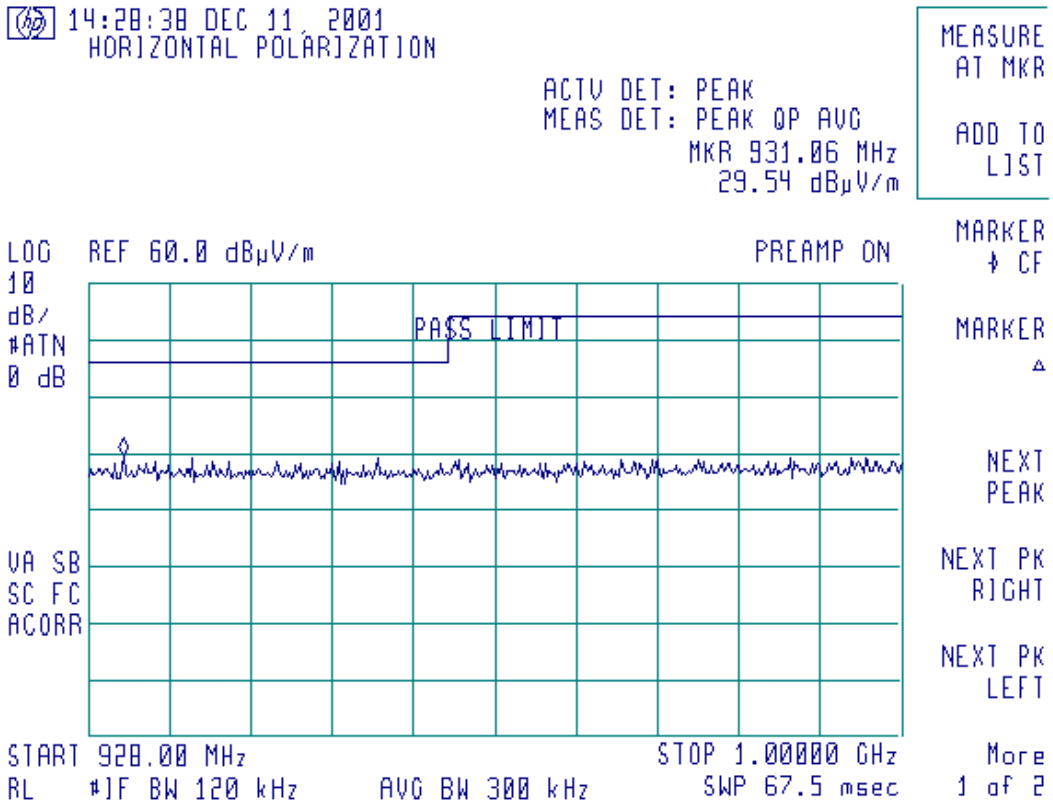
Plot A20 Field strength of spurious emissions,
928 – 1000 MHz frequency range, horizontal polarization



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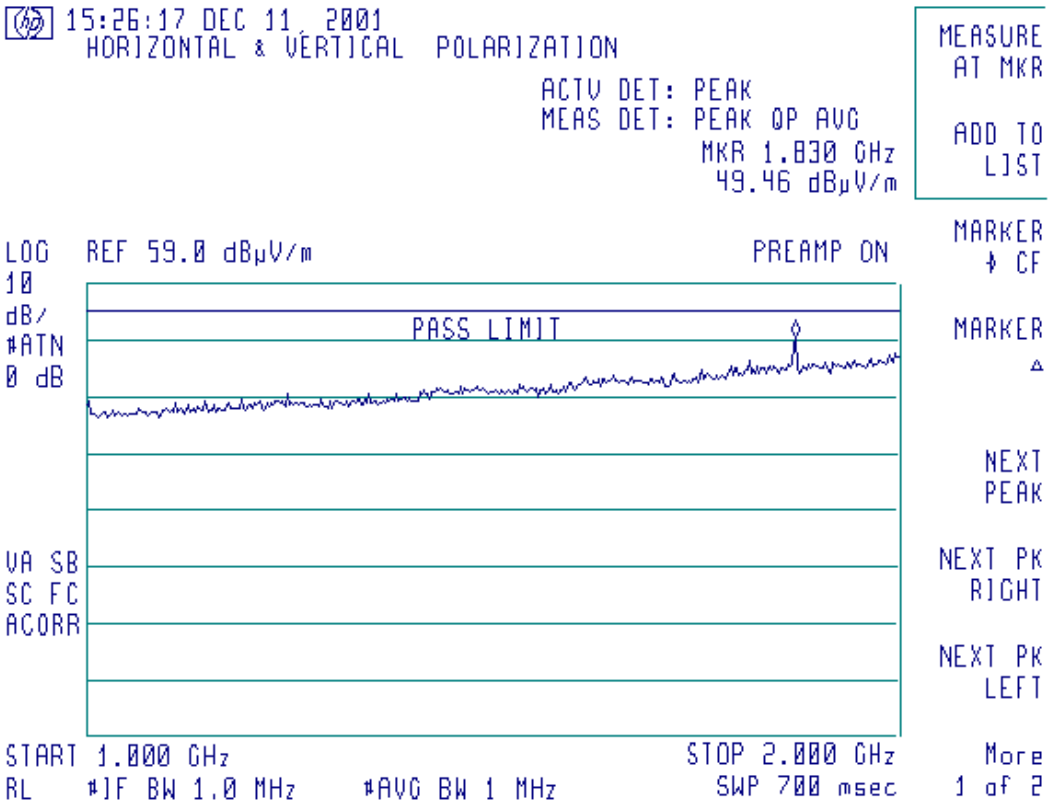
Plot A21 Field strength of spurious emissions,
1 – 2 GHz frequency range, vertical + horizontal polarization



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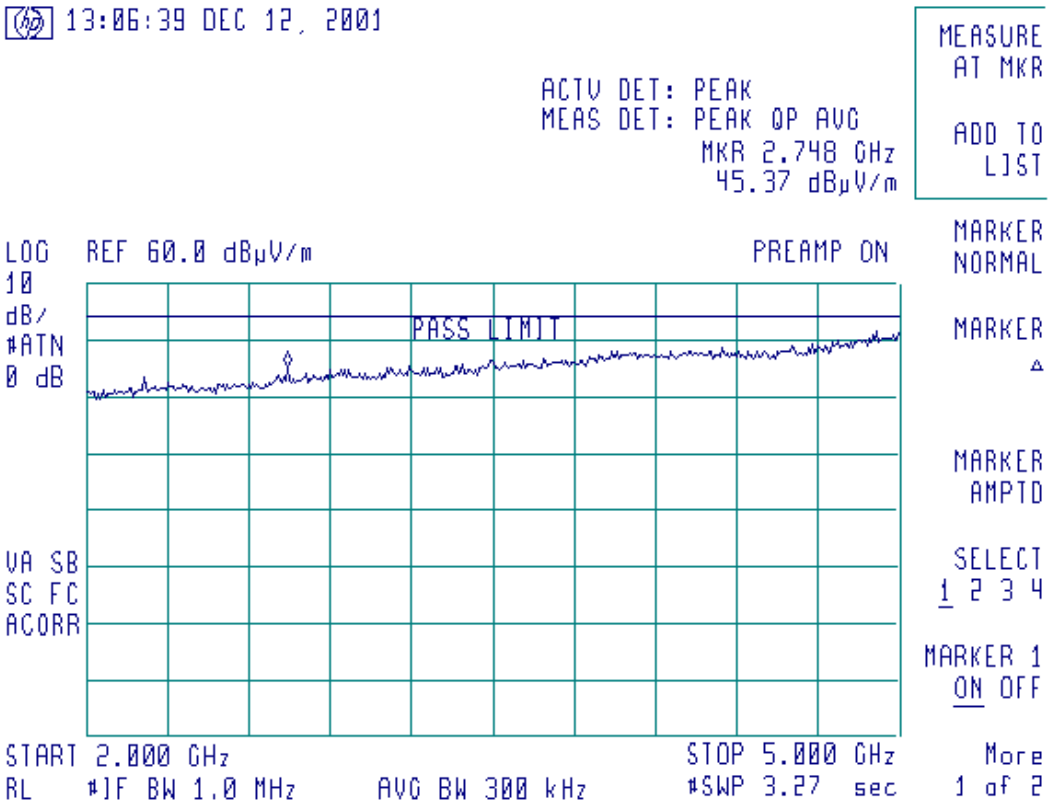
Plot A22 Field strength of spurious emissions,
2 – 5 GHz frequency range, vertical + horizontal polarization



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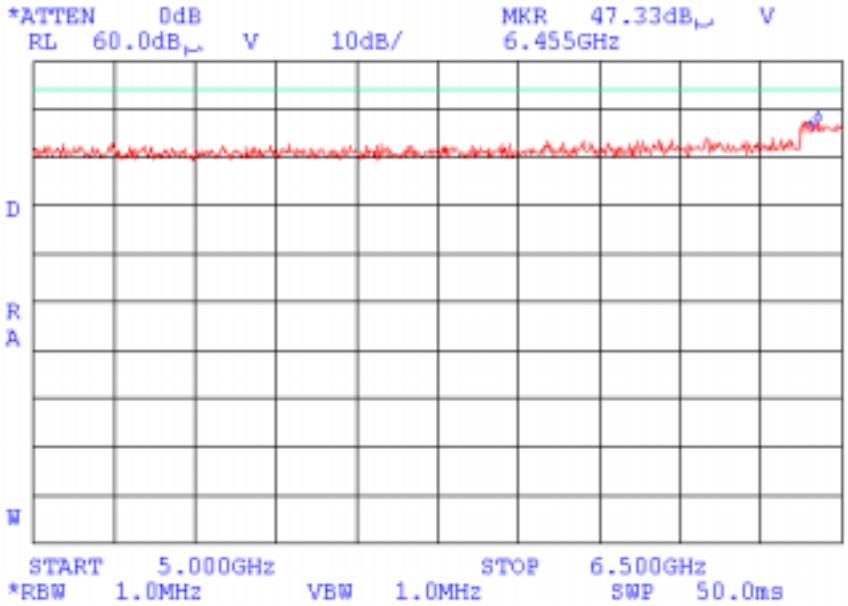
Plot A23 Field strength of spurious emissions,
5 – 6.5 GHz frequency range, vertical + horizontal polarization



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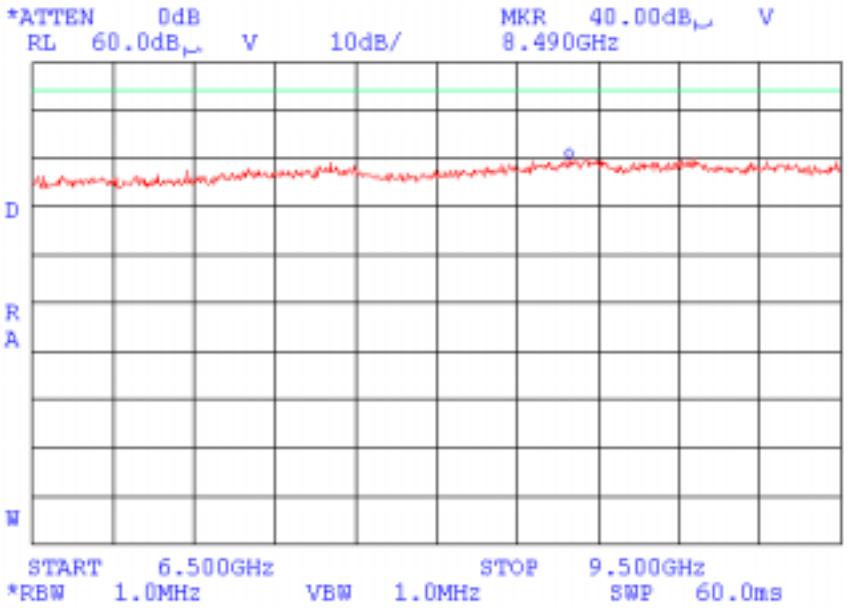
Plot A24 Field strength of spurious emissions,
6.5 – 9.5 GHz frequency range, vertical + horizontal polarization



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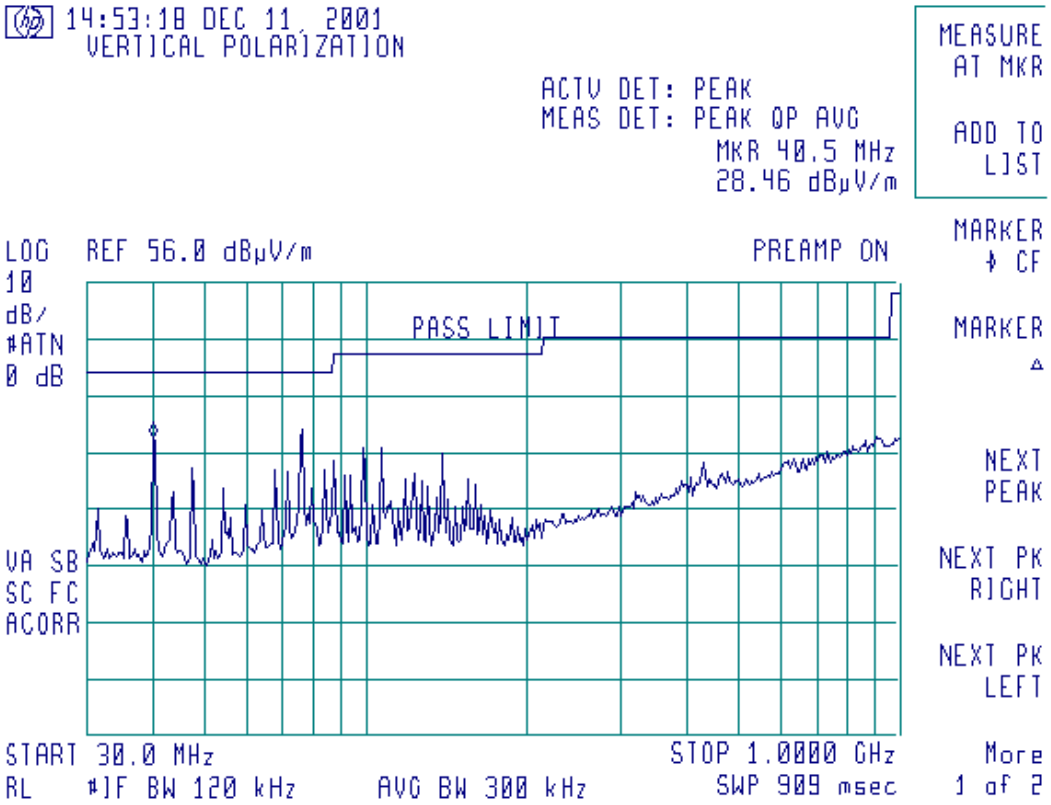
Plot A25 Receiver spurious emissions,
30 – 1000 MHz frequency range, vertical polarization



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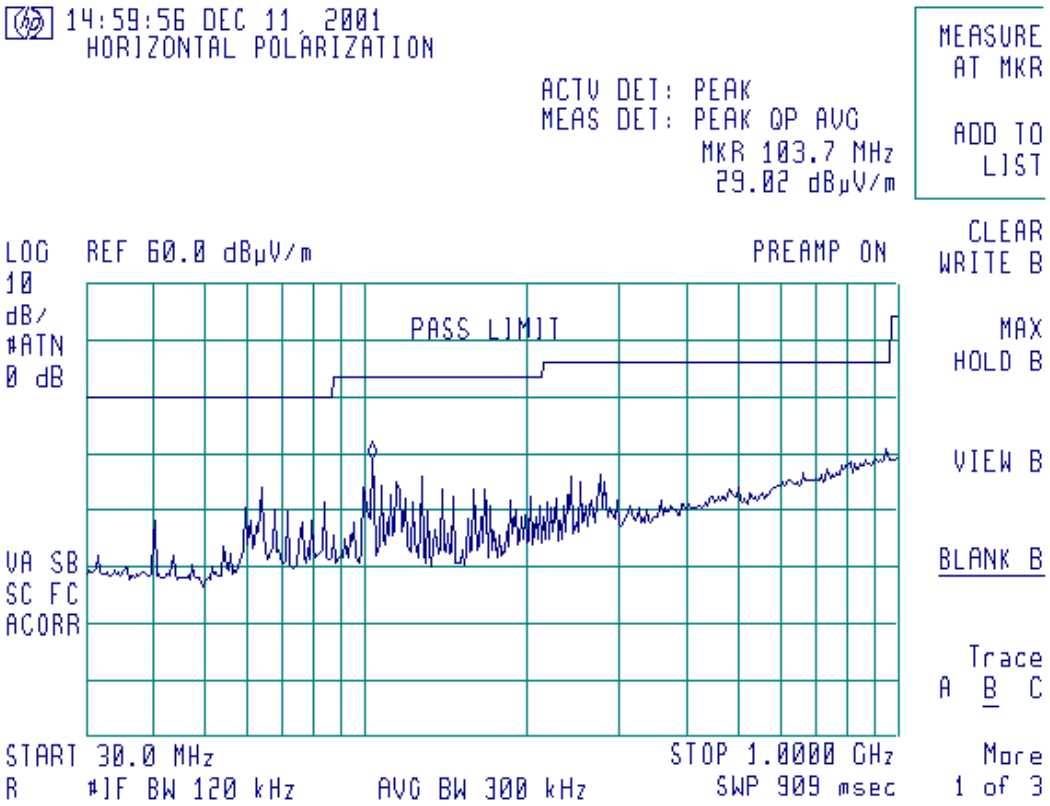
Plot A25 Receiver spurious emissions,
30 – 1000 MHz frequency range, horizontal polarization



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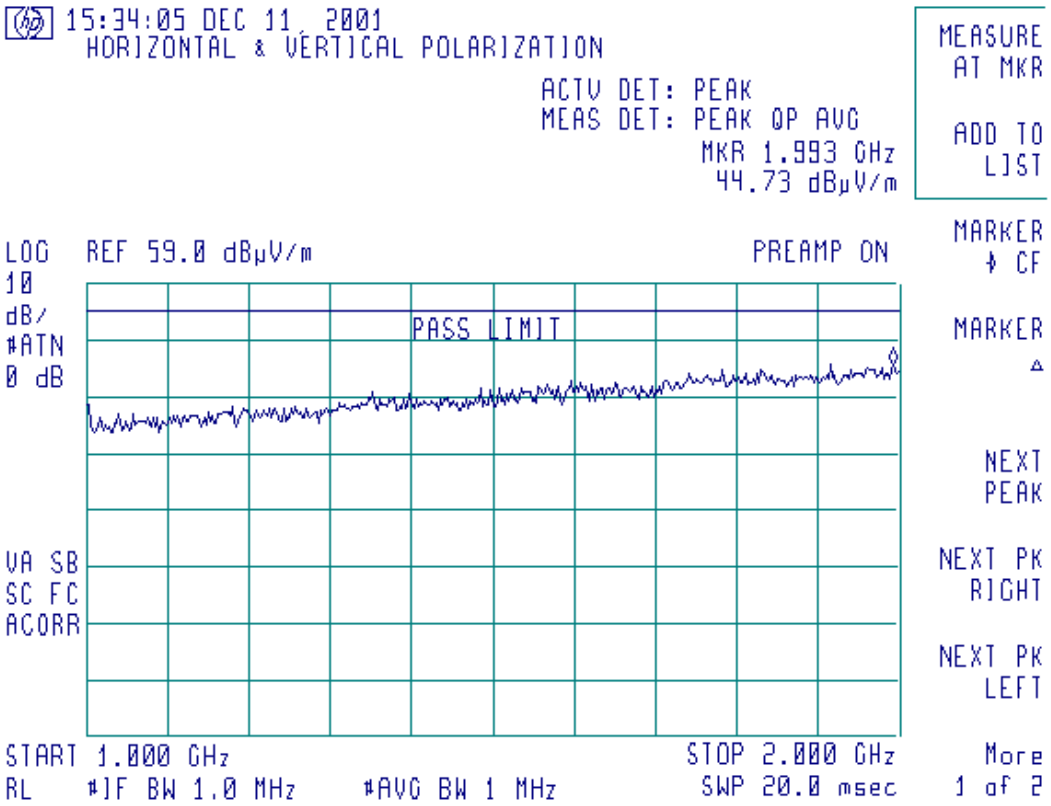
Plot A25 Receiver spurious emissions,
1 – 2 GHz frequency range, vertical + horizontal polarization



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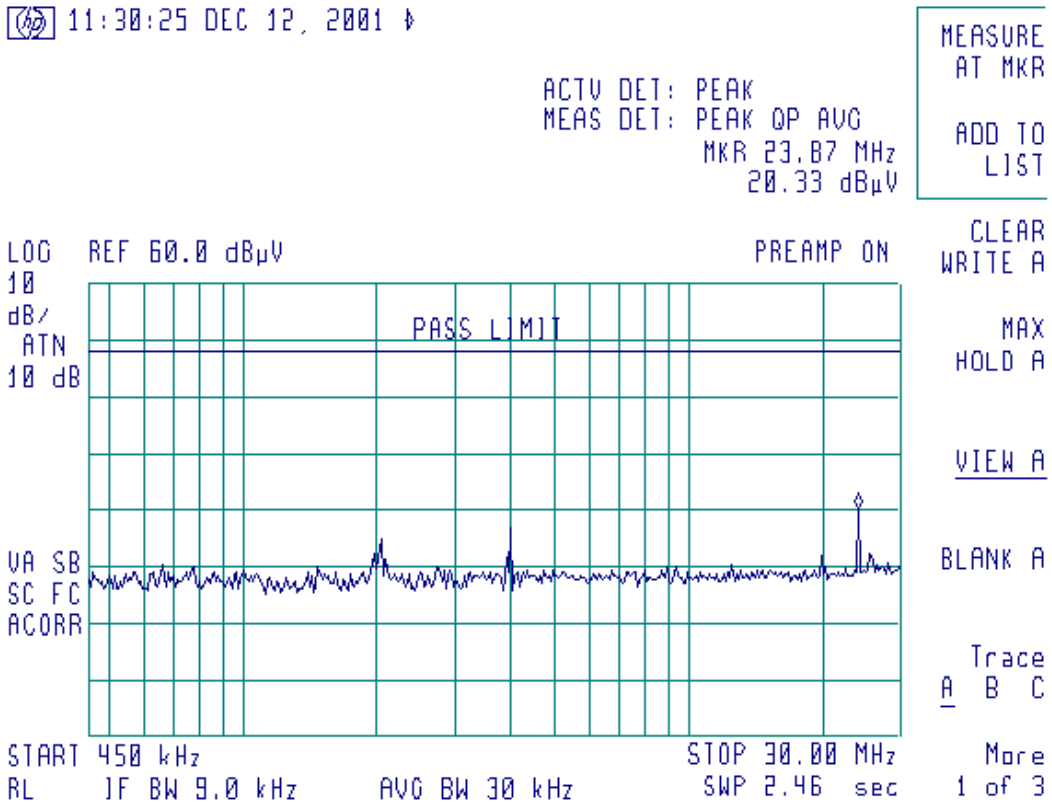
Plot A28 Unintentional conducted emissions on power line, Phase



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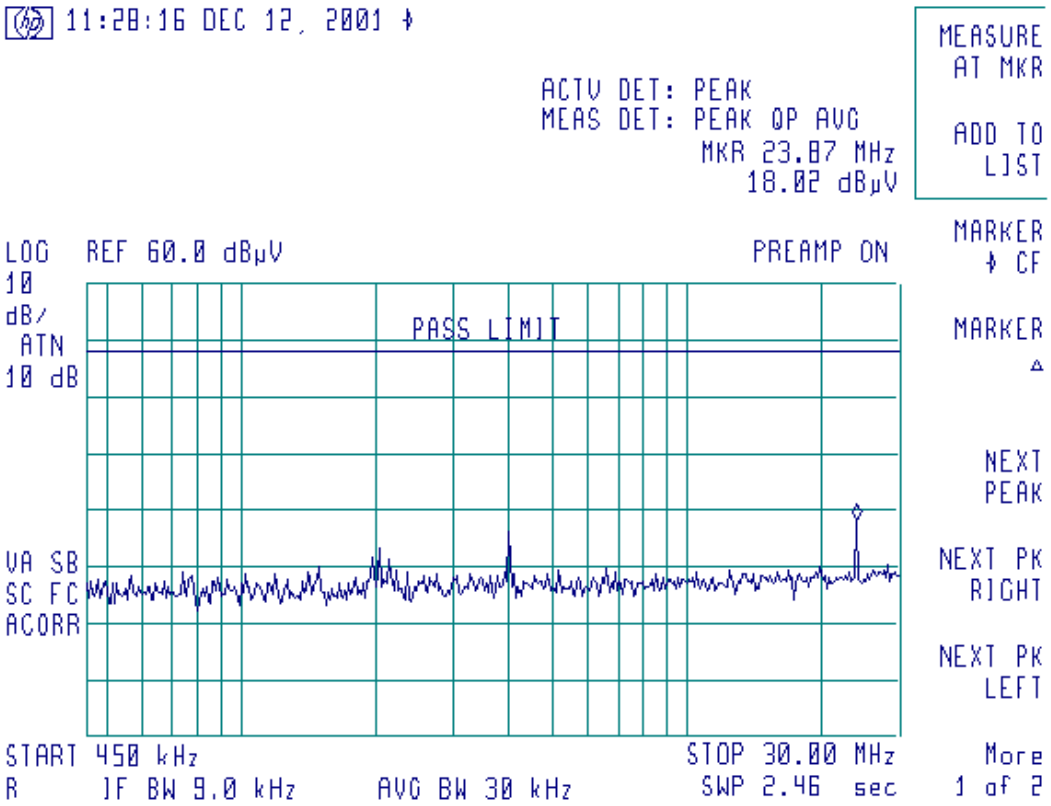
Plot A29 Unintentional conducted emissions on power line, Neutral



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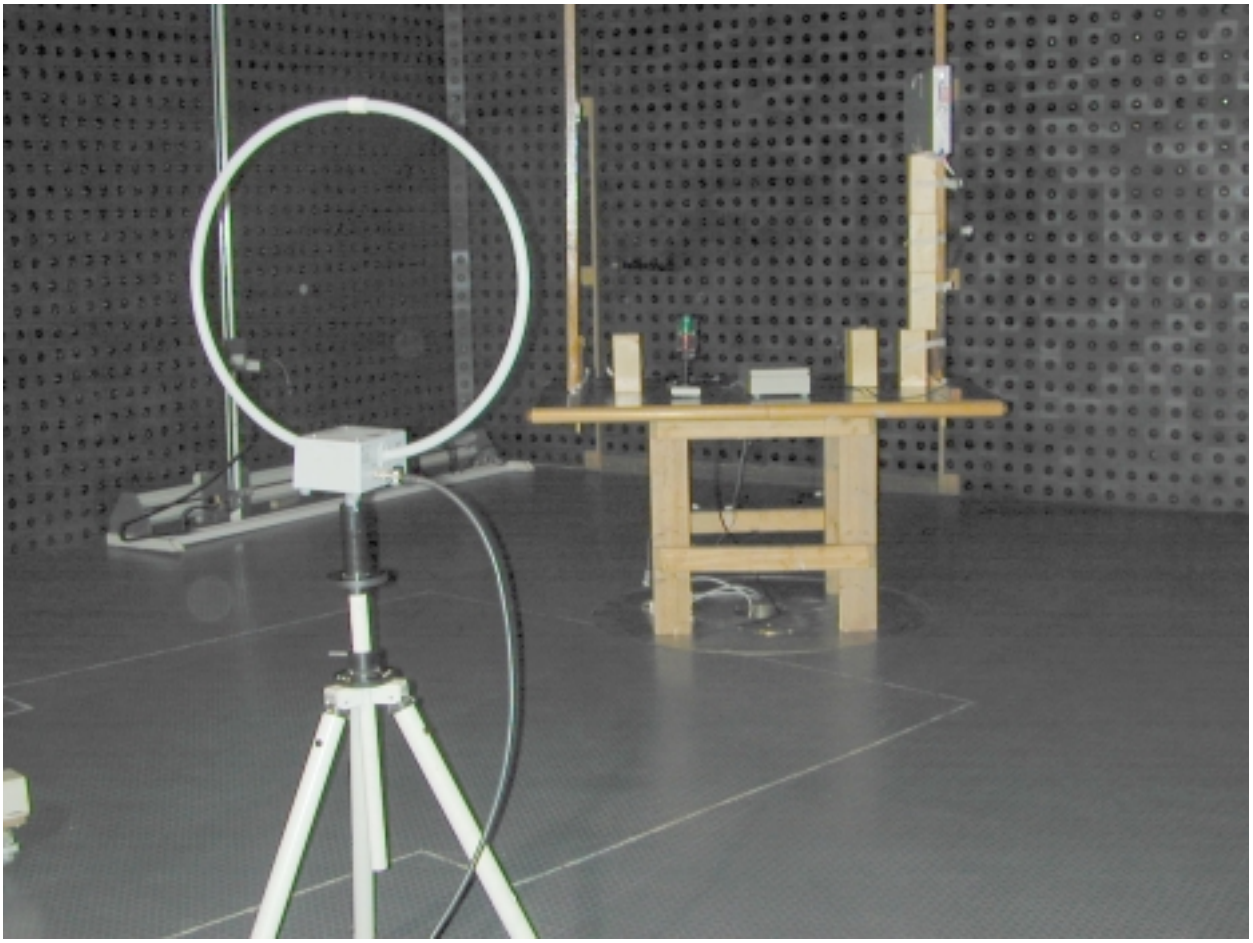
Appendix B Test setup photographs

Photograph 1 Radiated emission measurements test setup with loop antenna, 9 kHz – 30 MHz frequency range, anechoic chamber method



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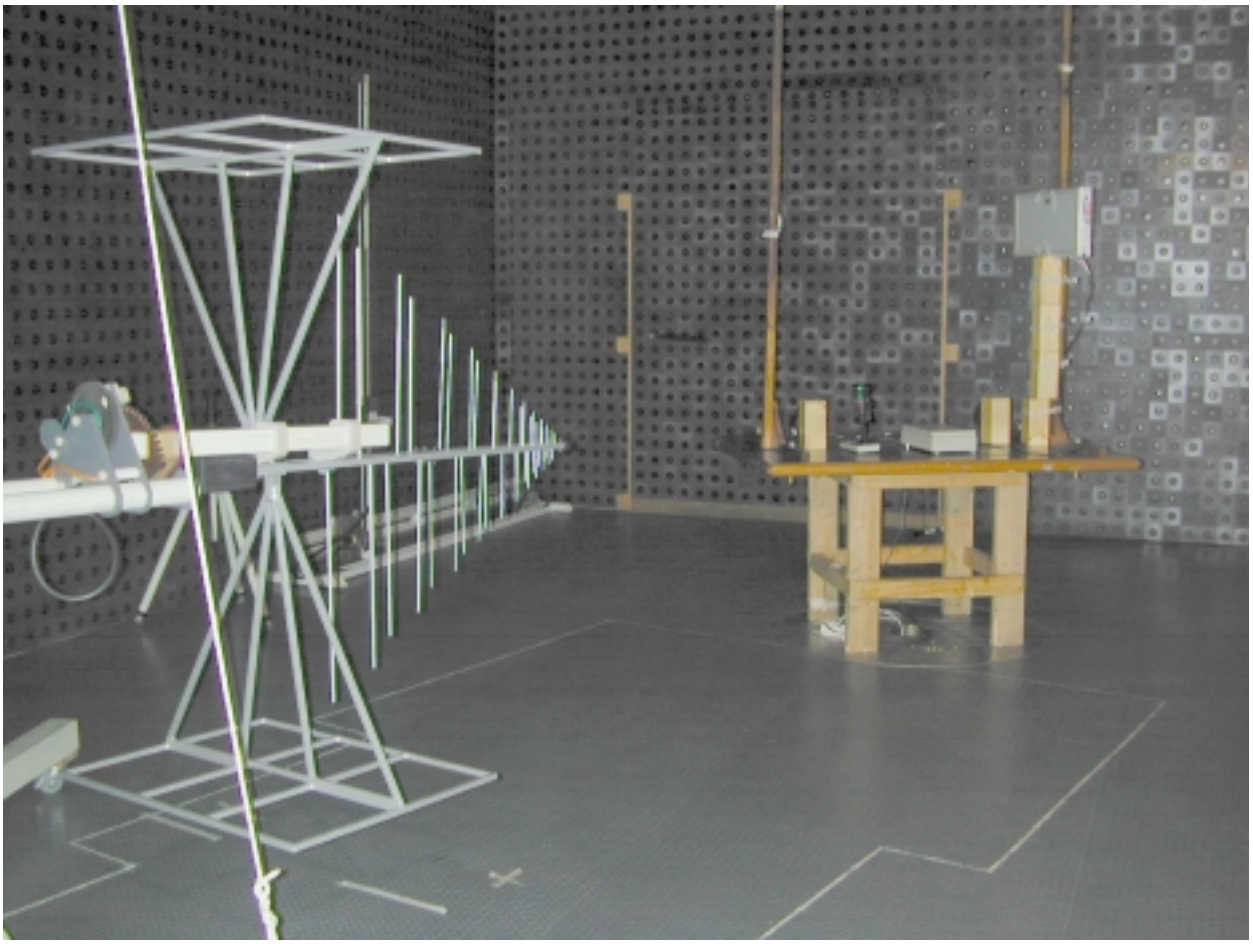
Photograph 2 Radiated emission measurements test setup with biconilog antenna, 30 MHz – 1000 MHz frequency range, anechoic chamber method



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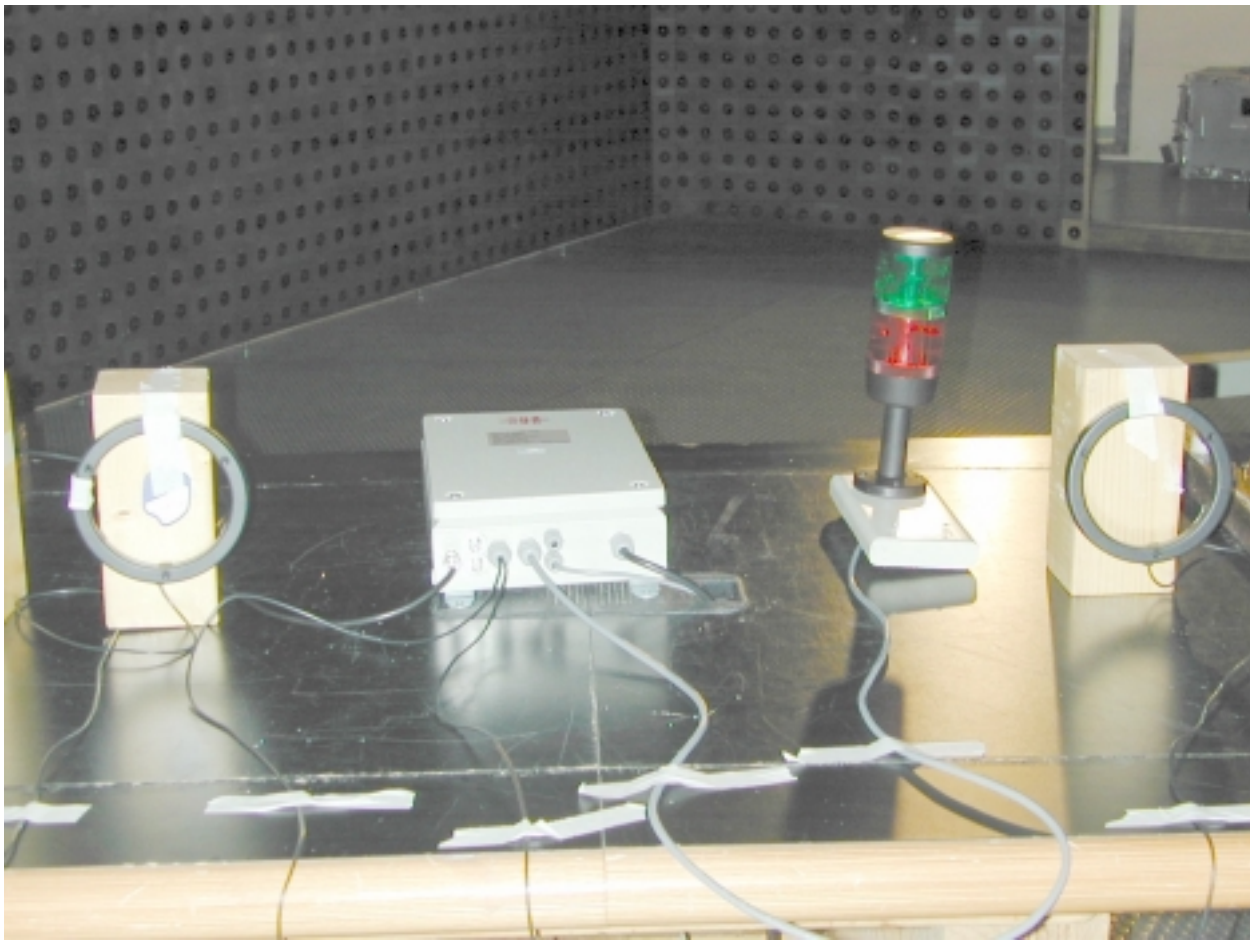
Photograph 3 Radiated emission measurements test setup with biconilog antenna, 30 MHz – 1000 MHz frequency range, anechoic chamber method



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Photograph 4 Radiated emission measurements test setup with biconilog antenna, 30 MHz – 1000 MHz frequency range, anechoic chamber method

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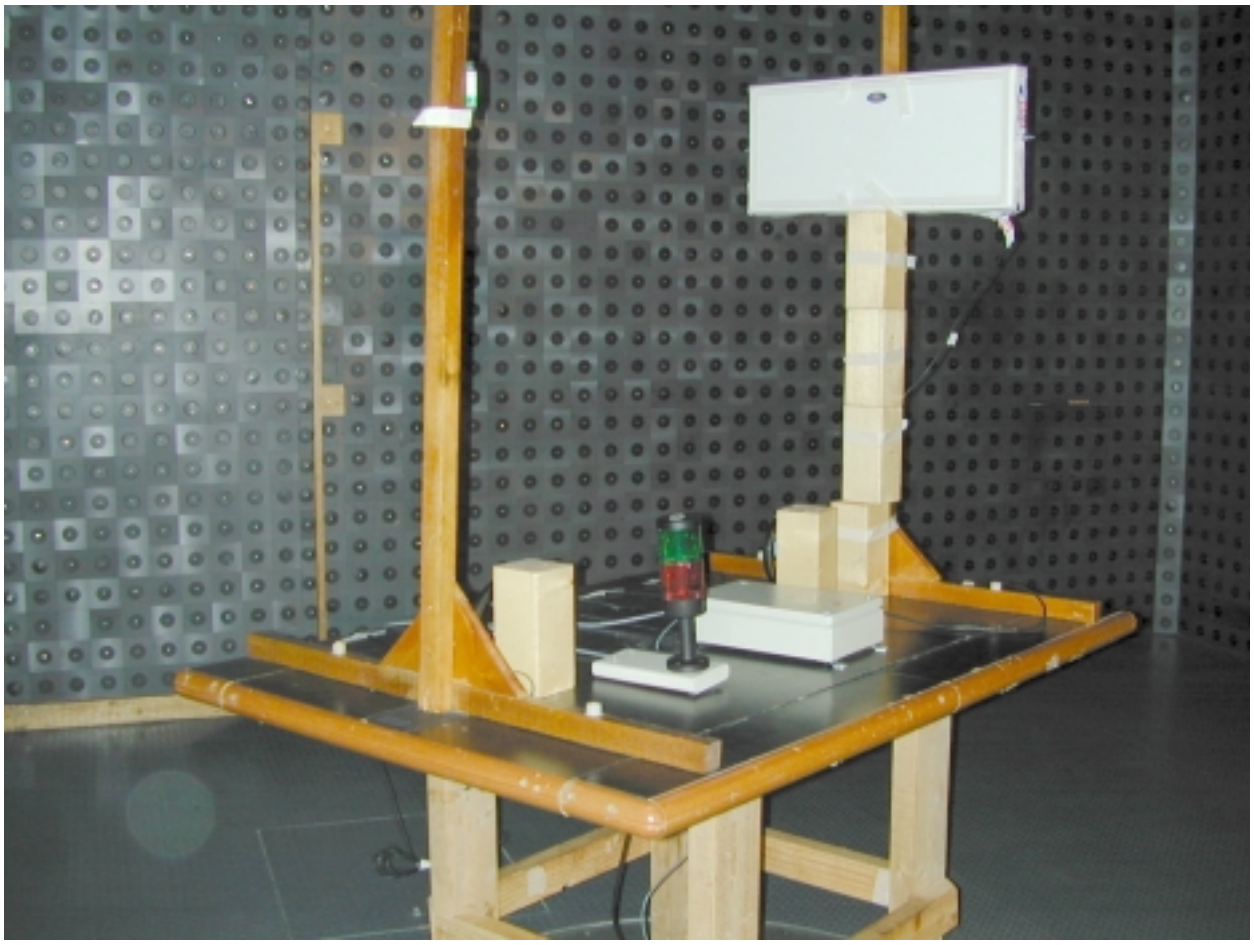
Photograph 5 Radiated emission measurements test setup with biconilog antenna, 30 MHz – 1000 MHz frequency range, anechoic chamber method



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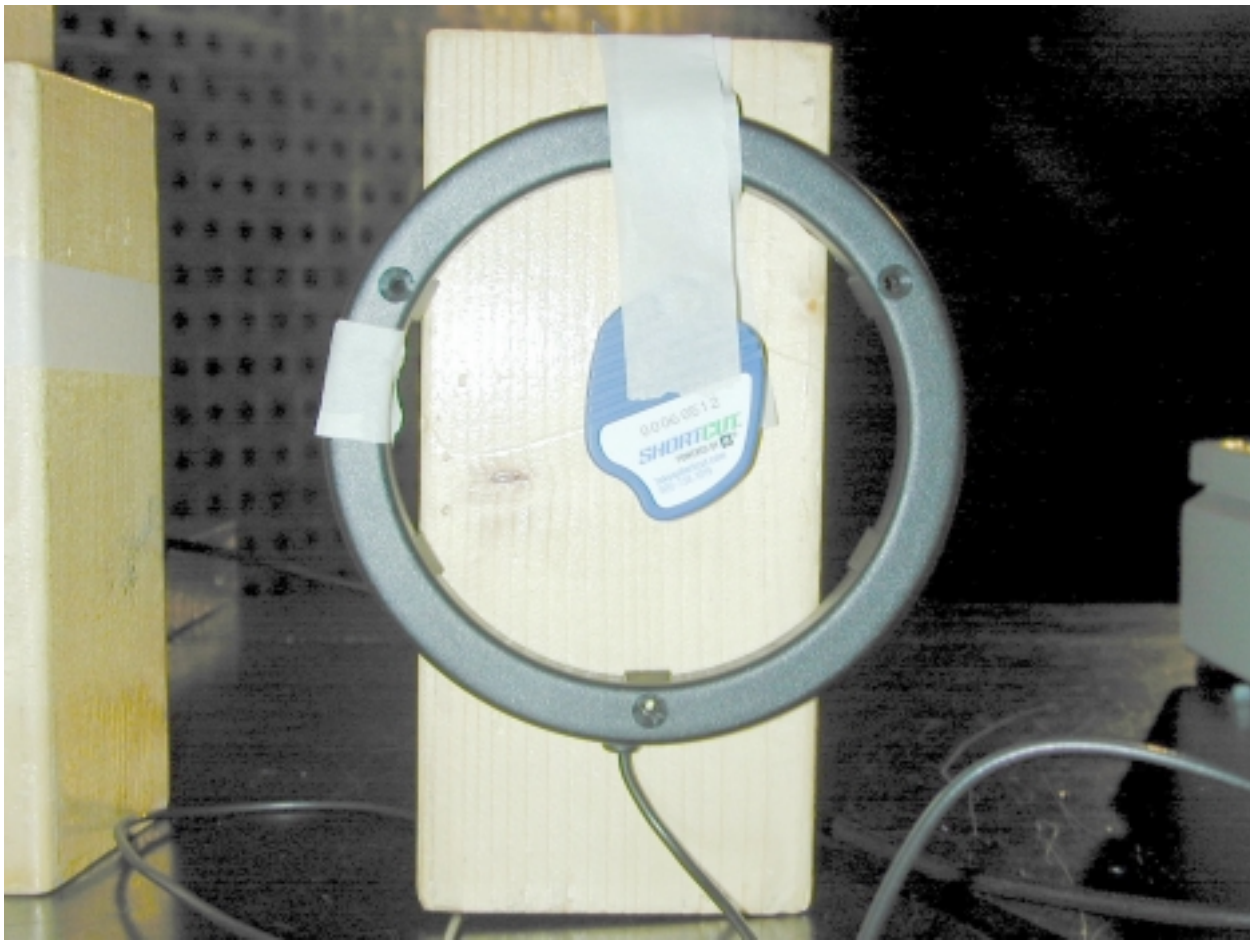
Photograph 6 Radiated emission measurements test setup with biconilog antenna, 30 MHz – 1000 MHz frequency range, anechoic chamber method



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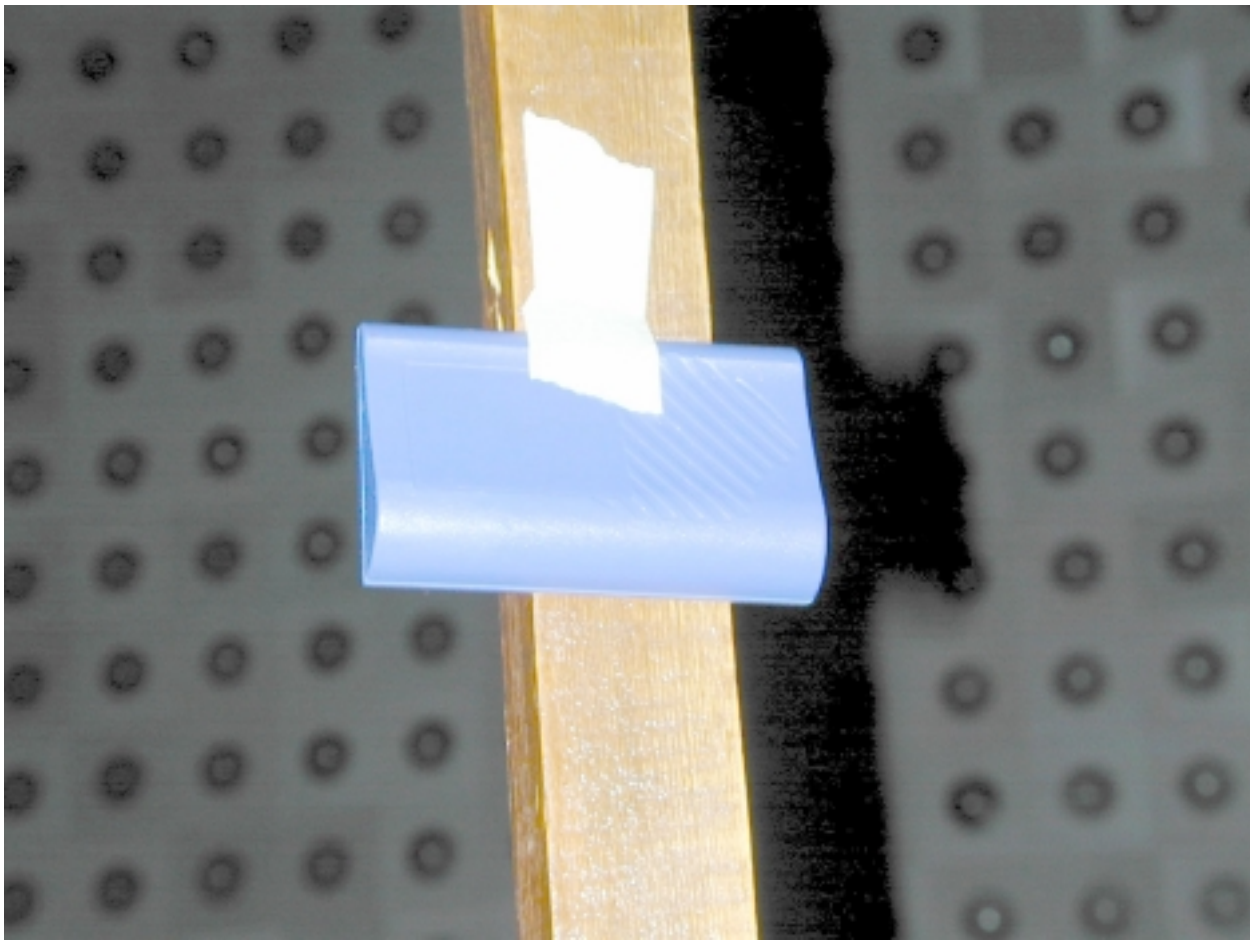
Photograph 7 Radiated emission measurements test setup with double ridge guide antenna, 30 MHz – 1000 MHz frequency range, anechoic chamber method



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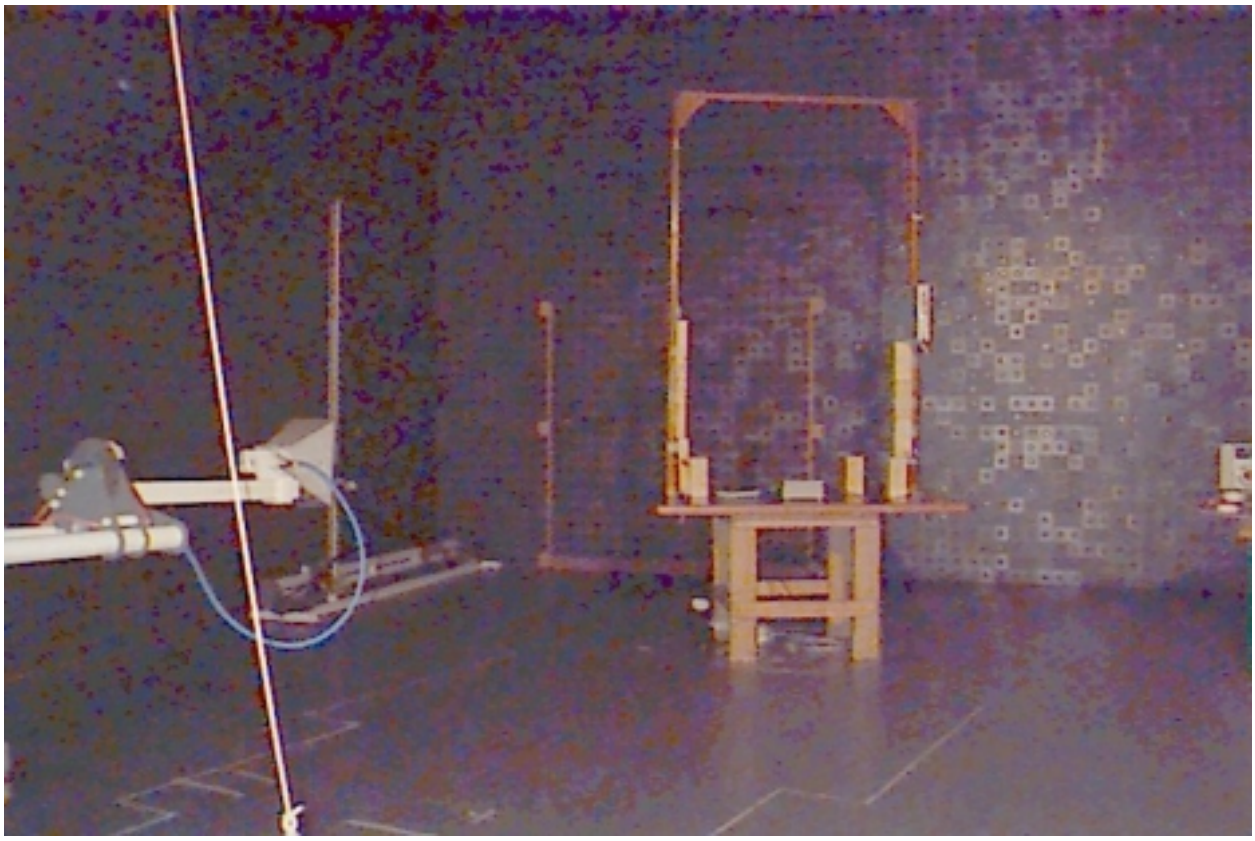
Photograph 8 Radiated emission measurements test setup with double ridge guide antenna, 1 GHz – 5 GHz frequency range, anechoic chamber method



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Photograph 9 Radiated emission measurements test setup with double ridge guide antenna, 5 GHz – 10 GHz frequency range, OATS method

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Photograph 10 Radiated emission measurements test setup with double ridge guide antenna, 5 GHz – 10 GHz frequency range, OATS method

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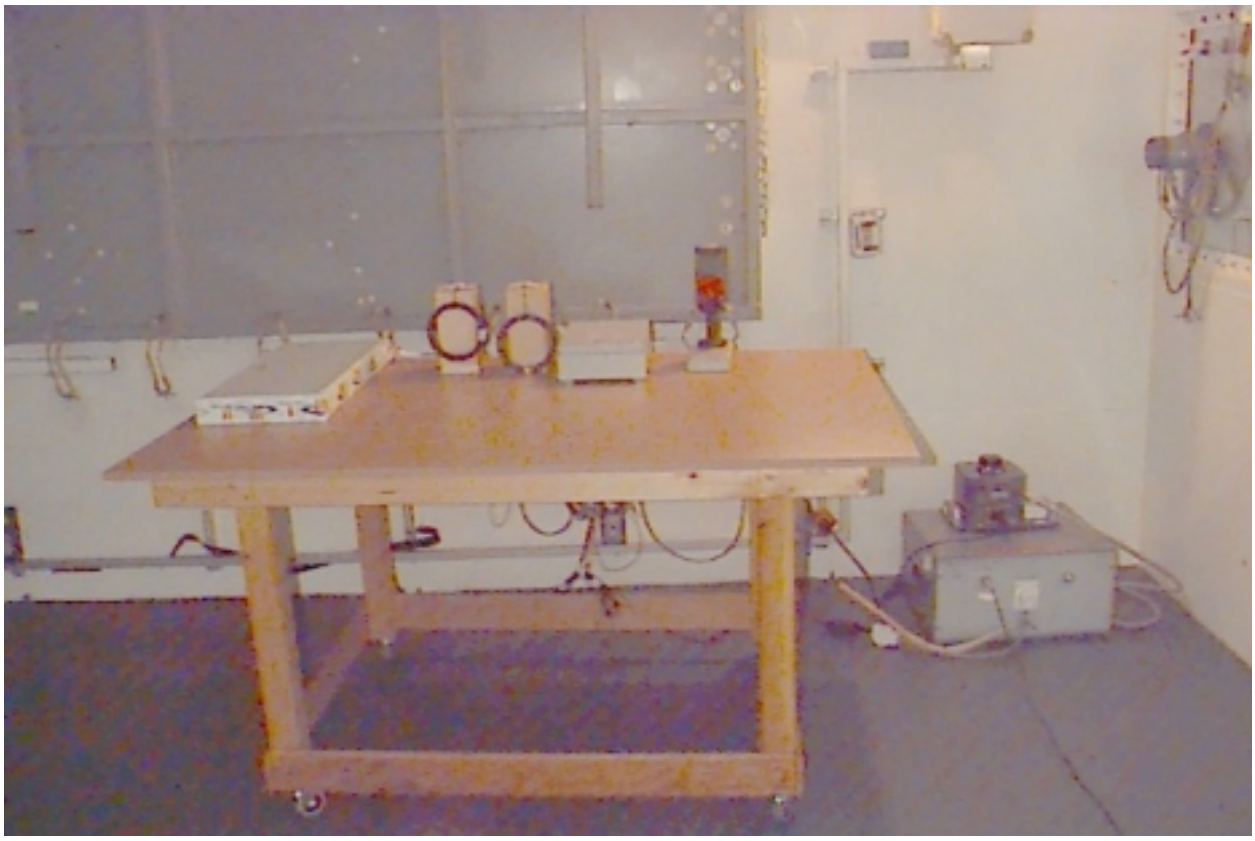
Photograph 11 Conducted emission measurements test setup



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Photograph 12 Frequency tolerance test setup

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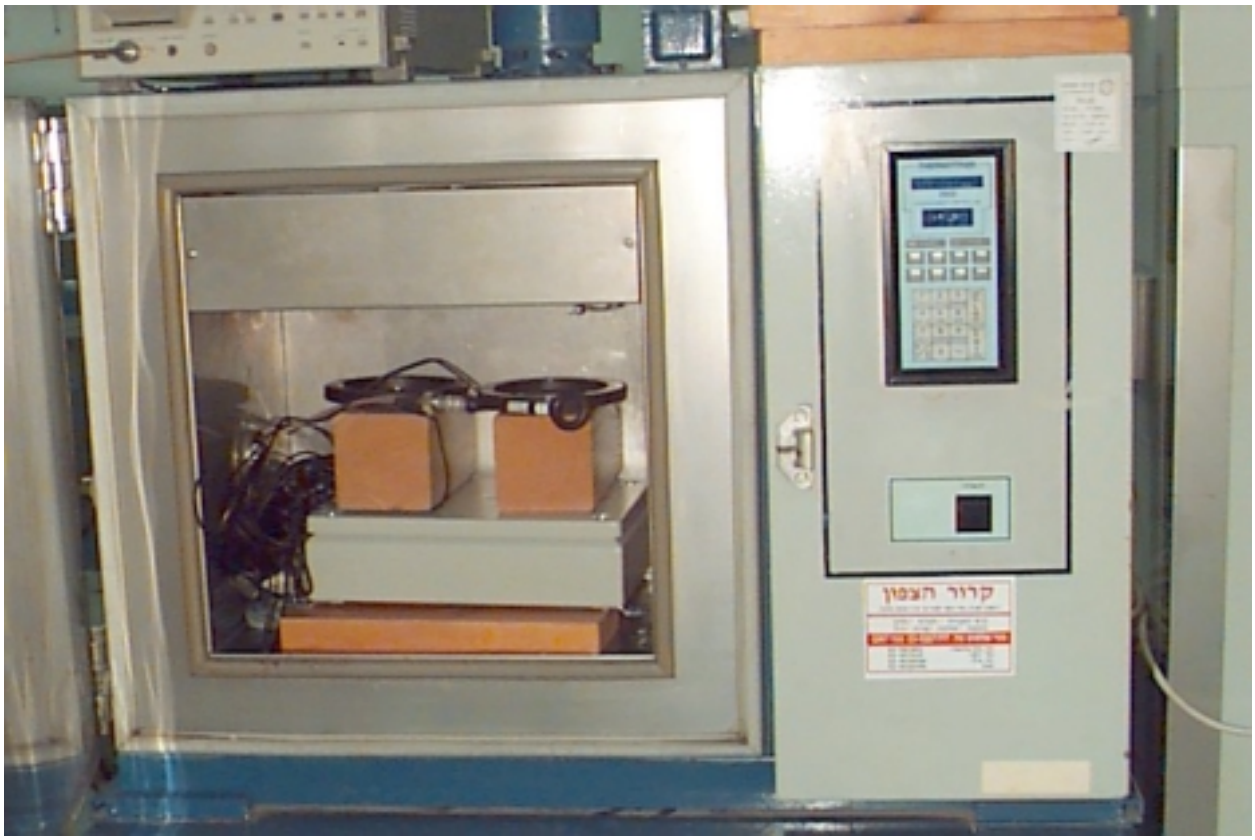
Photograph 13 Frequency tolerance test setup



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Appendix C Test equipment used for tests

HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ year
		Name	Model No.	Serial No.	
0026	Spectrum analyzer, 100 Hz-2.2 GHz	Anritsu	MS 2601A	3460	8/02
0038	Antenna Mast, 1-4 m	Hermon Labs	AM-1	028	2/02 Check
0041	DOUBLE RIDGED GUIDE ANTENNA, 1-18 GHZ	Electro-Metrics	RGA 50/60	2811	8/02
0446	Active Loop Antenna 10 kHz-30 MHz	Electro-Mechanics	6502	2857	11/02
0447	LISN, 16/2, 300 V RMS	Hermon Labs	LISN 16-1	447	12/02
0493	Oven temperature	Thermotron	S-1.2 Mini-Max	4016	3/02
0521	Spectrum Analyzer with RF filter section (EMI Receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	7/02
0539	Generator Signal	Marconi Instruments	52023-001H	1041	10/02
0554	Amplifier, 2 – 18 GHz RF	Miteq	AFD-4	4300	12/02
0589	Cable Coaxial, GORE A2POL118.2, 3m	Hermon Labs	GORE-3	589	11/02
0604	Antenna Biconilog Log-Periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	12/02
0787	Transient limiter	Hewlett Packard	11947A-8ZE	3107A01877	11/02
1004	Cable coaxial, ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/02
1412	Multimeter	Fluke	Fluke 11	76050235	07/02
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	9/02
1425	EMI Receiver System, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3710A00222	9/02
1503	Cable RF, 6 m	Belden	M17/167 MIL-C-17	NA	09/02
1942	Cable 18 GHz, 4 m, blue	Rhophase Microwave Ltd	SPS-1803A-4000-NPS	T4658	10/02

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Appendix D General information

Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private EMC, Safety 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) and by Industry Canada for electromagnetic emissions (file numbers IC 2186-1 for OATS and IC 2186-2 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), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, Telecommunications, Safety standards, and by AMTAC (UK) for safety of Medical Devices. 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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Person for contact: Mr. Alex Usoskin, QA manager.

Abbreviations and acronyms

The following abbreviations and acronyms are applicable to this test report:

AC	alternating current
AE	auxiliary equipment
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
EMC	electromagnetic compatibility
EUT	equipment under test
GHz	gigahertz
H	height
Hz	hertz
kHz	kilohertz
kV	kilovolt
L	length
LISN	line impedance stabilization network
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
RF	radio frequency
RE	radiated emission
rms	root mean square
s	second
V	volt
W	width

Specification references

47CFR part 15: 2001	Radio Frequency Devices
ANSI C63.2:96	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4:92	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

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FCC Equipment codes and descriptions

CYY	Communications Receiver used w/ P.15 transmitter
DCD	Part 15 Low Power transmitter Below 1705 kHz
DSC	Part 15 Security/Remote Control Transmitter
DSR	Part 15 Remote Control/Security Device Transceiver
DSS	Part 15 Spread Spectrum Transmitter
DXX	Part 15 Low Power Communication Device Transmitter
EAV	Part 15 Automatic Vehicle Identification System
ETB	Part 15 Cordless Telephone Base Transceiver
ETR	Part 15 Cordless Telephone Remote Transceiver
ETS	Part 15 Cordless telephone system
FAP	Part 15 Anti-Pilferage Device
FDS	Part 15 Field Disturbance Sensor
GAT	Part 15 Auditory Assistance Device (Transmitter)
HID	Part 15 TV Interface Device
JBC	Part 15 Class B Computing Device/ Personal Computer
JBP	Part 15 Class B Computing Device Peripheral
PUB	Part 15 Unlicensed PCS base station
PUE	Part 15 Unlicensed PCS portable Tx held to ear
PUF	Part 15 Unlicensed PCS portable Tx held to face
PUT	Part 15 Unlicensed PCS portable Tx worn on body