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Electrical

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ELECTROMAGNETIC EMISSIONS TEST REPORT

according to 47CFR Part 15, §15.247 and subpart B

for

WaveIP Ltd.

EQUIPMENT UNDER TEST:

Subscriber unit

Model: GigAccess 2.4 RSU

Document ID: WAVRAD_FCC.15569_rev2.doc
Date of Issue: December 03

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1 Project information

Description of equipment under test

Test items	: Subscriber unit (DSSS transceiver for Internet broadband access)
Manufacturer	: WaveIP Ltd.
Types (Models)	: GigAccess 2.4 RSU
Software revision(s) of radio unit as tested	: V2.4703
Hardware version:	: GA-RSU-2.4, PCB V4
Equipment FCC code	: DTS

Applicant information

Applicant's responsible person	: Mr. Michael Dayan, software director
Company	: WaveIP Ltd.
Address	: 1 Tavor Building
Postal code	: 20692
City	: Yokneam
Country	: Israel
Telephone number	:+972-4993 7333
Telefax number	:+972-4959 2614

Test performance

Project Number:	: 15569
Location	: Hermon Laboratories
Receipt date	: June 15, 2003
Test completed	: November 17, 2003
Purpose of test	: Apparatus compliance verification in accordance with emission requirements
Test specification(s)	47CFR Part 15, §15.247 and subpart B

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2 Summary of tests and signatures

The tests listed in the table below were performed.
The EUT was found complying with the limits of 47CFR Part 15, §15.247 and subpart B.

Test description	Specification reference	Tested by	Date tested	Test report paragraph	Verdict
Transmitter characteristics, §15.247, direct sequence systems					
Minimum 6 dB bandwidth	15.247(a)(2)	Mr. Y. Neuman, test engineer	November 13, 2003	4.1	Pass
Maximum peak output power	15.247(b)(3)	Mr. M. Nikishin, test engineer	November 17, 2003	4.2	Pass
Exposure compliance requirements	15.247(b)(5)	Calculated	NA	4.3	Pass
Spurious emissions (conducted)	15.247(c)	Mr. Y. Neuman, test engineer	November 16, 2003	4.4	Pass
Spurious emissions (radiated) in restricted bands	15.209, 15.205 (a, c)	Mr. Y. Neuman, test engineer	November 13, 2003	4.5	Pass
Peak power spectral density	15.247(d)	Mr. Y. Neuman, test engineer	November 13, 2003	4.6	Pass
Unintentional radiation					
Radiated emissions	15.109	Mr. Y. Neuman, test engineer	January 8, 2004	4.7	Pass
Conducted emissions	15.207, 15.107	Mr. Y. Neuman, test engineer	November 16, 2003	4.8	Pass

Test report prepared by:

Mrs. M. Cherniavsky, MScEE, certification engineer _____

Test report approved by:

Mr. Michael Nikishin, MScEE, group leader _____

Mr. Edward Usoskin, PhD, C.E.O. _____

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3 EUT description

3.1 General description

The EUT is a part of GigAccess™ WaveIP's wireless point-to-point and point-to-multipoint broadband communication system. The basic subsystem is a sector, consisting of an AU (access unit) and up to 64 subscriber units (SUs), each with full-duplex communication SUs and the WAN via the AU. The residential subscriber unit (RSU) is a self- installed desktop radio for SOHO and residential customers, providing wireless high-speed Internet access.

3.2 Transmitter description

Type of equipment								
√	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						
√	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						
Assigned frequency range		2400 – 2483.5 MHz						
Operating frequency range		2412 - 2462 MHz						
RF channel spacing		5000 kHz						
Maximum rated output power		At transmitter 50 Ω RF output connector					23.9 dBm	
		Effective radiated power (for equipment with no RF connector)						
Antenna connection								
	unique coupling		standard connector	√	integral		with temporary RF connector	
							without temporary RF connector	
External / Integrated Antenna/s technical characteristics								
Type		Manufacturer		Model number			Gain	
Integrated Directional Antenna		MARS		MA-WA24-3X			11.5	
Transmitter aggregate data rate/s		2 Mbs / 5.5 Mbps / 11 Mbps						
Transmitter aggregate symbol (baud) rate/s		1.375 Msymbols (MBaud) per second						
Type of modulation		DQPSK, 16CCK[1], 256 CCK						
Type of multiplexing		TDMA						
Modulating test signal (baseband)		256 CCK						
Maximum transmitter duty cycle in normal use		65 %						
Transmitter duty cycle supplied for test		100 %	**Tx ON time**	NA	**Period**	NA		
Transmitter power source								
√	DC	Nominal rated voltage	3.3 VDC					
	AC mains	Nominal rated voltage		Frequency				
Is there common power source for transmitter and receiver			√ yes			no		
Spread spectrum technique used				Frequency hopping (FHSS)				
			√	Direct sequence (DSSS)				
				Hybrid				
Spread spectrum parameters for transmitters tested per FCC 15.247 only								
DSSS	chip sequence length		11 bits Barker Sequence					

[1] CCK - Complementary Code Keying (See INTERSIL AN9850.2)

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3.3 EUT test configuration

The EUT ports and lines description is given in Table 3.2.1, the support/test equipment description - in Table 3.2.2, operating frequencies generated by clocks and oscillators are provided in Table 3.2.3 and test configuration - in Figure 3.2.1.
The Laptop computer was used to reconfigure the RSU during the tests, to change operating frequency and transmit power when needed.

Table 3.2.1

EUT ports and lines

Port type	Port description	Connected from / to		Connector type	Qty.	Cable type	Cable length, m
Power	3.3 V DC	RSU	AC/DC adapter	DC jack	1	unshielded	2
Power	AC	mains	AC/DC adapter	Non-detachable	1	unshielded	2
Signal / data	Ethernet 802.3	RSU	Computer	RJ45	1	CAT 5 shielded	10
Signal / data	Ethernet 802.3	RSU	Open circuit	RJ45	1	CAT 5 shielded	2

Table 3.2.2

EUT support/test equipment

Description	Manufacturer	Model number	Serial number
Laptop	IBM	Think Pad	55565C0

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Table 3.2.3

EUT operating frequencies

Frequency, MHz	Description
25 MHz	Clock for Ethernet section
44 MHz	Clock for digital section
132 MHz	Clock for SDRAM / DDR
374 MHz	Output of IF section
748 MHz	Synthesizer for IF section
2038 ÷ 2088 MHz	Synthesizer for RF section
2412 MHz	CH1 output frequency
2417 MHz	CH2 output frequency
2422 MHz	CH3 output frequency
2427 MHz	CH4 output frequency
2432 MHz	CH5 output frequency
2437 MHz	CH6 output frequency
2442 MHz	CH7 output frequency
2447 MHz	CH8 output frequency
2452 MHz	CH9 output frequency
2457 MHz	CH10 output frequency
2462 MHz	CH11 output frequency

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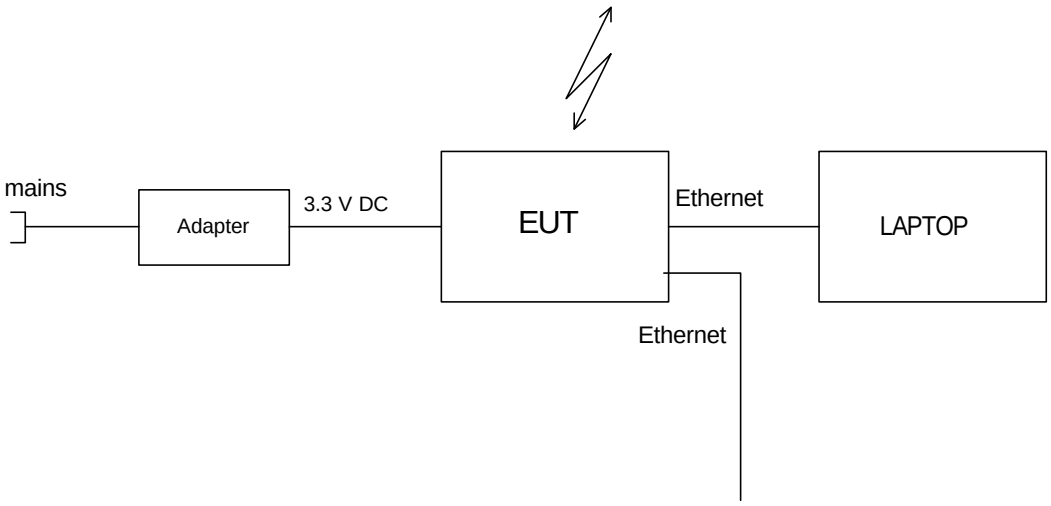
Figure 3.2.1

EUT test configuration



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4 Test results

4.1 Occupied bandwidth for DSSS systems according to § 15.247(a) (2)

METHOD OF MEASUREMENTS	FCC Docket No.96-8; FCC 97-114
DATE of TEST:	November 13, 2003
RELATIVE HUMIDITY:	42 %
AMBIENT TEMPERATURE:	22°C
AIR PRESSURE:	1015 hPa
OPERATING FREQUENCY RANGE:	2.412 – 2.462 GHz
MODULATION TECHNIQUE:	DSSS
BIT RATE:	11 Mbps
MEASUREMENT UNCERTAINTY:	±487 Hz

Carrier frequency, MHz	Measured 6 dB bandwidth, MHz	Reference to Plot in Appendix A
2412	11.07	A1
2437	11.10	A2
2462	11.13	A3

LIMIT

Operating frequency range, MHz	Minimum allowed bandwidth
2400 - 2483.5	≥ 500 kHz @ 6 dBc

TEST PROCEDURE

The EUT RF output was connected to the spectrum analyzer through 40 dB attenuator (plus 1.0 dB cable loss), the settings are shown in the plots. Spectrum analyzer readings were corrected for external attenuation and cable loss. The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at low and high edges and at the middle of the 2.412 - 2.462 GHz frequency range.

TEST EQUIPMENT USED:

HL 1424	HL 1651	HL 2254				

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4.2 Maximum peak output power test according to §15.247 (b)(3)

METHOD OF MEASUREMENTS	FCC Docket No.96-8; FCC 97-114
DATE of TEST:	November 17, 2003
RELATIVE HUMIDITY:	42 %
AMBIENT TEMPERATURE:	22°C
AIR PRESSURE:	1015 hPa
OPERATING FREQUENCY RANGE	2.412 – 2.462 GHz
MODULATION TECHNIQUE	DSSS
BIT RATE:	11 Mbps
MEASUREMENT UNCERTAINTY:	±3.5 dB

Carrier frequency, GHz	Peak output power, dBm		Margin, dB	Reference to Plots in Appendix A
	Measured	Limit		
2.412	23.2	24.5	1.3	A4
2.437	23.9		0.6	A5
2.462	23.4		1.1	A6

LIMIT

Operating frequency range, MHz	Maximum peak output power*, W
2400-2483.5	1

* Notes to table

a) 1. If transmitting antennas of directional gain greater than 6 dB are used, the peak output power shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 6 dBi

The antenna gain is 11.5 dBi, the peak output limit is 30 – (11.5 - 6) = 24.5 dBm.

TEST PROCEDURE

The transmitter output power was measured by substitution conducted method with a wideband detector connected to oscilloscope as shown in Figure 4.2.1. Peak output voltage from the wideband detector was captured with oscilloscope. The EUT was replaced with a signal generator, set to the same frequency, and the output power was adjusted to produce the same voltage as was captured with oscilloscope. The RF signal generator output was recorded. The transmitter output power P_T was calculated according to formula:

$$P_T = RF_{gen} - CL + Att$$

as shown in Plots A4 to A6.
The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at low and high edges and at the middle of the 2.412 - 2.462 GHz frequency range.

TEST EQUIPMENT USED:

HL 0661	HL 1509	HL 1562	HL 1650	HL 1651	HL 2227	HL 2400

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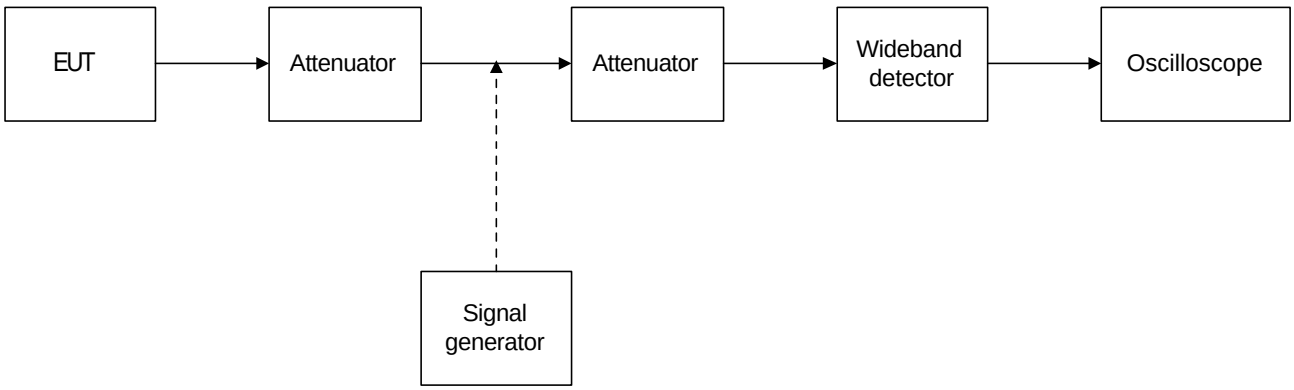
Figure 4.2.1

Peak output power measurement setup



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Exposure limit according to §15.247(b)(5) and §1.1310

The subscriber unit is classified as mobile device.

Limit for power density for general population/uncontrolled exposure is 1 mW/cm^2 (for 1500 –100,000 MHz frequency range).

The power density $\mathbf{P\ (mW/cm^2) = P_T / 4\pi r^2}$, where

P_T is the transmitted power, which is equal to the transmitter output power 23.9 dBm plus maximum antenna gain 11.5 dBi, the maximum equivalent isotropically radiated power EIRP is

$$P_T = 23.9\ dBm + 11.5\ dBi = 35.4\ dBm = 3467\ mW.$$

The power density at 20 cm (minimum safe distance, required for mobile devices), calculated as follows:

$$3467\ mW / 4\pi\ (20\ cm)^2 = 0.69\ mW/cm^2 < 1\ mW/cm^2$$

was found below the limit.

Hence, no safety hazard exists for human being.

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4.3 Out of band conducted emissions test according to §15.247(c)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.5
DATE:	November 16, 2003
RELATIVE HUMIDITY:	43 %
AMBIENT TEMPERATURE:	22°C
AIR PRESSURE:	1015 hPa
OPERATING FREQUENCY RANGE	2412-2462 MHz
MODULATION TECHNIQUE	DSSS
BIT RATE:	11 Mbps
FREQUENCY RANGE*	9 kHz - 25 GHz
MEASUREMENT UNCERTAINTY:	± 5.5 dB

* The frequency spectrum was investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency.

All emissions were found below the specified limit. For test results refer to Plots A7 – A28.

LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

TEST PROCEDURE

The EUT RF output was connected to the spectrum analyzer, the settings are shown in the plots. Spectrum analyzer readings were corrected for external attenuation and cable loss. The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at low and high edges and at the middle of the 2412 – 2462 MHz range.

TEST EQUIPMENT USED:

HL 1424	HL 1650	HL 1651	HL 2254			

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4.4 Radiated emissions which fall in restricted bands test according to §15.247(c) and § 15.205, §15.209(a)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4
DATE:	November 2, 4, 2003
RELATIVE HUMIDITY:	39 %
AMBIENT TEMPERATURE:	29°C
AIR PRESSURE:	1014 hPa
OPERATING FREQUENCY RANGE	2412-2462 MHz
MODULATION TECHNIQUE	DSSS
BIT RATE:	11 Mbps
FREQUENCY RANGE*	9 kHz - 24 GHz
MEASUREMENT UNCERTAINTY:	± 4.5 dB

* The frequency spectrum was investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency. All emissions were found below the specified limit. For test results refer to Plots A29 – A80.

LIMIT

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

Quasi-peak detector

Frequency, MHz	Antenna height, m	Turntable position, °	Radiated emissions, dB (mV/m)	Limit, dB (mV/m)	Margin, dB	Reference to Plots in Appendix A
37.61	1.0	86	28.4	40.00	11.6	A66 (a), (b)
266.7	1.1	229	31.84	46.00	14.16	A31, A49, A66(a)
333.4	1.0	190	39.61	46.00	6.39	A31, A49, A66(a)
400.0	1.0	256	32.88	46.00	13.12	A31, A49, A66(a)

The recorded test results were obtained throughout measurements with biconilog antenna in horizontal polarization.
Turntable position: 0^o = EUT front panel faces the receiving antenna

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Peak detector

Carrier frequency, MHz	Frequency, MHz	Radiated emissions, dB (mV/m)	Limit, dB (mV/m)	Margin, dB	Reference to Plots in Appendix A
2437	2385	61.77	74	12.23	A52
2412	2390	64.37	74	9.63	A35
2462	2488	68.35	74	5.65	A71
2437	2487	63.57	74	10.43	A54
2412	2485	60.60	74	13.40	A37

Average detector

Carrier frequency, MHz	Frequency, MHz	Radiated emissions, dB (mV/m)	Limit, dB (mV/m)	Margin, dB	Reference to Plots in Appendix A
2437	2376	44.77	54	9.23	A53
2437	2385	48.14	54	5.86	A53
2412	2390	46.61	54	7.39	A36
2462	2483.5	52.9	54	1.1	A72
2437	2485	46.67	54	7.33	A55
2412	2485	47.59	54	6.41	A38

The recorded test results were obtained through measurements with double ridged guide antenna in vertical polarization**.**

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

TEST PROCEDURE

The test was performed with transmitter operating 3 carrier frequencies F_{min} = 2412 MHz, F_{cent} = 2437 MHz, F_{max} = 2462 MHz from 9 kHz to 24 GHz. The measurements were performed at 3 m test distance, the EUT was placed on a wooden 80 cm height turntable.

9 kHz – 30 MHz frequency range. The loop antenna was positioned with its plane vertical. The loop center was 1 meter above the ground plane. To find maximum radiation the turntable was rotated 360 and the measuring antenna was rotated about its vertical axis.

30 MHz – 24 GHz frequency range. The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360^{o}, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

TEST EQUIPMENT USED AT OATS:

HL 0038	HL 0091	HL 0287	HL 1200	HL 1424	HL 1942	HL 1984
HL 2254	HL 2259	HL 2260	HL 2387	HL 2399		

TEST EQUIPMENT USED IN ANECHOIC CHAMBER:

HL 0446	HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594
HL 0604	HL 1004	HL 1200	HL 1947	HL 2009	HL 2432	

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4.5 Peak power spectral density of DSSS according to § 15.247(d)

METHOD OF MEASUREMENTS	FCC Docket No.96-8; FCC 97-114
DATE of TEST:	November 13, 2003
RELATIVE HUMIDITY:	42 %
AMBIENT TEMPERATURE:	22°C
AIR PRESSURE:	1015 hPa
OPERATING FREQUENCY RANGE	2412 - 2462 MHz
MODULATION TECHNIQUE	DSSS
BIT RATE:	11 Mbps
LIMIT FOR PEAK POWER SPECTRAL DENSITY	8 dBm
MEASUREMENT UNCERTAINTY:	± 3.5 dB

Carrier frequency, MHz	**Measured peak power spectral density, dBm/3 kHz**	**Reference to Plots in Appendix A**
2412	-2.17	A81, A82
2437	-1.33	A83, A84
2462	-1.50	A85, A86

LIMIT

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

TEST PROCEDURE

The EUT RF output was connected to the spectrum analyzer through 41 dB attenuator, the settings are shown in the plots. Spectrum analyzer readings were corrected for external attenuation and cable loss. The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at low and high edges and at the middle of the 2.412 – 2.462 GHz frequency range according to method #1 for peak power spectral density.

TEST EQUIPMENT USED:

HL 1424	HL 1651	HL 2254				

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4.6 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT:	ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
DATE of TEST:	January 8, 2004
TEST PERFROMED AT:	Anechoic chamber
AMBIENT TEMPERATURE:	21°C
RELATIVE HUMIDITY	51%
AIR PRESSURE:	1013 hPa
DISTANCE BETWEEN ANTENNA AND EUT:	3 m
THE EUT WAS TESTED AS:	Table-top
FREQUECNY RANGE:	30 MHz – 5 GHz
MEASUREMENT UNCERTAINTY:	± 6 dB max

Quasi-peak detector, RBW = 120 kHz

Frequency, MHz	Antenna polarization	Antenna height, m	Turntable position (^{o})	Radiated emissions, dB (μV/m)	Limit, dB (μV/m)	Margin, dB	Reference to Plot in Appendix A
44.145	Vertical	1.0	158	31.58	40.00	8.42	A87
65.150	Vertical	1.0	104	32.84	40.00	7.16	
157.507	Horizontal	1.0	256	32.77	46.00	10.73	
389.889	Vertical	1.0	168	43.24	46.00	2.76	
454.879	Vertical	1.0	167	42.63	46.00	3.37	
611.190	Horizontal	1.2	153	39.19	46.00	6.81	
896.500	Vertical	1.0	155	35.55	46.00	10.45	

The recorded test results were obtained through measurements with biconilog antenna**.**
Verdict: Pass

Average detector, RBW = 1 MHz

Frequency, MHz	Antenna polarization	Antenna height, m	Turntable position (^{o})	Radiated emissions, dB (μV/m)	Limit, dB (μV/m)	Margin, dB	Reference to Plots in Appendix A
1495.995	Vertical	1.0	161	38.06	54.00	15.94	A88

The recorded test result was obtained through measurements with double ridged guide antenna**.**
Verdict: Pass

Table abbreviations:
Turntable position: 0^o = EUT front panel faces the receiving antenna

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LIMIT (§ 15.109)

Frequency, MHz	**Class B equipment @ 3 m dB(mV/m)**
30 - 88	40
88 - 216	43.5
216 - 960	46
960 - 5000	54

TEST EQUIPMENT USED:

HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604
HL 1004	HL 1947	HL 2009	HL 2432			

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4.7 Conducted emissions test according to §15.207, 15.107

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.3
DATE of TEST:	November 16, 2003
RELATIVE HUMIDITY:	40%
AMBIENT TEMPERATURE:	24°C
AIR PRESSURE:	1020 hPa
THE EUT WAS TESTED AS:	TABLE-TOP
DETECTOR USED:	QUASI-PEAK
FREQUECNY RANGE:	150 kHz – 30 MHz
RESOLUTION BANDWIDTH:	9 kHz
MEASUREMENT UNCERTAINTY, dB	± 3.9 dB in 9 – 150 kHz ± 3.8 dB in 150 kHz – 30 MHz

Quasi-peak detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification QP limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.158975	2	53.25	65.56	12.31	Pass	A90
0.317115	1	47.32	59.81	12.49	Pass	A89
0.793163	2	44.45	56.00	11.55	Pass	A90
0.950640	2	43.90	56.00	12.10	Pass	A90
1.421545	2	42.31	56.00	13.69	Pass	A90
1.598720	2	40.80	56.00	15.20	Pass	A90
2.510630	1	44.33	56.00	11.67	Pass	A89
2.674820	1	46.10	56.00	9.90	Pass	A89

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Average detector

Frequency, MHz	Line identification	Measured emissions, dB (mV)	Specification AVRG limit, dB (mV)	Margin, dB	Verdict	Reference to Plots in Appendix A
0.158975	2	48.52	55.56	7.04	Pass	A90
0.317115	1	44.45	49.81	5.36	Pass	A89
0.793163	2	35.64	46.00	10.36	Pass	A90
0.950640	2	33.29	46.00	12.71	Pass	A90
1.421545	2	28.04	46.00	17.96	Pass	A90
1.598720	2	24.22	46.00	21.78	Pass	A90
2.510630	1	27.23	46.00	18.77	Pass	A89
2.674820	1	29.78	46.00	16.22	Pass	A89

LIMIT

Frequency, MHz	Class B equipment, dB(mV)	
	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5	56	46
5 - 30	60	50

*The limit decreases linearly with the logarithm of frequency.

TEST PROCEDURE

The measurements were performed at mains terminals by means of LISN, connected to spectrum analyzer in the frequency range as referred to in the table above. The unused coaxial connector of the LISN was terminated with 50 Ω. The measurements were made with quasi-peak and average detectors as referred to in the tables.
The position of the EUT cables was varied to determine maximum emission level.

TEST EQUIPMENT USED:

HL 0163	HL 0787	HL 1430	HL 1502	HL 1510		

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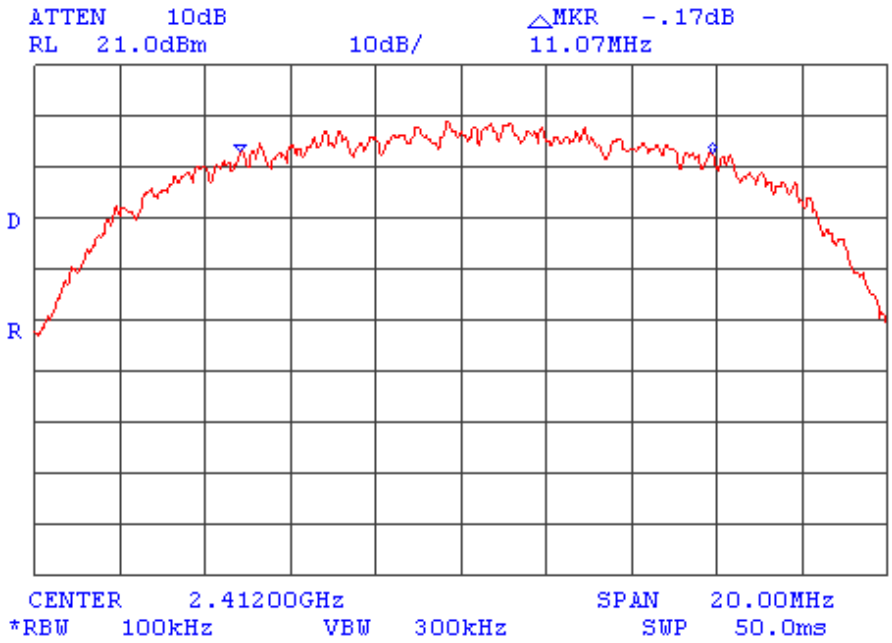
Appendix A Plots

Plot A 1

6 dB bandwidth @ 2.412 GHz

Limit:	>500 kHz
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)=2412 MHz, bitrate 11 Mbit/sec



External attenuator 40 dB
Cable loss 1.0 dB

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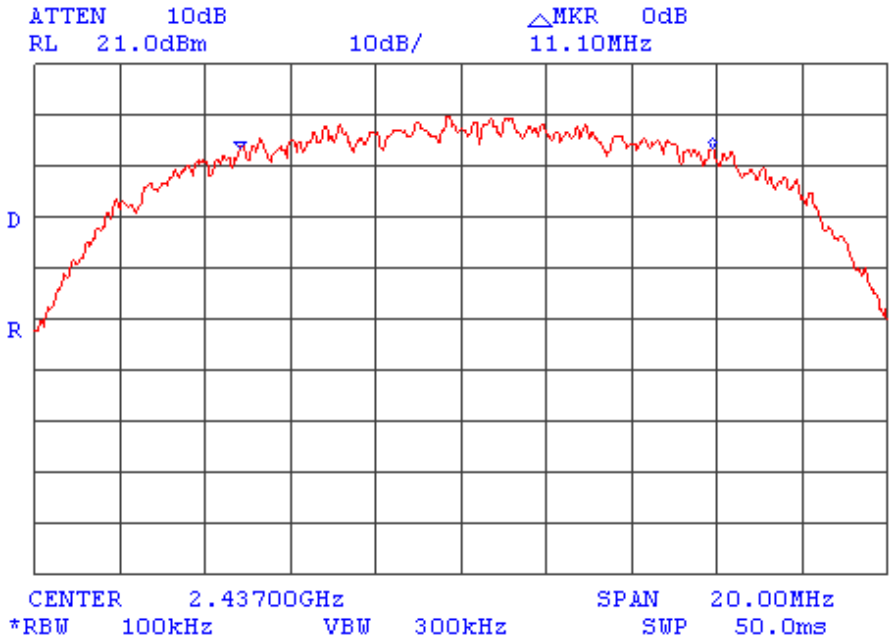
Plot A 2

6 dB bandwidth @ 2.437 GHz

Limit:	>500 kHz
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)=2437MHz, bitrate 11 Mbit/sec



External attenuator 40 dB
Cable loss 1.0 dB

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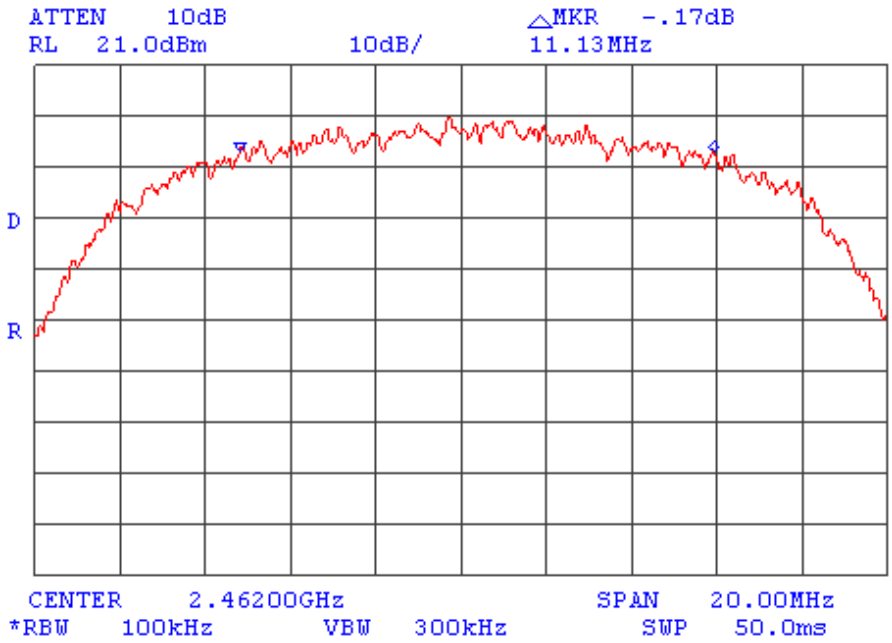
Plot A 3

6 dB bandwidth @ 2.462 GHz

Limit:	>500 kHz
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)=2462 MHz, bitrate 11Mbit/sec



External attenuator 40 dB
Cable loss 1.0 dB

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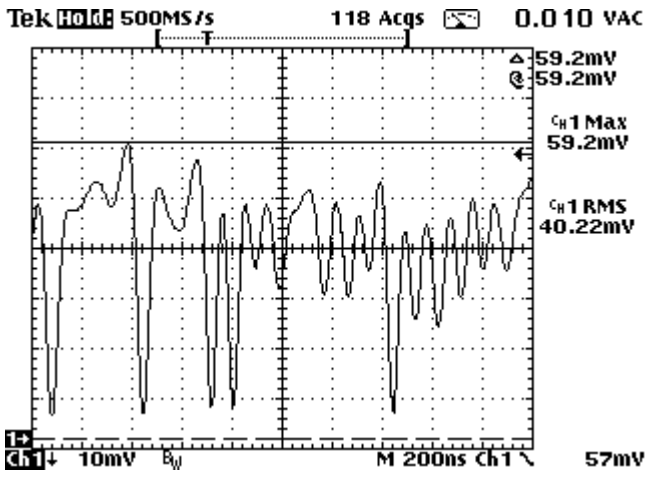
Plot A 4

Peak output power measurements@ 2.412 GHz

Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)=2412 MHz, bitrate 11Mbit/sec



External attenuator: 15 dB

Cable loss: 0.9 dB

RF generator output: 9.1 dBm
Transmitter output power= RF gen – CL + Att= 9.1 – 0.9 + 15 = 23.2 dBm < 24.5 dBm - **PASS**

Limit FCC 15.247b(1): 1 Watt providing antenna gain does not exceed 6 dBi, otherwise proper correction shall be provided.
For antenna gain 11.5 dBi maximum permitted output power (30 dBm + 6 dBi) – 11.5 dBi = 24.5 dBm

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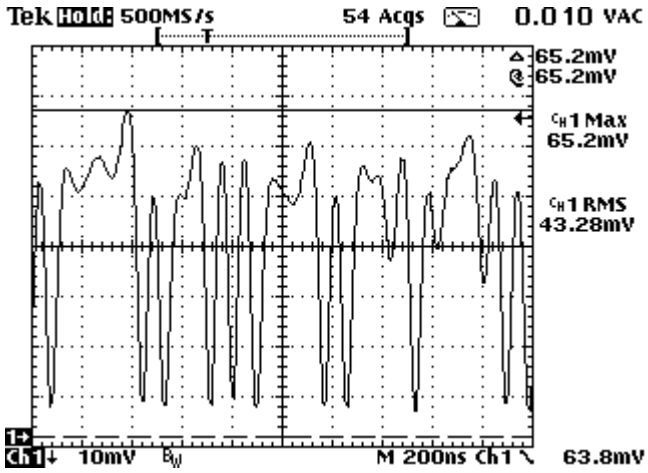
Plot A 5

Peak output power measurements@ 2.437 GHz

Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)=2437 MHz, bitrate 11Mbit/sec



External Attenuator: 15 dB

Cable loss: 0.9 dB

RF generator output: 9.8 dBm
Transmitter output power= RF gen – CL + Att= 9.8 – 0.9 + 15 = 23.9 dBm < 24.5 dBm - PASS

Limit FCC 15.247b(1): 1 Watt providing antenna gain does not exceed 6 dBi, otherwise proper correction shall be provided.
For antenna gain 11.5 dBi maximum permitted output power (30 dBm + 6 dBi) – 11.5 dBi = 24.5 dBm

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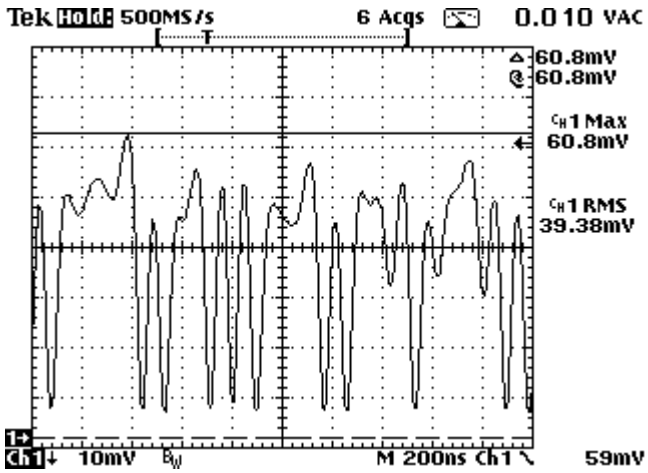
Plot A 6

Peak output power measurements@ 2.462 GHz

Detector: Peak
Test Method: measurement at antenna connector
Notes: f(Tx)=2462 MHz, bitrate 11Mbit/sec



External Attenuator: 15 dB

Cable loss: 0.9 dB

RF generator output: 9.3 dBm
Transmitter output power= RF gen – CL + Att= 9.3 – 0.9 + 15 = 23.4 dBm < 24.5 dBm - PASS

Limit FCC 15.247b(1): 1 Watt providing antenna gain does not exceed 6 dBi, otherwise proper correction shall be provided.
For antenna gain 11.5 dBi maximum permitted output power (30 dBm + 6 dBi) – 11.5 dBi = 24.5 dBm

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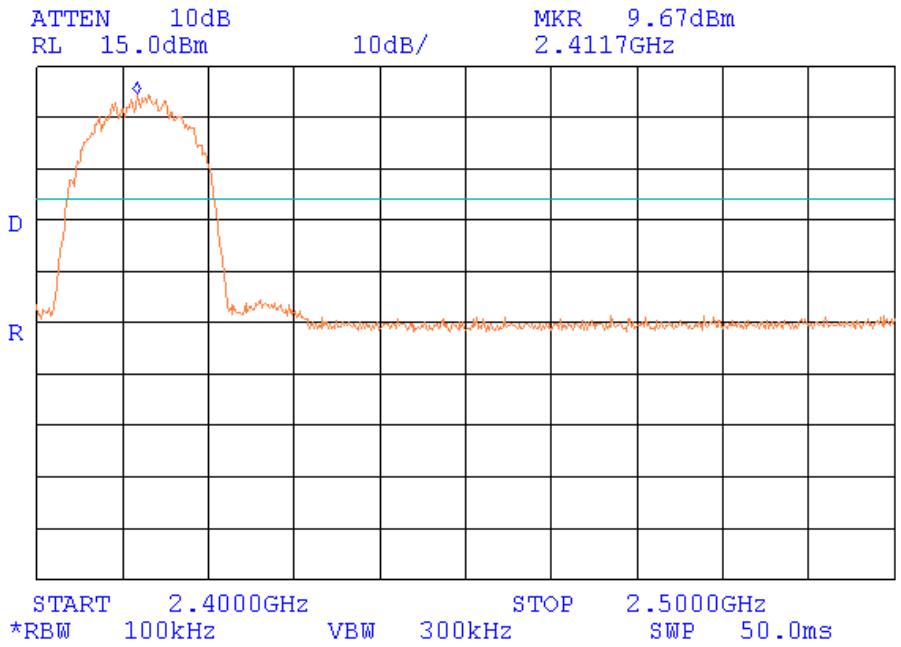
Plot A 7

In-band emission measurements @ 2.412 MHz carrier

Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)=2412 MHz, bitrate 11 Mbit/sec



External attenuator 41 dB (reference level offset).
Limit for spurious= 9.67 dBm– 20 dB =-10.3 dBm

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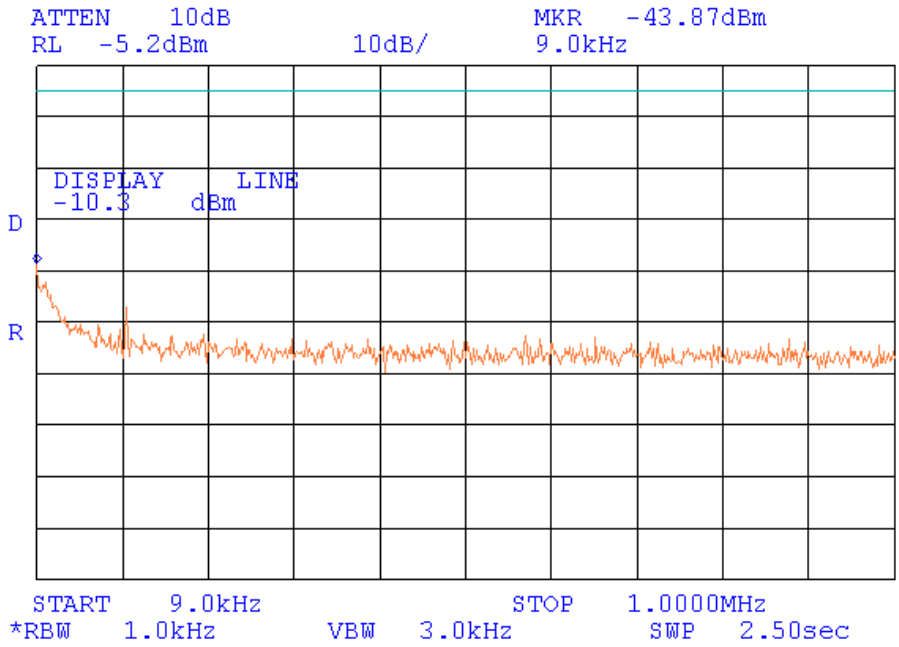
Plot A 8

Conducted spurious emission measurements in 9 kHz – 1 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2412 MHz, bitrate 11 Mbit/sec



External attenuator 40.5 dB (reference level offset).

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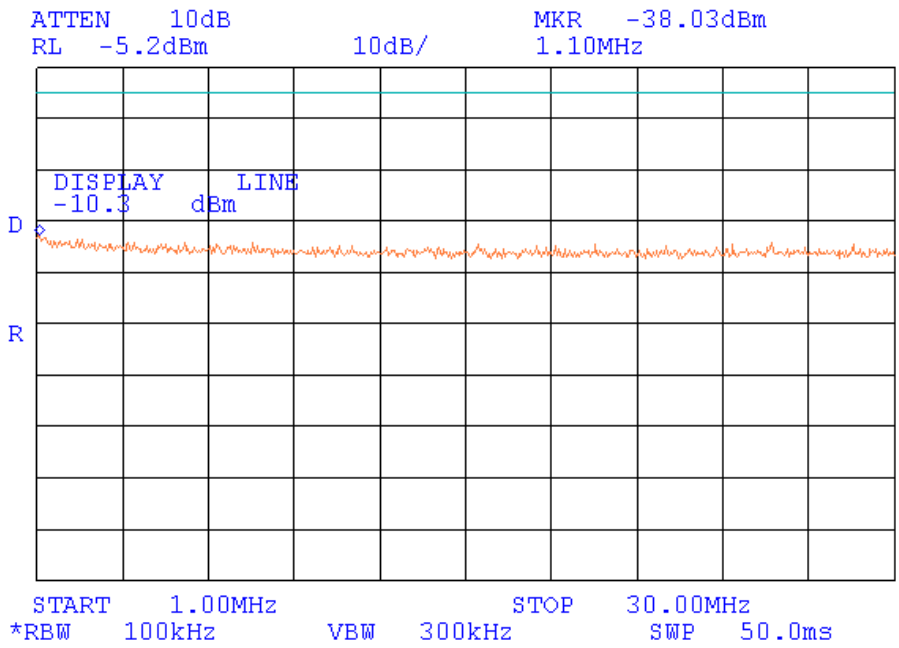
Plot A 9

Conducted spurious emission measurements in 1 MHz – 30 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2412 MHz, bitrate 11Mbit/sec



External attenuator 40.5 dB (reference level offset).

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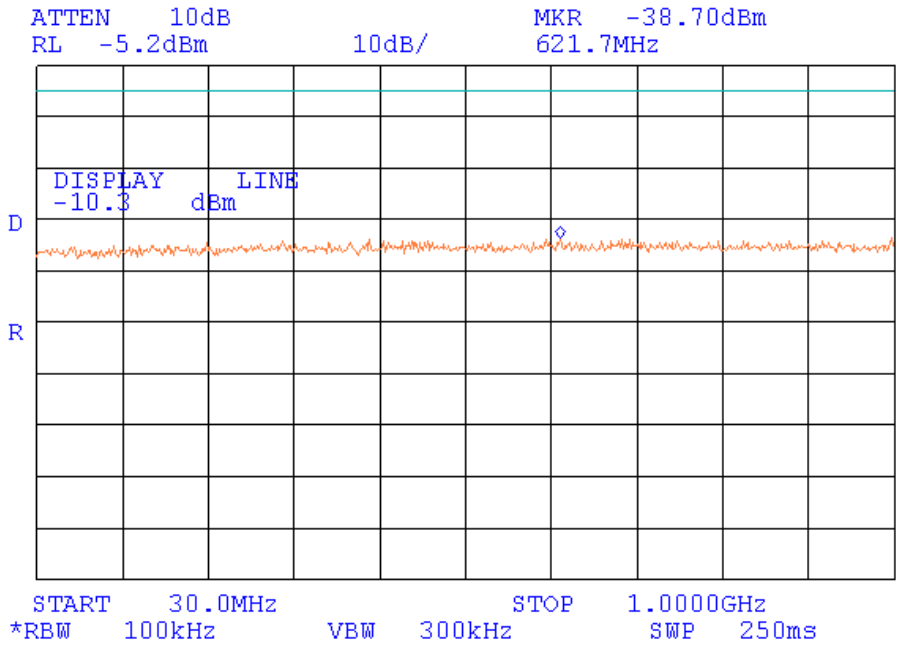
Plot A 10

Conducted spurious emission measurements in 30 MHz – 1000 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2412 MHz, bitrate 11 Mbit/sec



External attenuator 40.8 dB (reference level offset).

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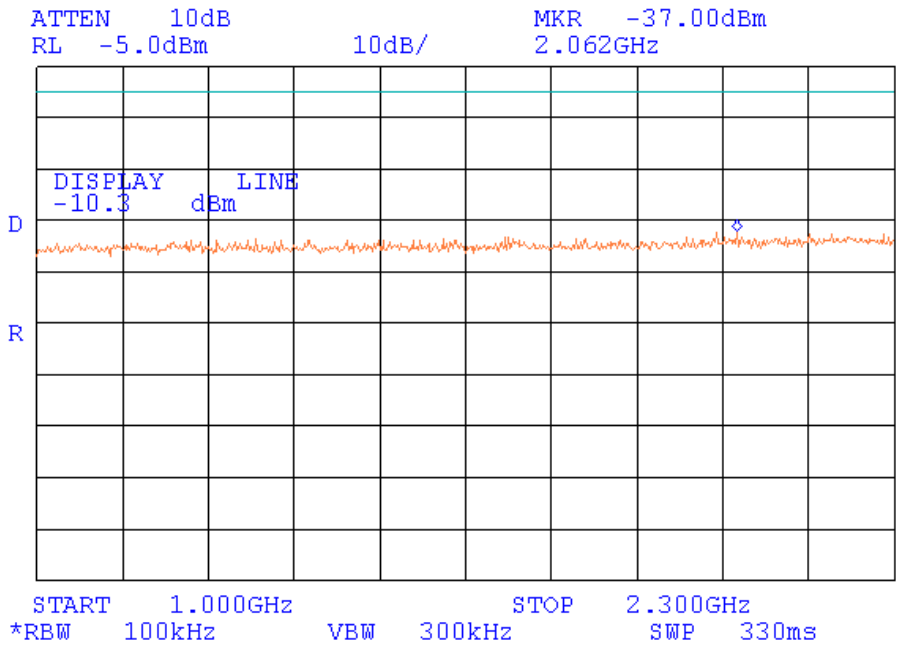
Plot A 11

Conducted spurious emission measurements in 1.0 GHz – 2.3 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2412 MHz, bitrate 11Mbit/sec



External attenuator 41 dB (reference level offset).

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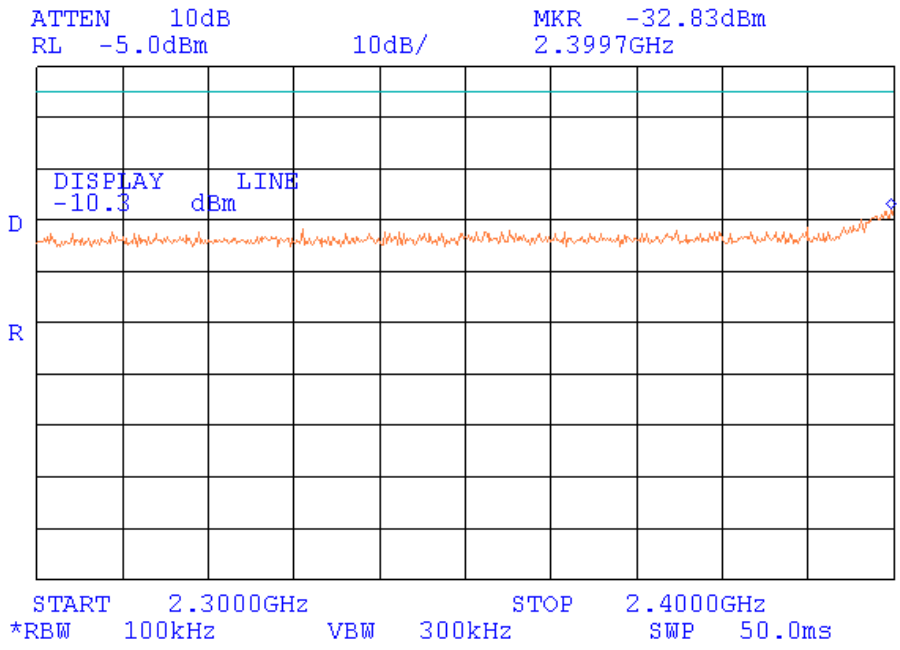
Plot A 12

Conducted spurious emission measurements in 2.3 GHz – 2.4 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2412 MHz, bitrate 11Mbit/sec



External attenuator 41 dB (reference level offset).

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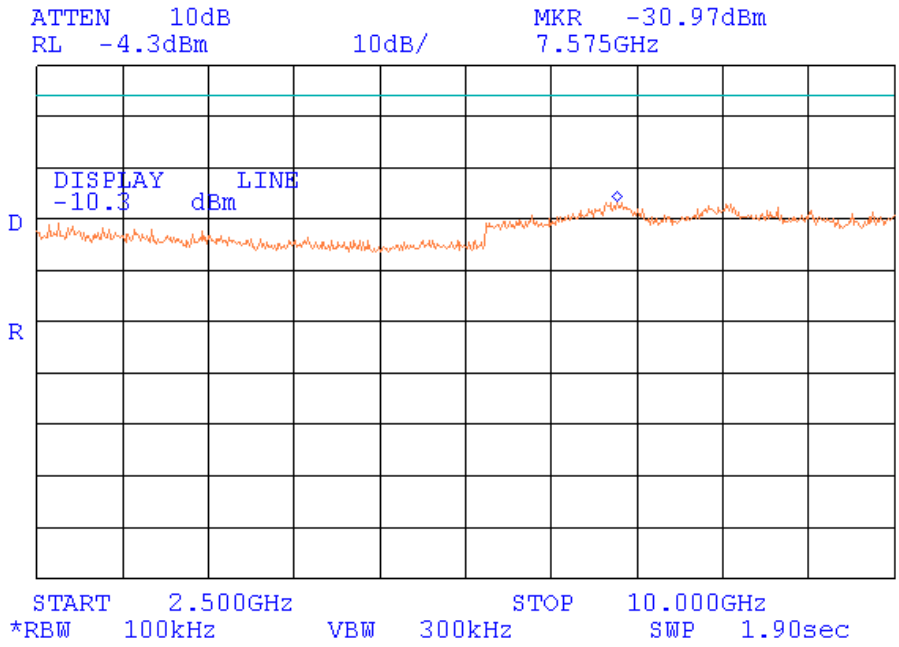
Plot A 13

Conducted spurious emission measurements in 2.5 GHz – 10 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2412 MHz, bitrate 11Mbit/sec



External attenuator 41.7 dB (reference level offset).

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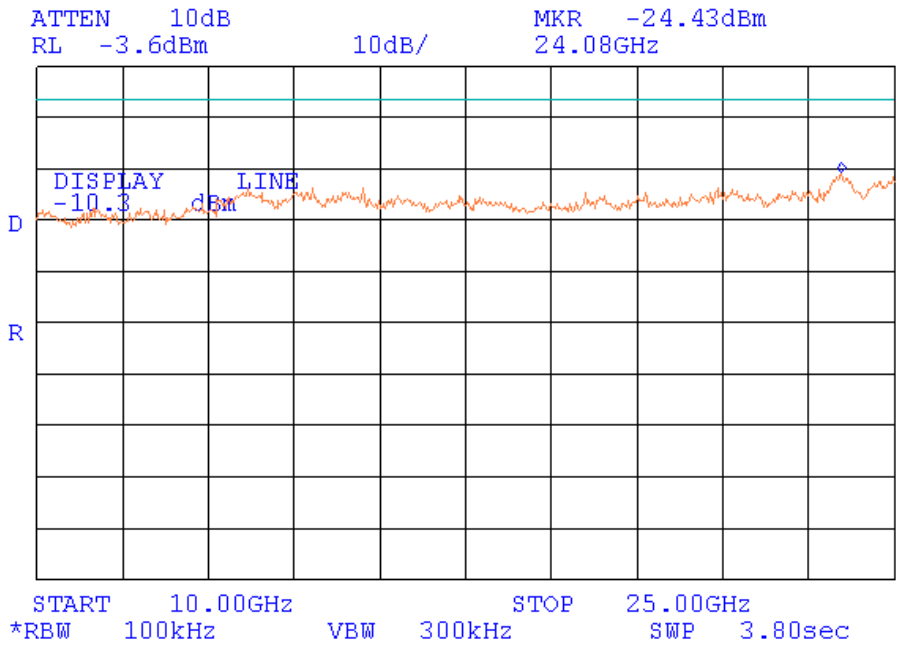
Plot A 14

Conducted spurious emission measurements in 10 GHz – 25 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2412 MHz, bitrate 11 Mbit/sec



External attenuator 42.4 dB (reference level offset).

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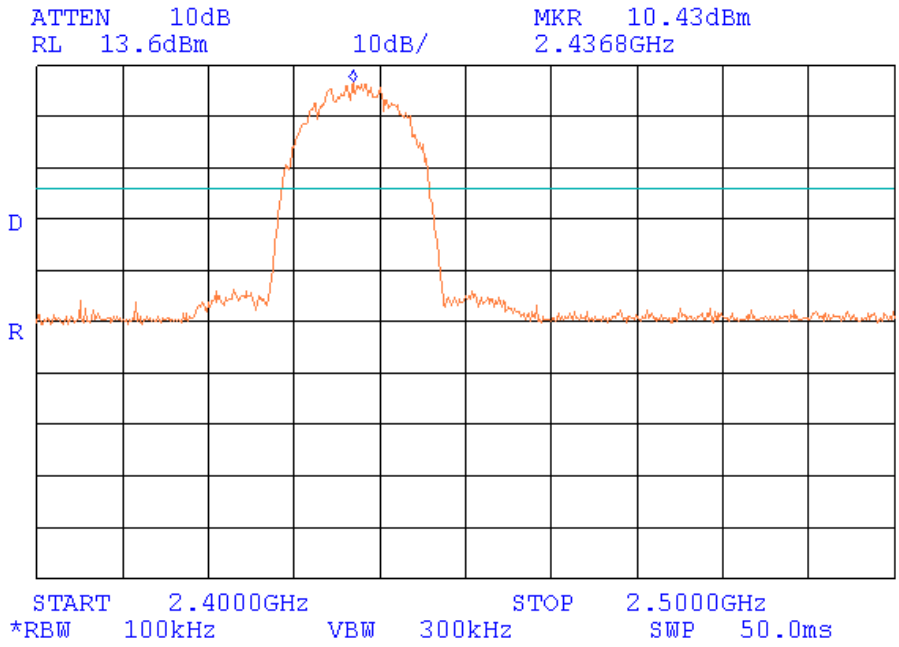
Plot A 15

In-band spurious emission measurements @ 2437 MHz

Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)=2437 MHz, bitrate 11Mbit/sec



External attenuator 41 dB (reference level offset).

Limit for spurious emissions -9.6 dBm

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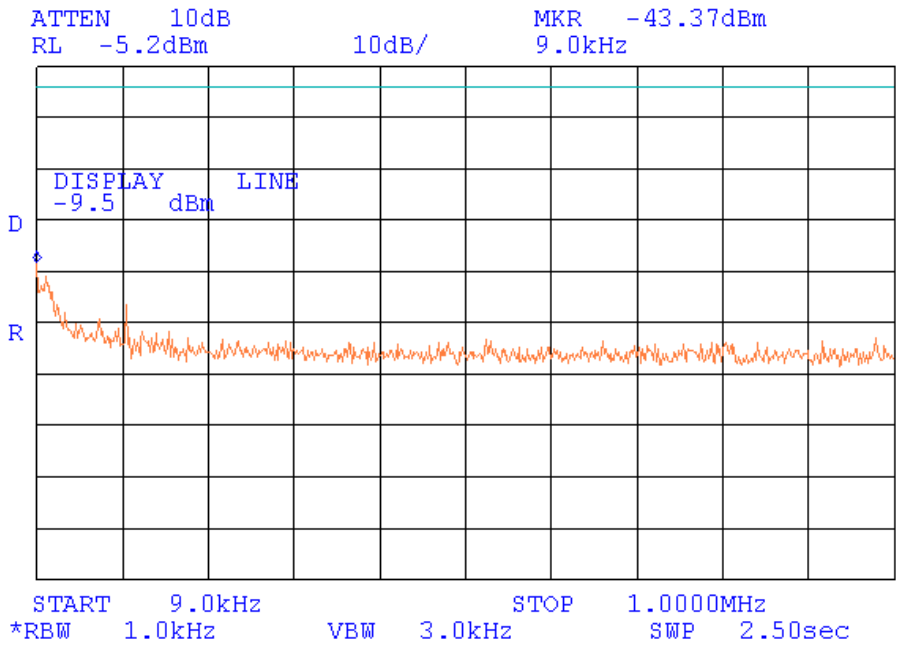
Plot A 16

Conducted spurious emission measurements in 9 kHz – 1 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2437 MHz, bitrate 11 Mbit/sec



External attenuator 40.5 dB (reference level offset).

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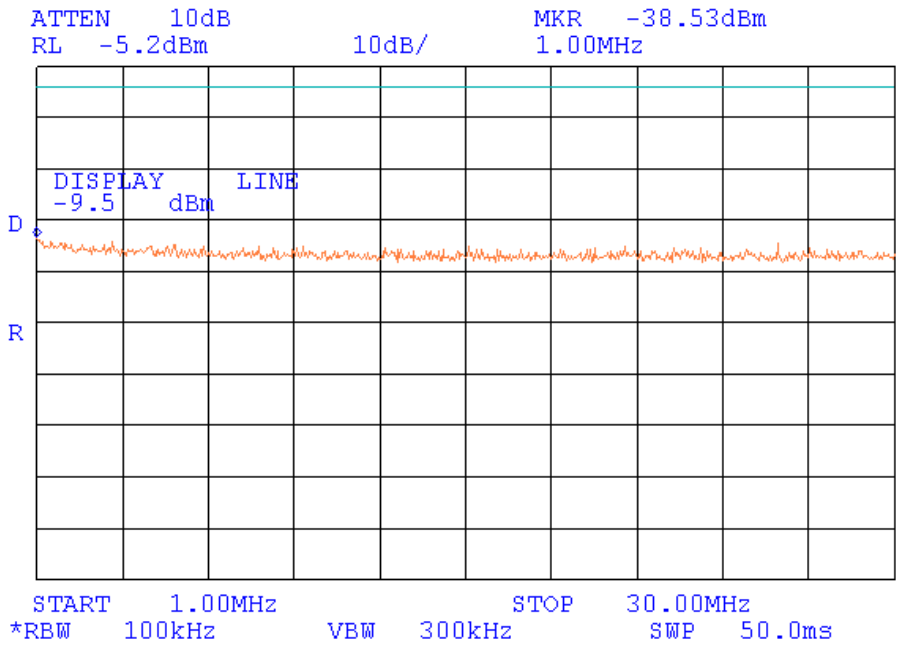
Plot A 17

Conducted spurious emission measurements in 1 MHz – 30 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2437 MHz, bitrate 11Mbit/sec



External attenuator 40.5 dB (reference level offset).

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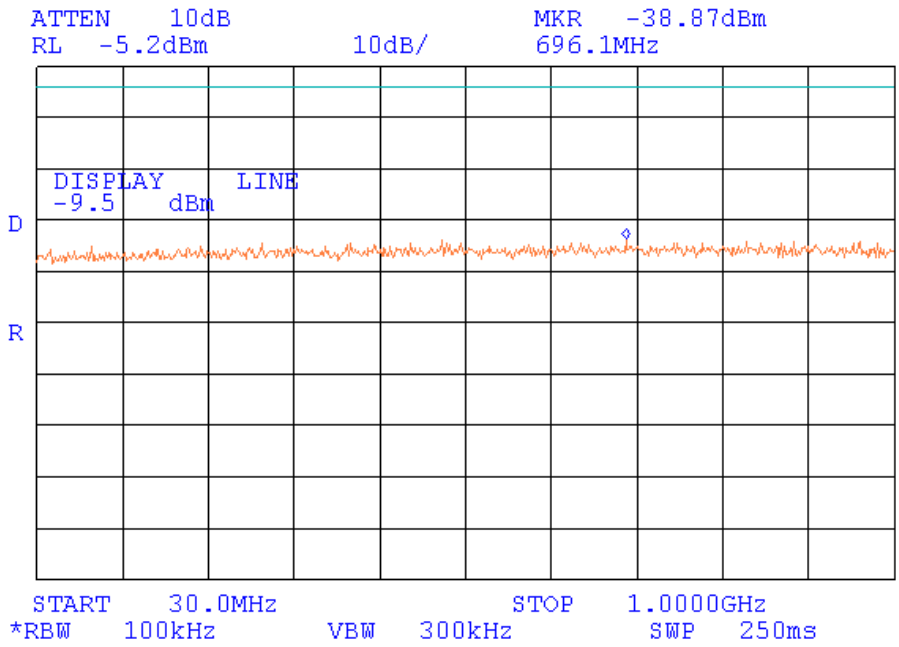
Plot A 18

Conducted spurious emission measurements in 30 MHz – 1000 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2437 MHz, bitrate 11 Mbit/sec



External attenuator 40.8 dB (reference level offset).

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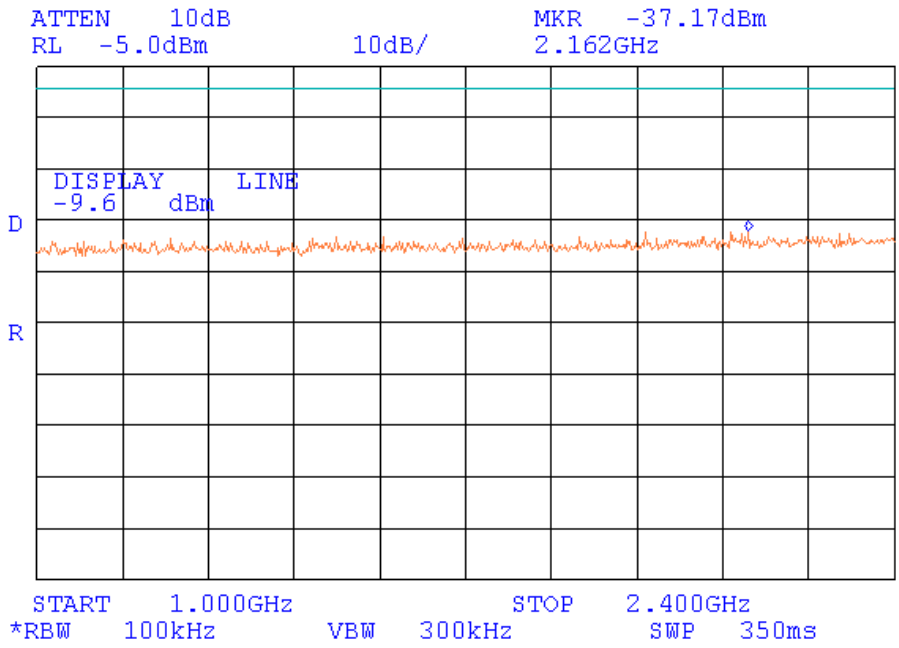
Plot A 19

Conducted spurious emission measurements in 1.0 GHz – 2.4 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2437 MHz, bitrate 11Mbit/sec



External attenuator 41 dB (reference level offset).

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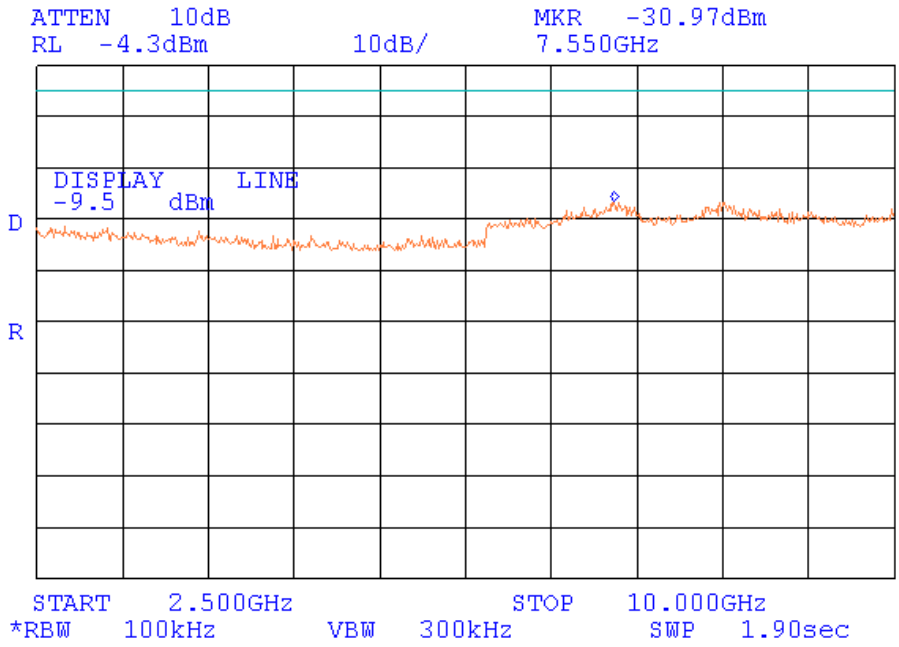
Plot A 20

Conducted spurious emission measurements in 2.5 GHz – 10 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2437 MHz, bitrate 11Mbit/sec



External attenuator 41.7 dB (reference level offset).

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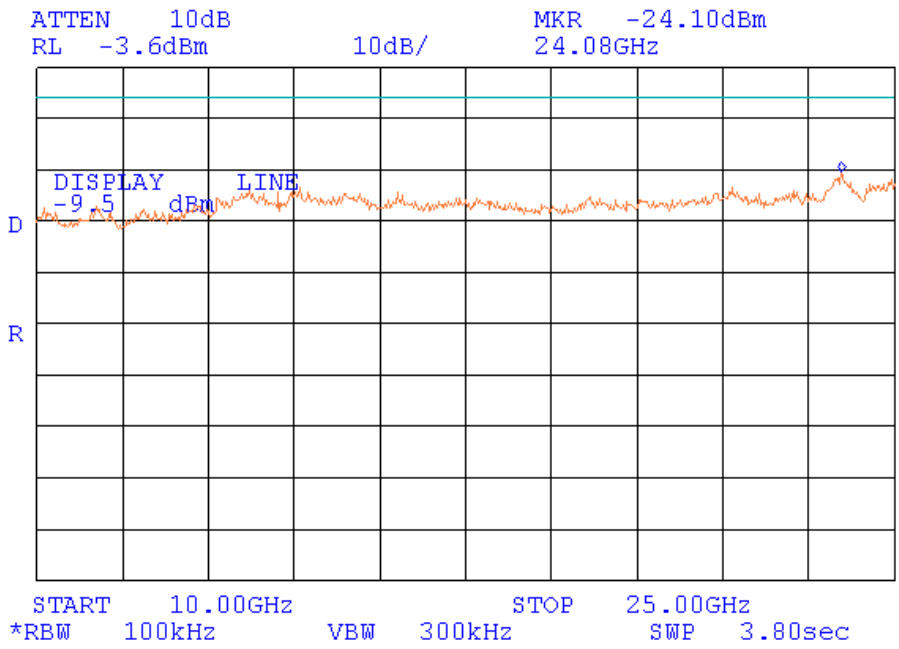
Plot A 21

Conducted spurious emission measurements in 10 GHz – 25 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2437 MHz, bitrate 11 Mbit/sec



External attenuator 42.4 dB (reference level offset).

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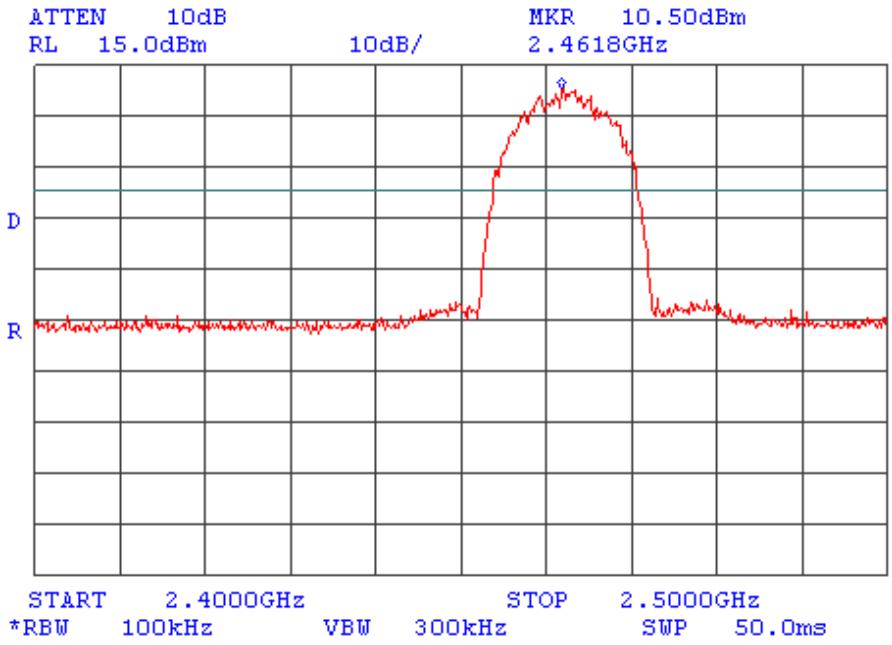
Plot A 22

In-band spurious emission measurements @ 2462 MHz

Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)=2462 MHz, bitrate 11Mbit/sec



External attenuator 41 dB (reference level offset).

Limit for spurious emissions -9.5 dBm

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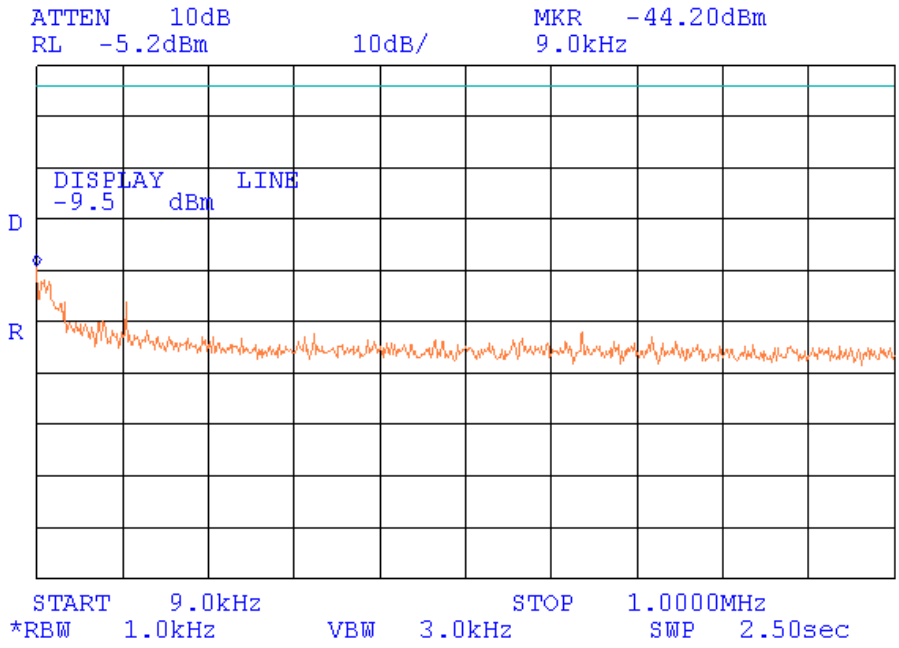
Plot A 23

Conducted spurious emission measurements in 9 kHz – 1 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2462 MHz, bitrate 11 Mbit/sec



External attenuator 40.5 dB (reference level offset).

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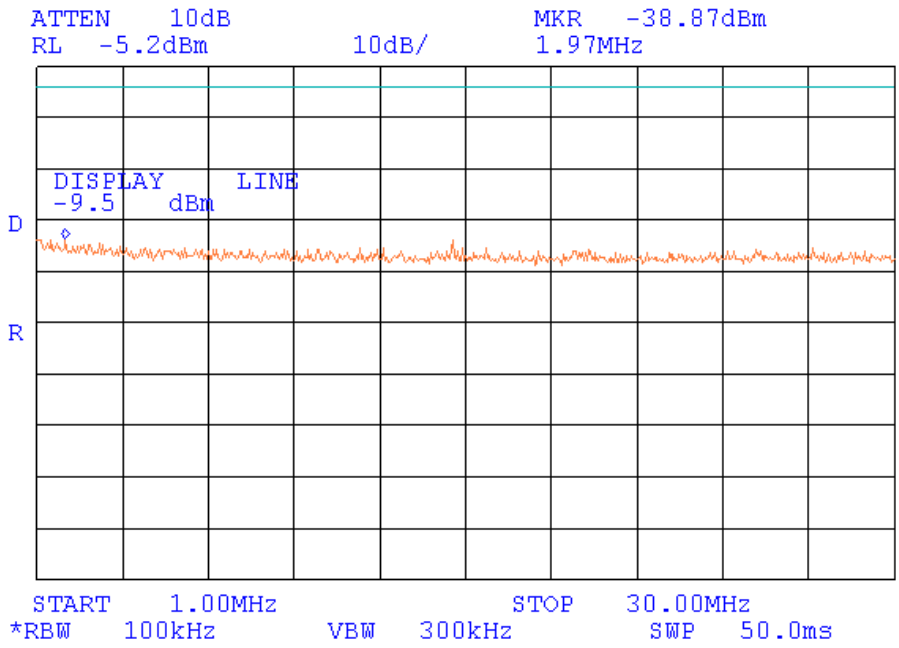
Plot A 24

Conducted spurious emission measurements in 1 MHz – 30 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2462 MHz, bitrate 11Mbit/sec



External attenuator 40.5 dB (reference level offset).

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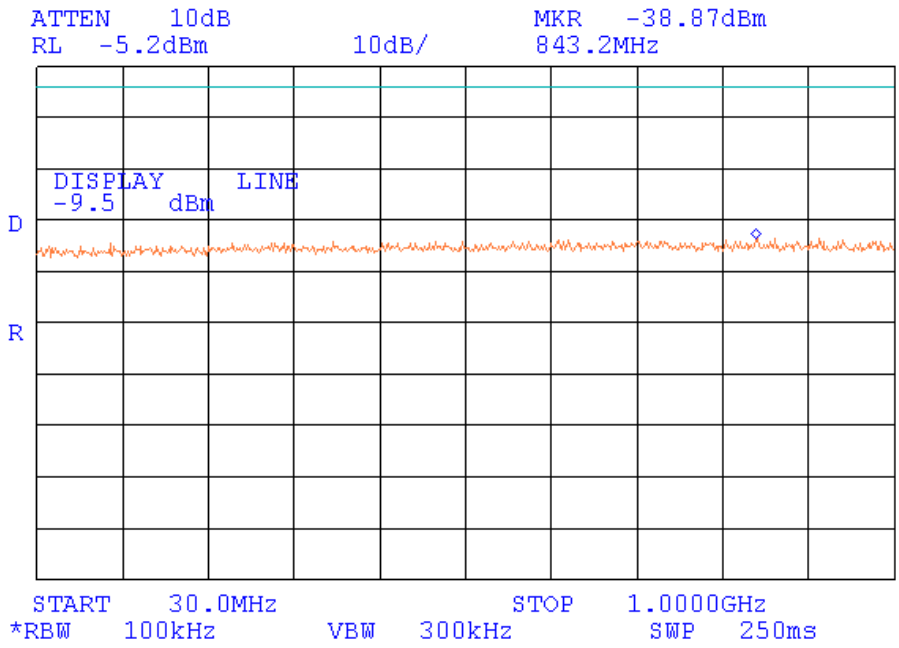
Plot A 25

Conducted spurious emission measurements in 30 MHz – 1000 MHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2462 MHz, bitrate 11 Mbit/sec



External attenuator 40.8 dB (reference level offset).

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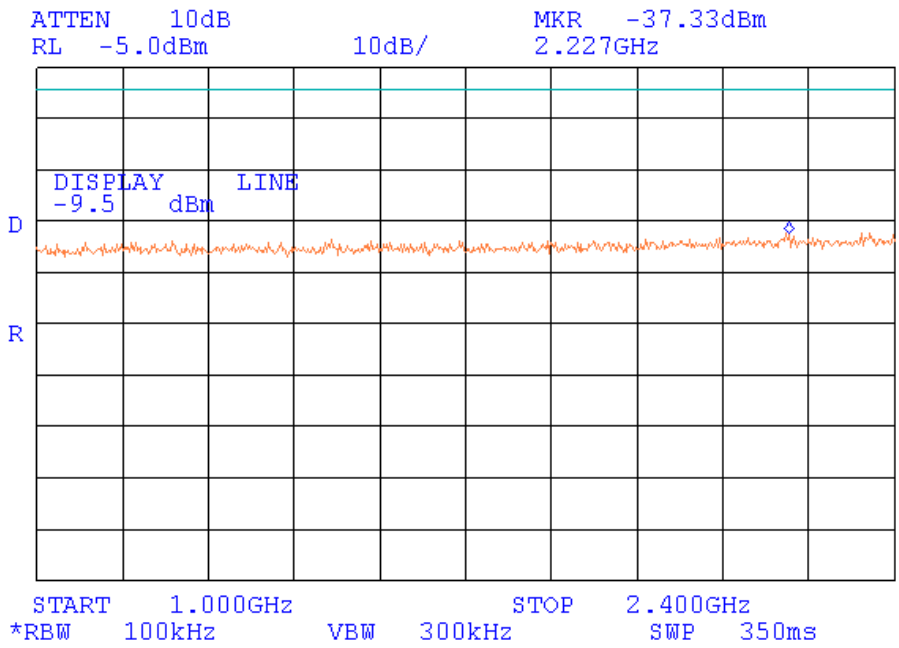
Plot A 26

Conducted spurious emission measurements in 1.0 GHz – 2.4 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2462 MHz, bitrate 11Mbit/sec



External attenuator 41 dB (reference level offset).

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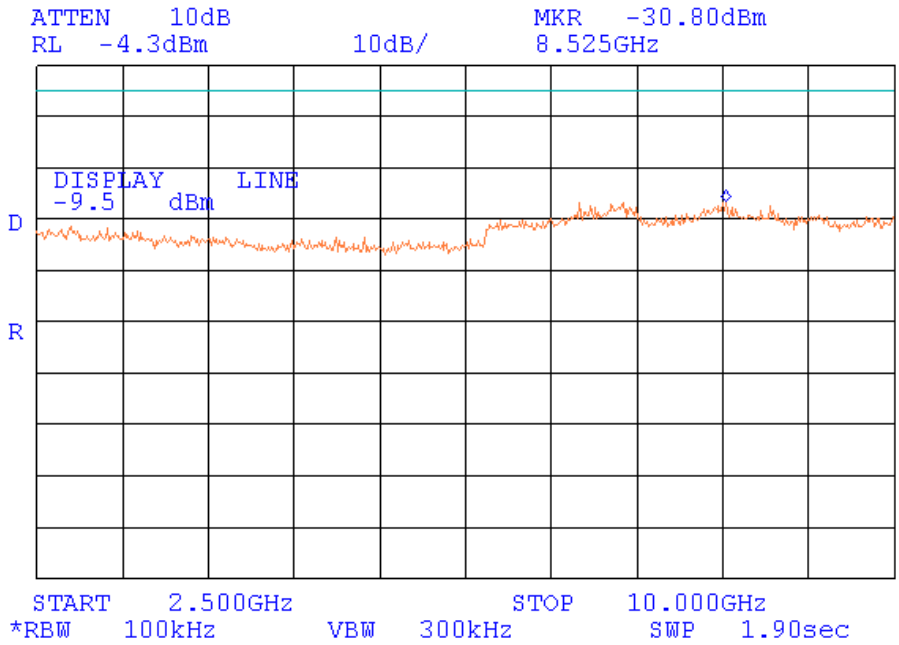
Plot A 27

Conducted spurious emission measurements in 2.5 GHz – 10 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2462 MHz, bitrate 11Mbit/sec



External attenuator 41.7 dB (reference level offset).

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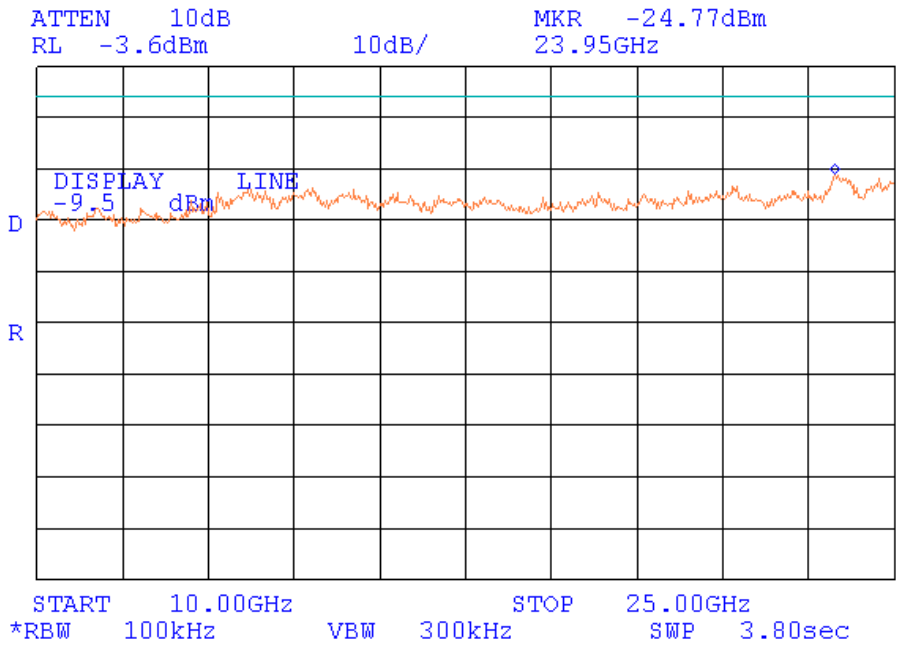
Plot A 28

Conducted spurious emission measurements in 10 GHz – 25 GHz

Limit:	20 dB below the carrier
Detector:	Peak
Test Method:	measurement at antenna connector
Notes:	f(Tx)= 2462 MHz, bitrate 11 Mbit/sec



External attenuator 42.4 dB (reference level offset).

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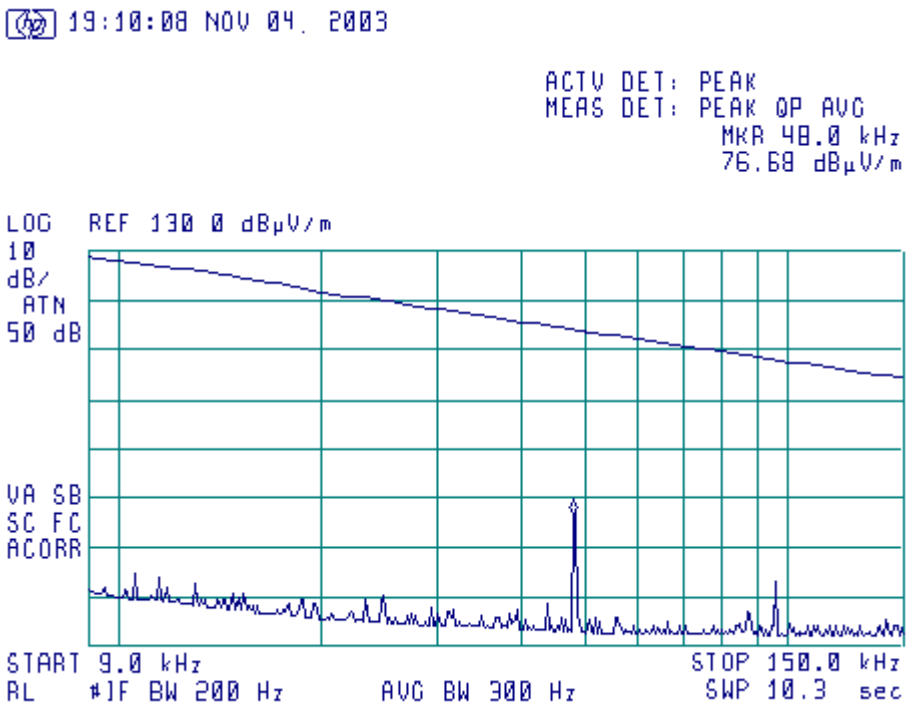
Plot A 29

Radiated spurious emission measurements from 9 kHz to 150 kHz in the anechoic chamber, carrier frequency 2412 MHz



All spurious emissions were found more than 20 dB below the limit.

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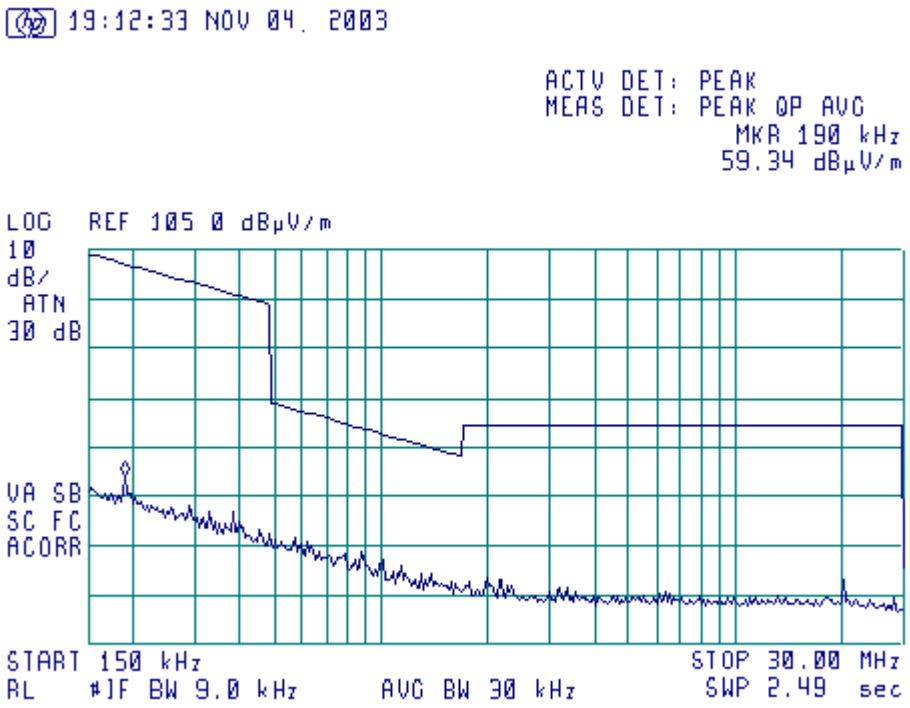
Plot A 30

Radiated spurious emission measurements from 150 kHz to 30 MHz in the anechoic chamber, carrier frequency 2412 MHz



No spurious emissions were found

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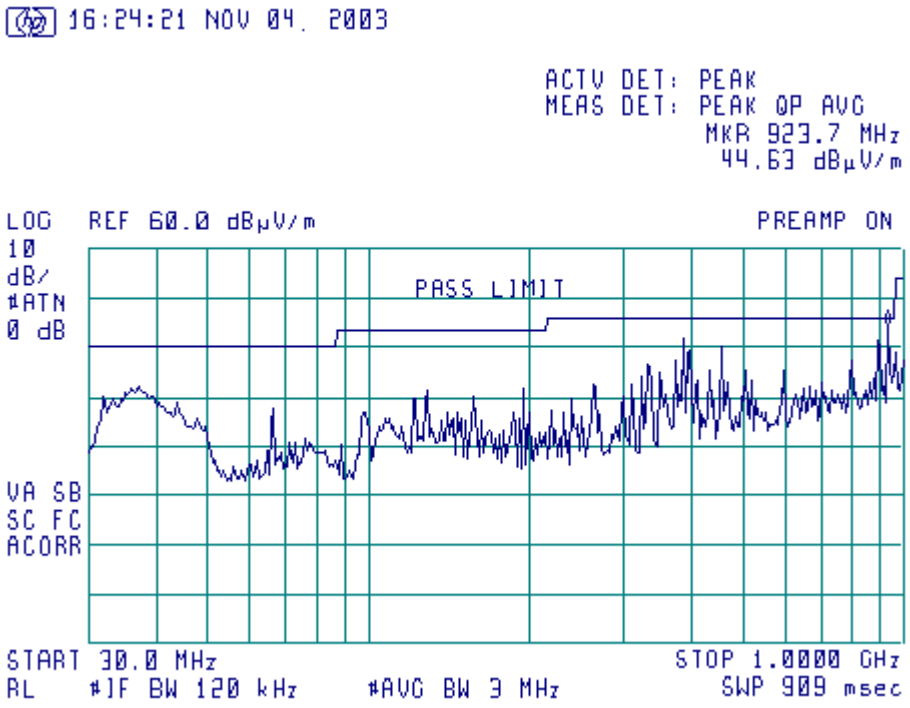
Plot A 31

Radiated spurious emission measurements from 30 MHz to 1 GHz in the anechoic chamber, carrier frequency 2412 MHz



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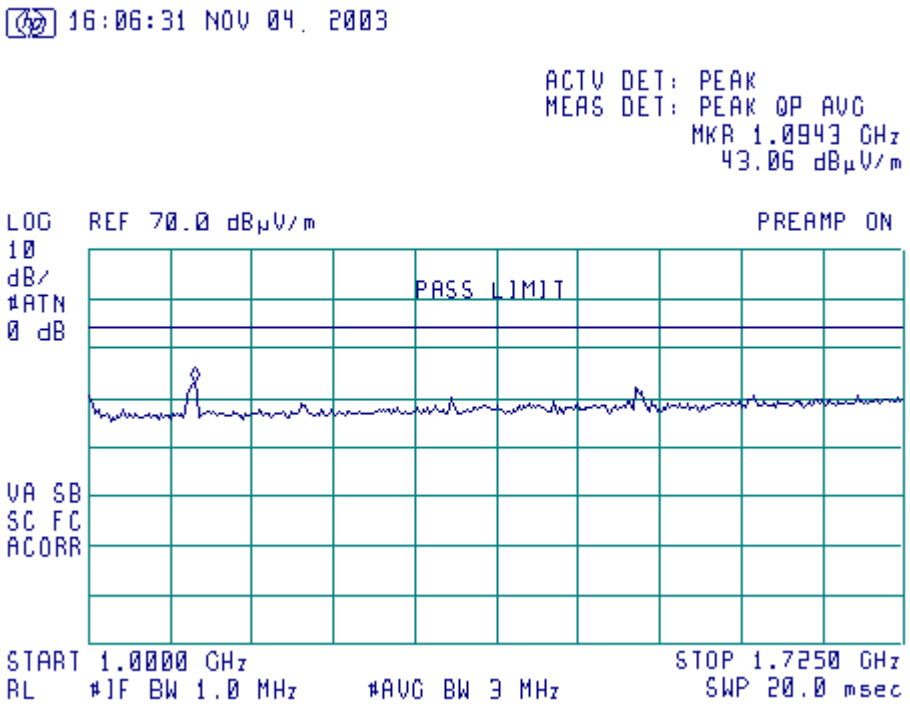
Plot A 32

Radiated spurious emission measurements in restricted bands in the anechoic chamber, carrier frequency 2412 MHz



Laptop emissions (refer to Plot A33)

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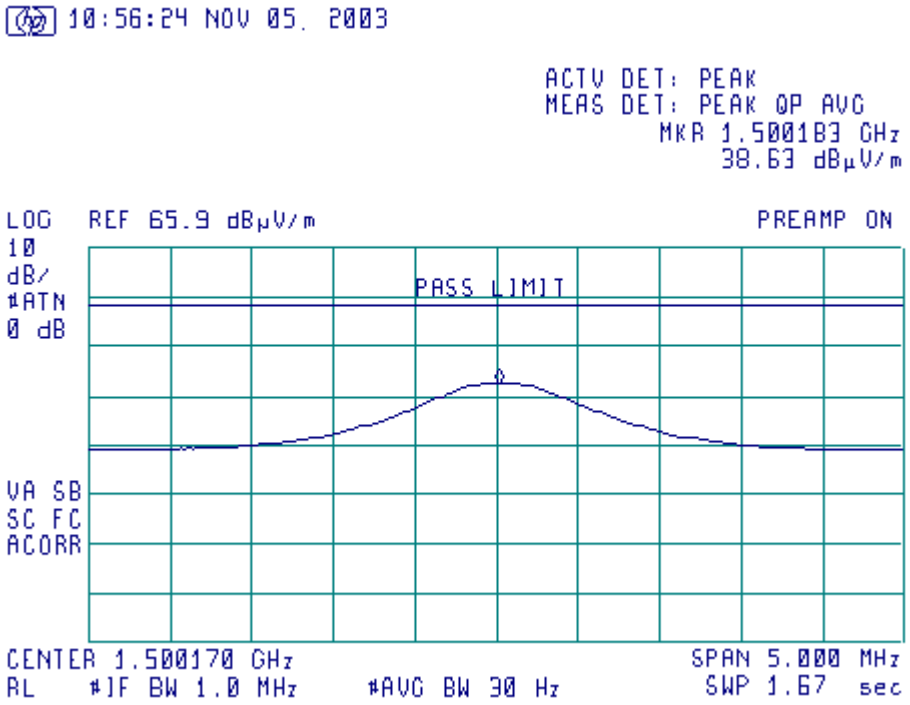
Plot A 33

Radiated spurious emission measurements in restricted bands in the anechoic chamber, carrier frequency 2412 MHz



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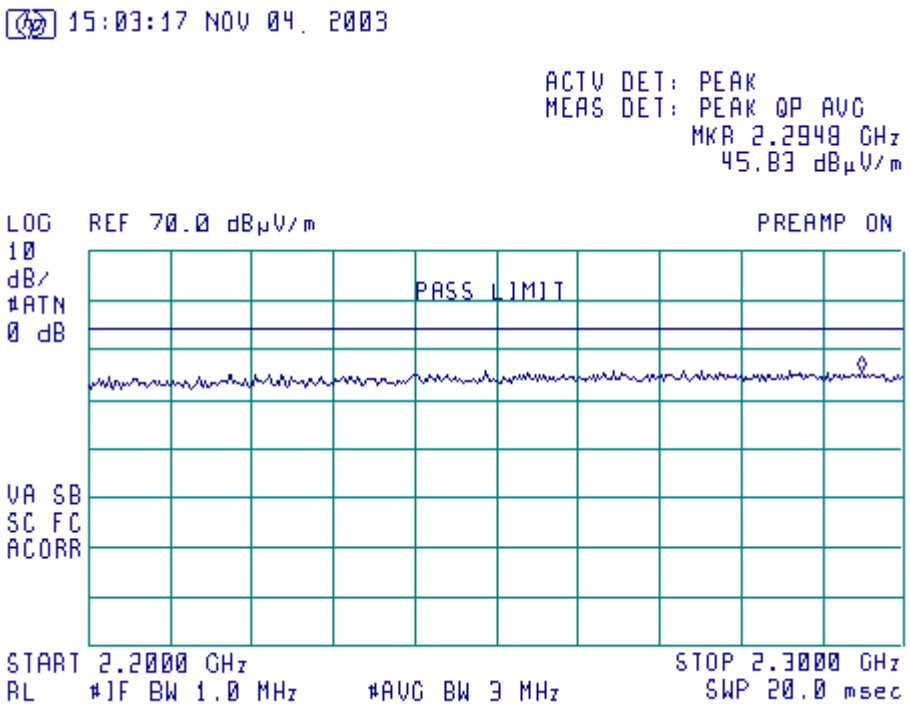
Plot A 34

Radiated spurious emission measurements in restricted bands in the anechoic chamber, carrier frequency 2412 MHz



No spurious emissions were found

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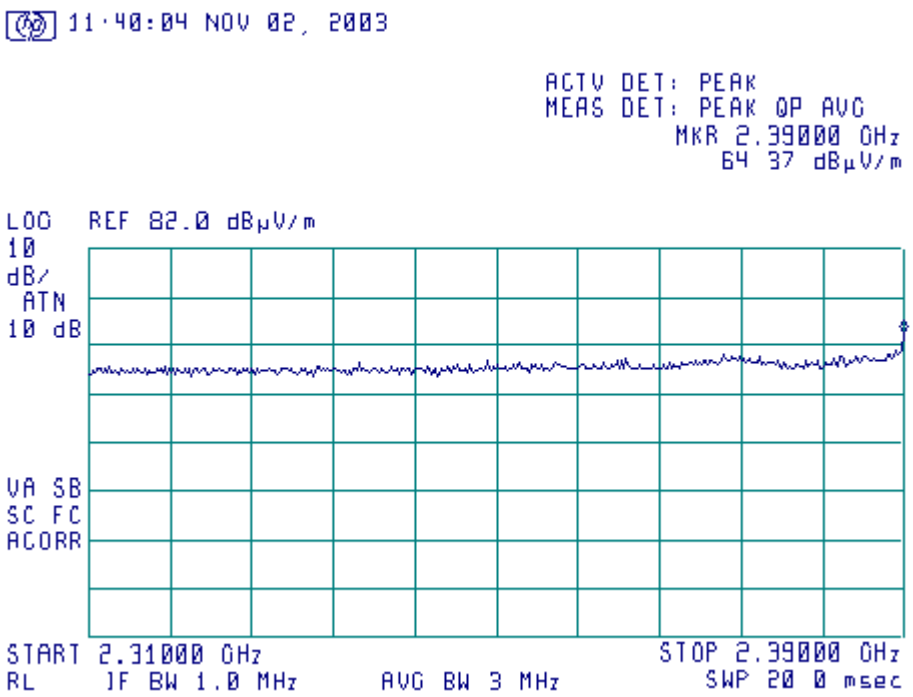
Plot A 35

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



RESTRICTED BAND
Limit: according to §15.209, 15.35
Peak value 64.37 dB(µV/m), limit = 74 dB(µV/m)

Verdict: Pass

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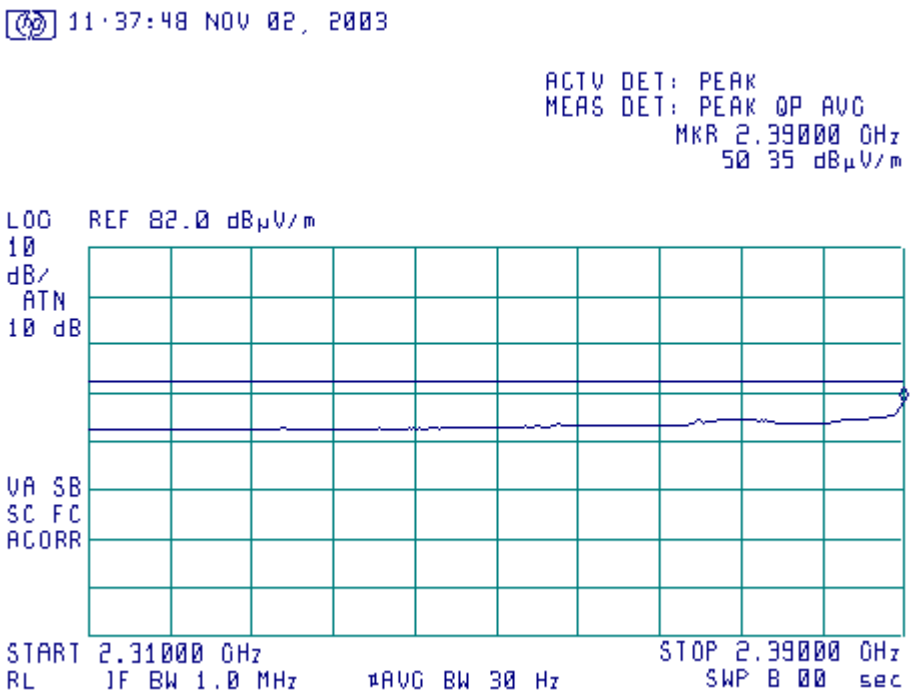
Plot A 36

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



Maximum duty cycle in normal use is 65%
Average factor=20*log(0.65)= -3.74 dB
Average value 50.35 dB(µV/m)– 3.74 dB = 46.61 dB(µV/m)
Limit (AVG)=54 dBuV/m

Verdict: Pass

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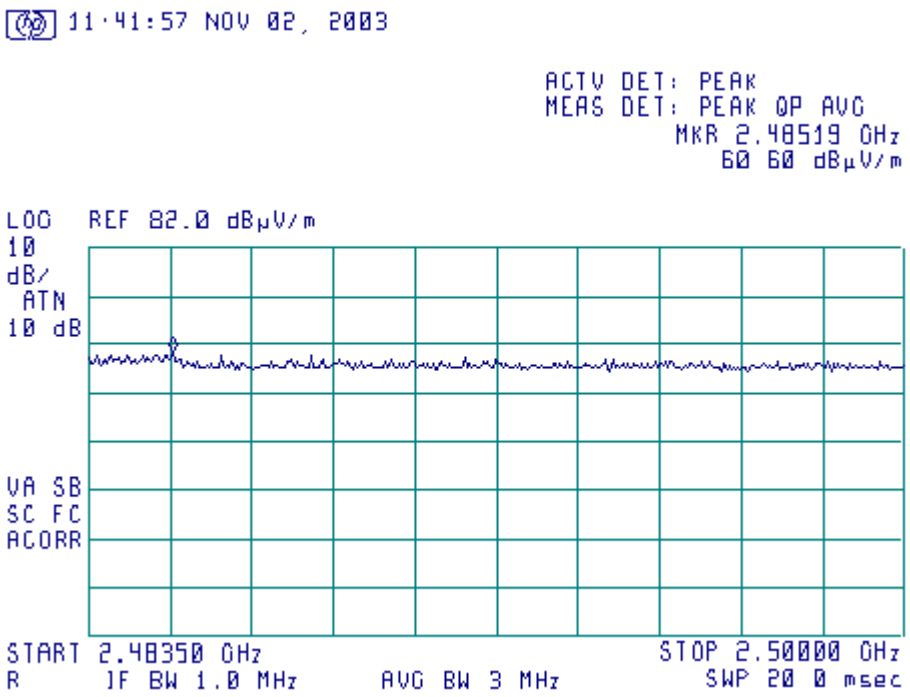
Plot A 37

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



RESTRICTED BAND
Limit: according to §15.209, 15.35
Peak value 60.60 dB(µV/m), limit = 74 dB(µV/m)

Verdict: Pass

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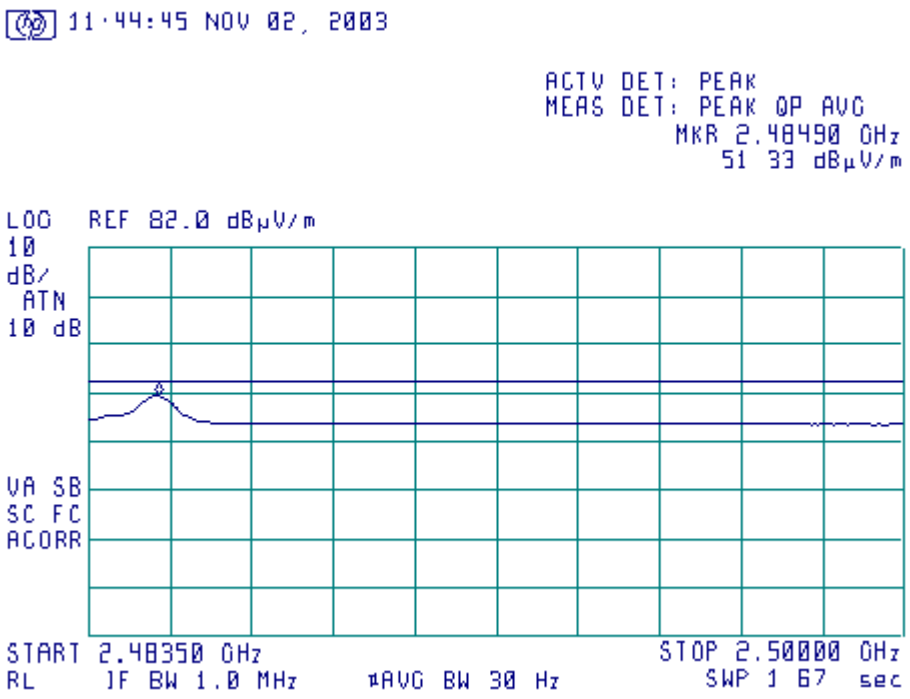
Plot A 38

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



Maximum duty cycle in normal use is 65%
Average factor=20*log(0.65)= -3.74 dB
Average value 51.33 dB(µV/m) -3.74 dB = 47.59 dB(µV/m),
Limit (AVG)=54 dBuV/m

Verdict: Pass

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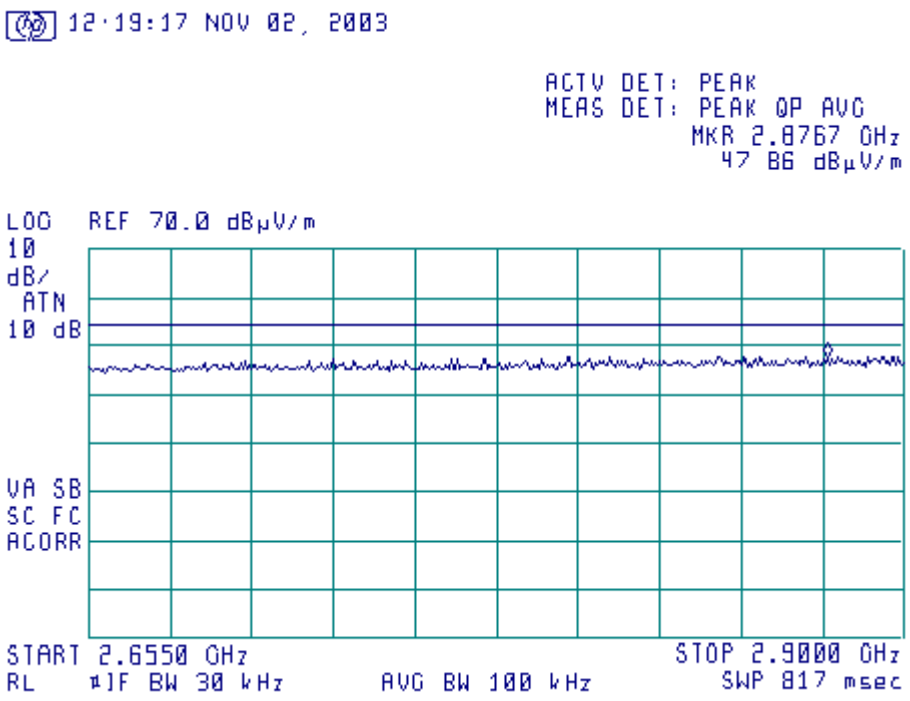
Plot A 39

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



No spurious emissions were found

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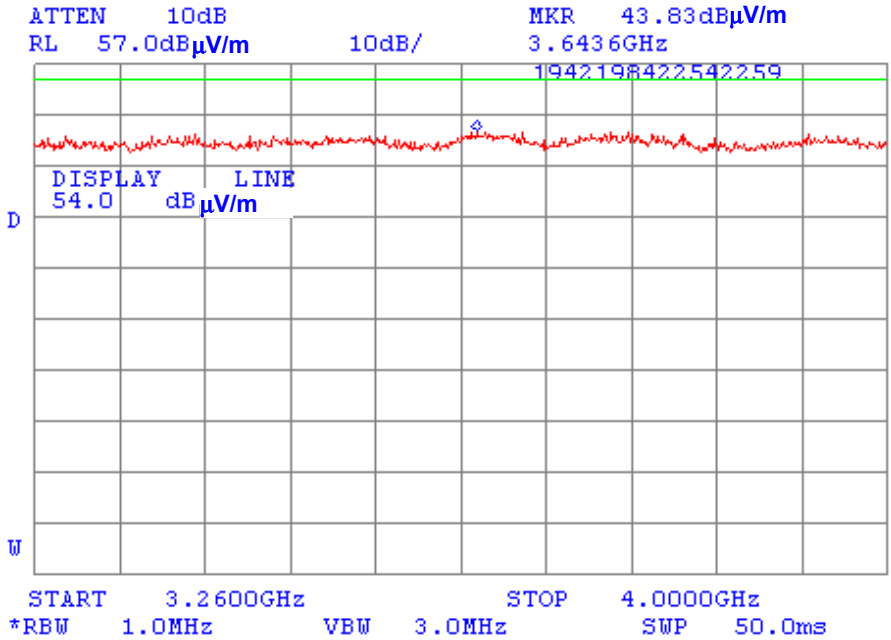
Plot A 40

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



No spurious emissions were found

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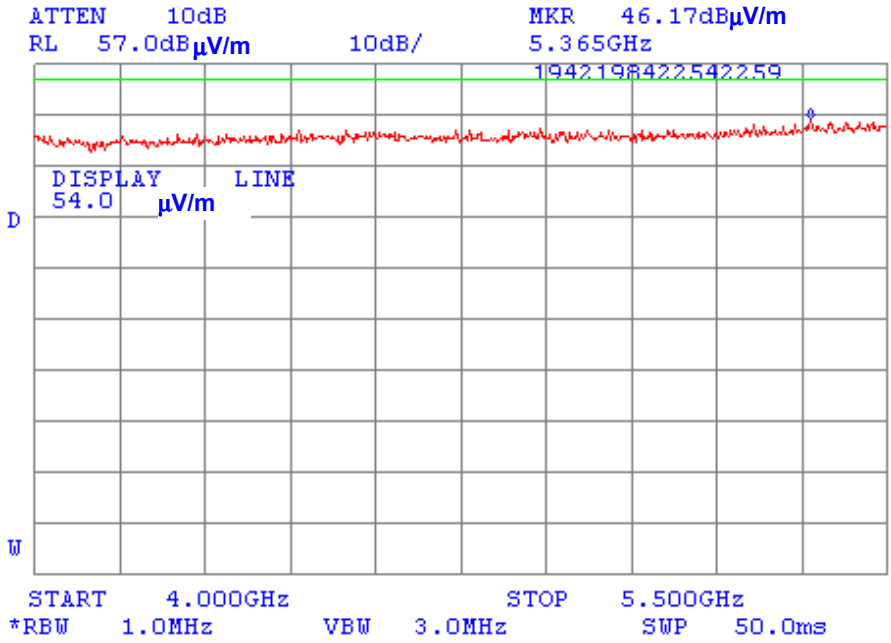
Plot A 41

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



No spurious emissions were found

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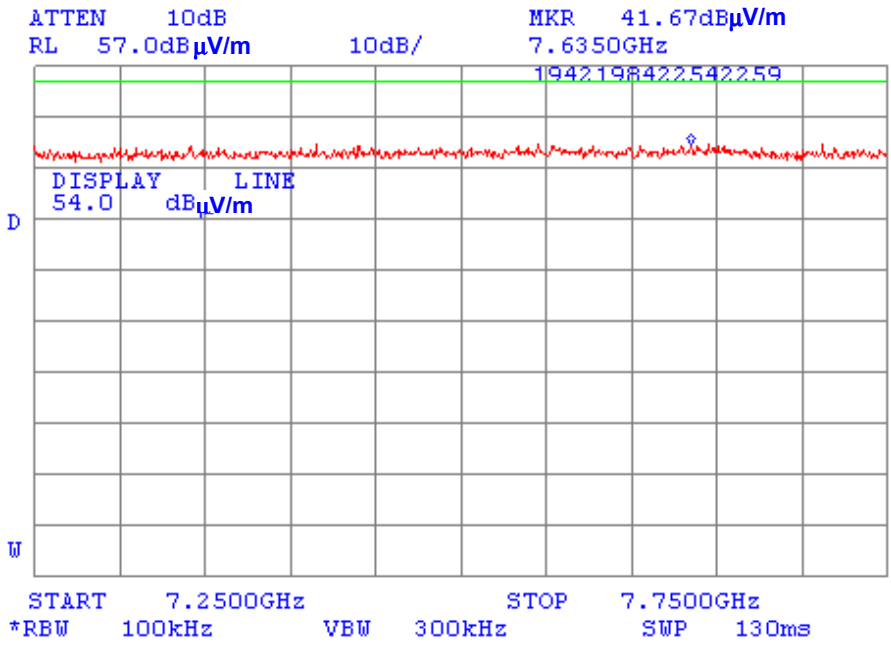
Plot A 42

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



No spurious emissions were found

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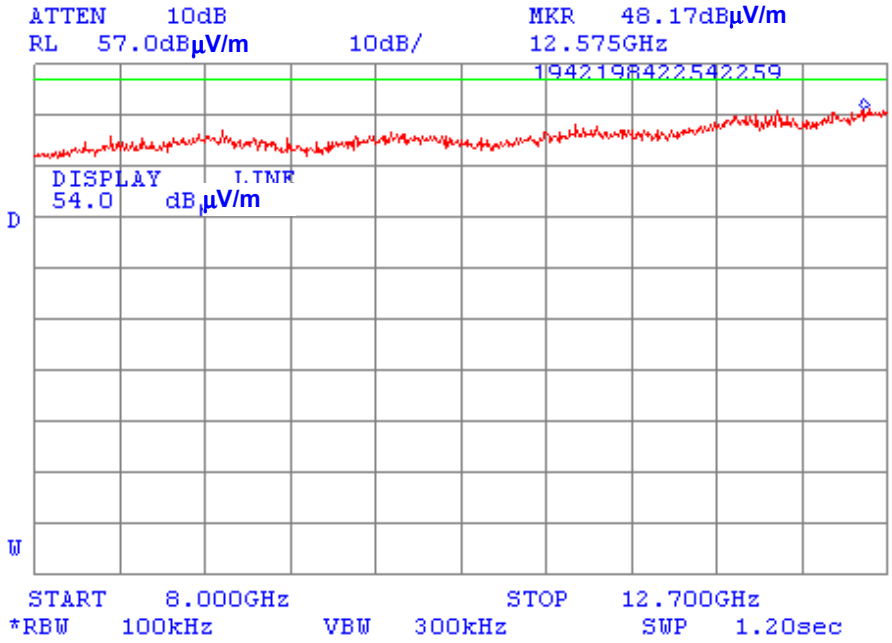
Plot A 43

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



No spurious emissions were found

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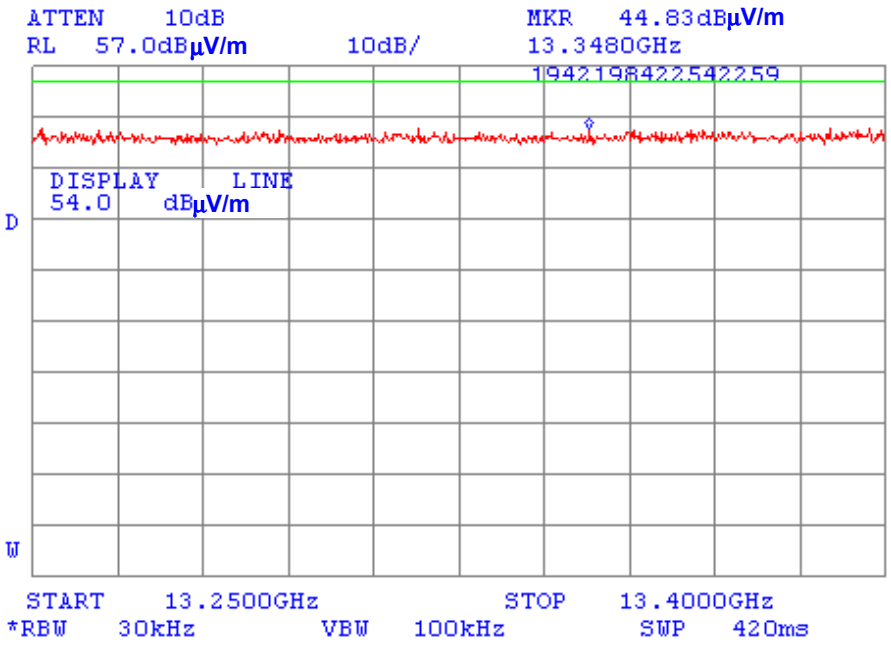
Plot A 44

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



No spurious emissions were found

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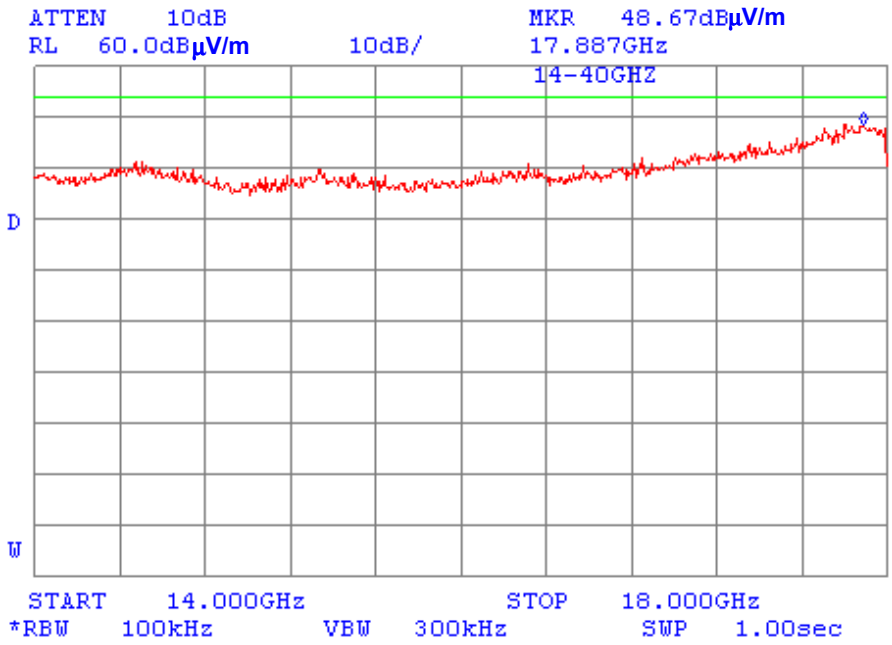
Plot A 45

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



No spurious emissions were found

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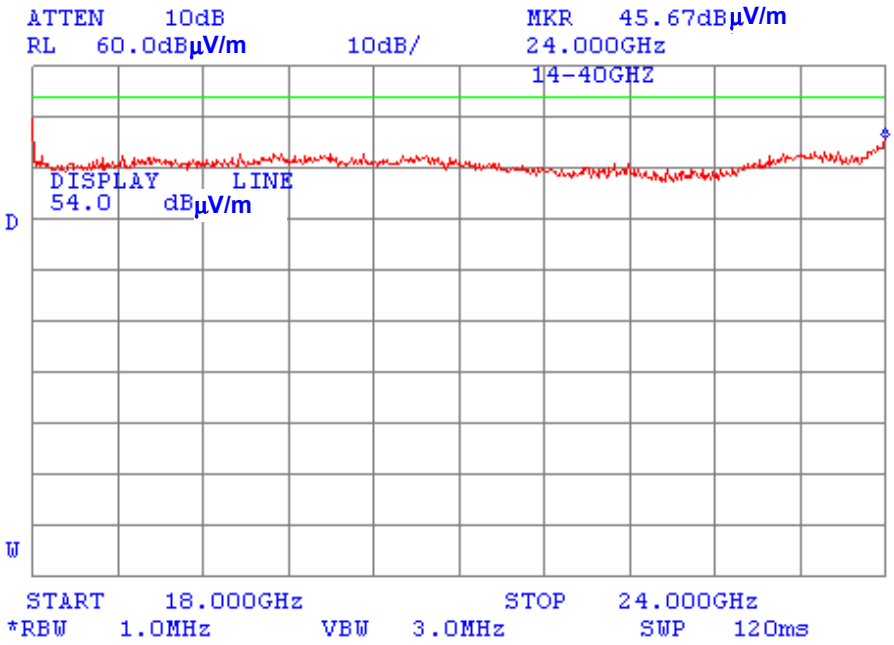
Plot A 46

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2412 MHz



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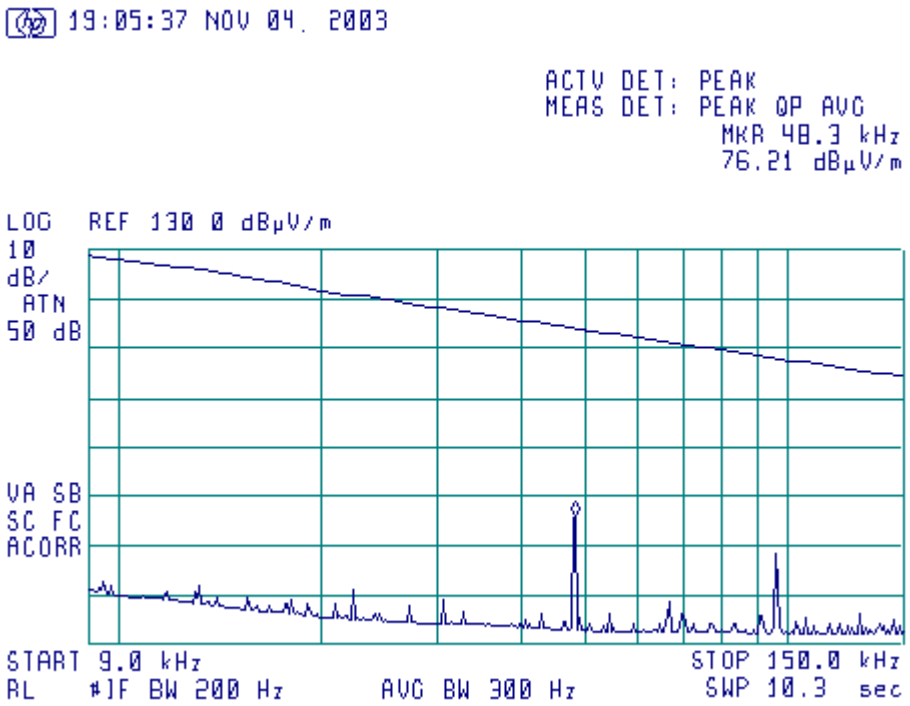
Plot A 47

Radiated spurious emission measurements from 9 kHz to 150 kHz in the anechoic chamber, carrier frequency 2437 MHz



All spurious emissions were found more than 20 dB below the limit.

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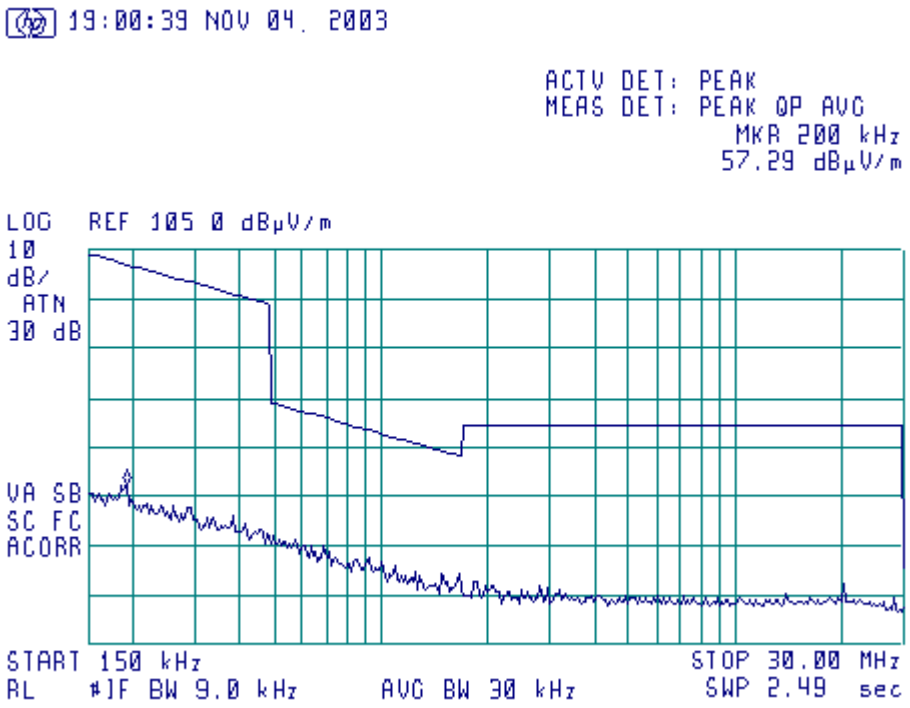
Plot A 48

Radiated spurious emission measurements from 150 kHz to 30 MHz in the anechoic chamber, carrier frequency 2437 MHz



No spurious emissions were found

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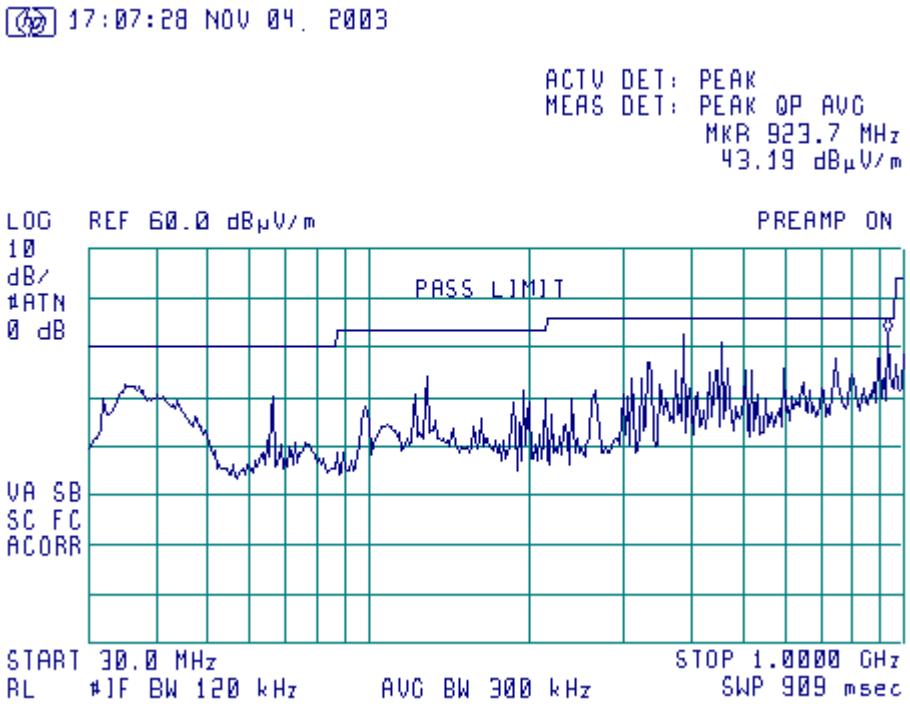
Plot A 49

Radiated spurious emission measurements from 30 MHz to 1 GHz in the anechoic chamber, carrier frequency 2437 MHz



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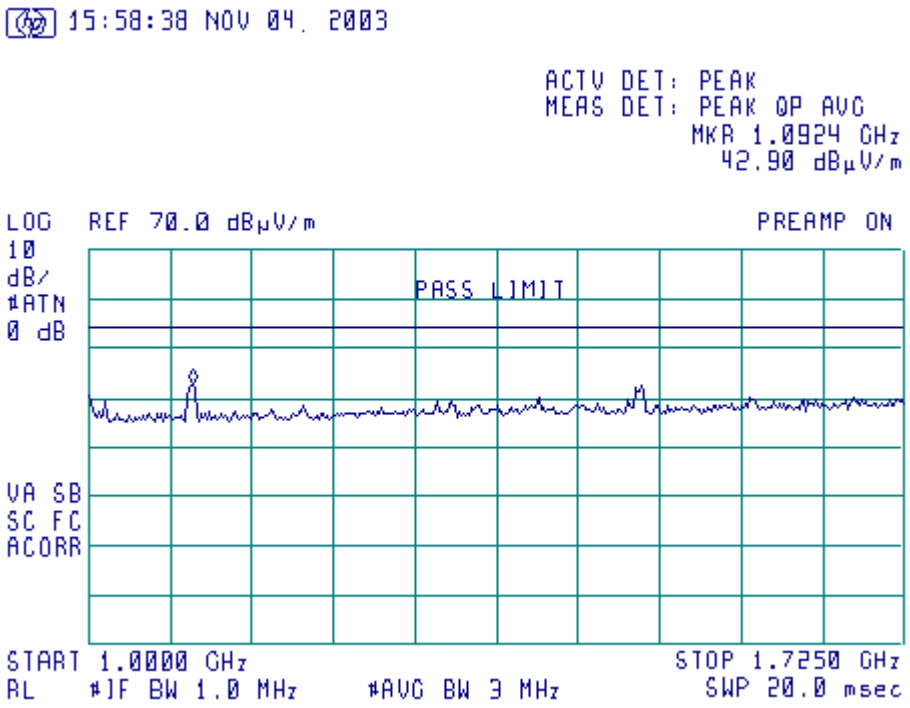
Plot A 50

Radiated spurious emission measurements in restricted bands in the anechoic chamber, carrier frequency 2437 MHz



Laptop emissions (refer to Plot A33)

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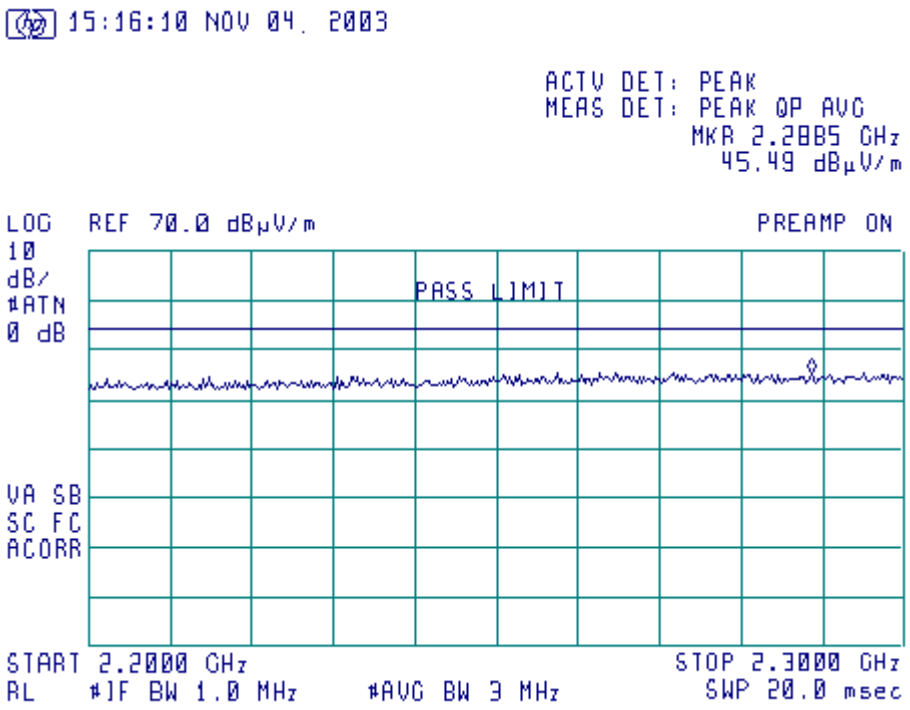
Plot A 51

Radiated spurious emission measurements in restricted bands in the anechoic chamber, carrier frequency 2437 MHz



No spurious emissions were found

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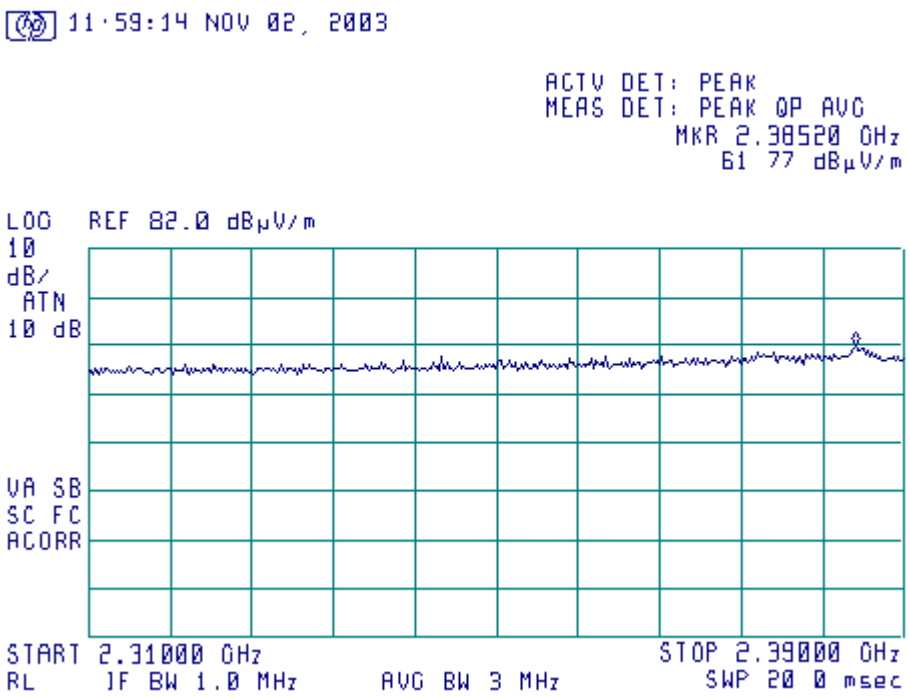
Plot A 52

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



RESTRICTED BAND
Limit: according to §15.209, 15.35
Peak value 61.77 dB(µV/m), limit = 74 dB(µV/m)

Verdict: Pass

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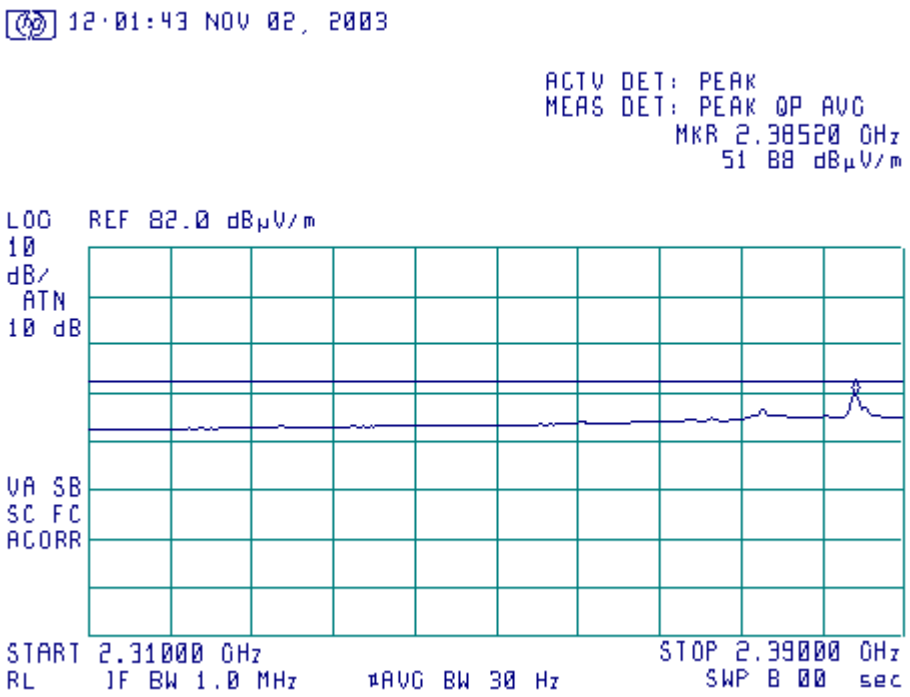
Plot A 53

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



Maximum duty cycle in normal use is 65%
Average factor=20*log(0.65)= -3.74 dB

Average values:
@ 2385.2 MHz: 51.88 dB(µV/m) -3.74 dB = 48.14 dB(µV/m)
@ 2376.2 MHz: 48.51 dB(µV/m) -3.74 dB = 44.77 dB(µV/m)
Limit (AVG)=54 dBuV/m

Verdict: Pass

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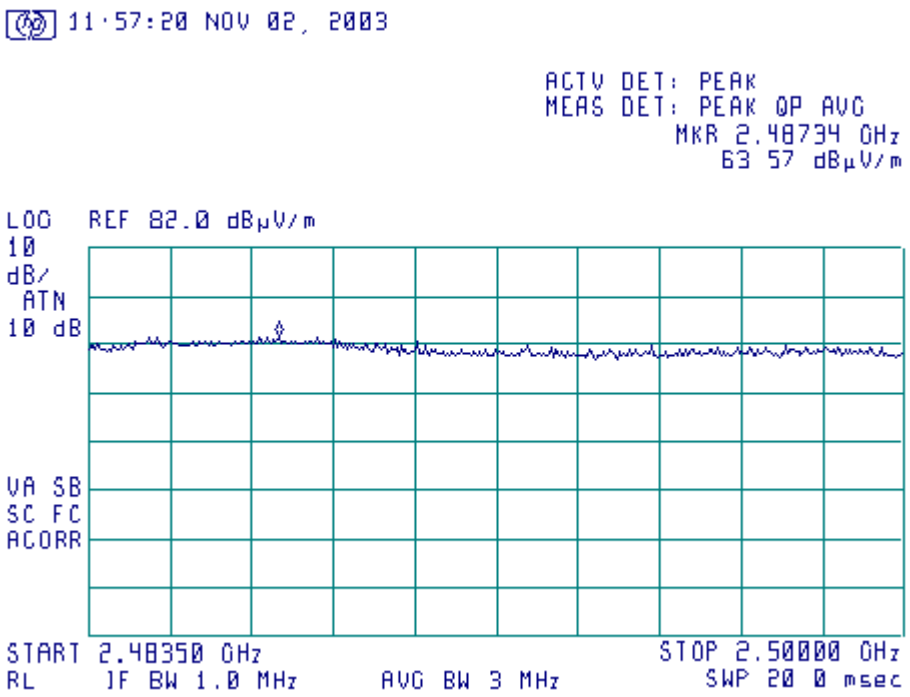
Plot A 54

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



RESTRICTED BAND
Limit: according to §15.209, 15.35
Peak value 63.57 dB(µV/m), limit = 74 dB(µV/m)

Verdict: Pass

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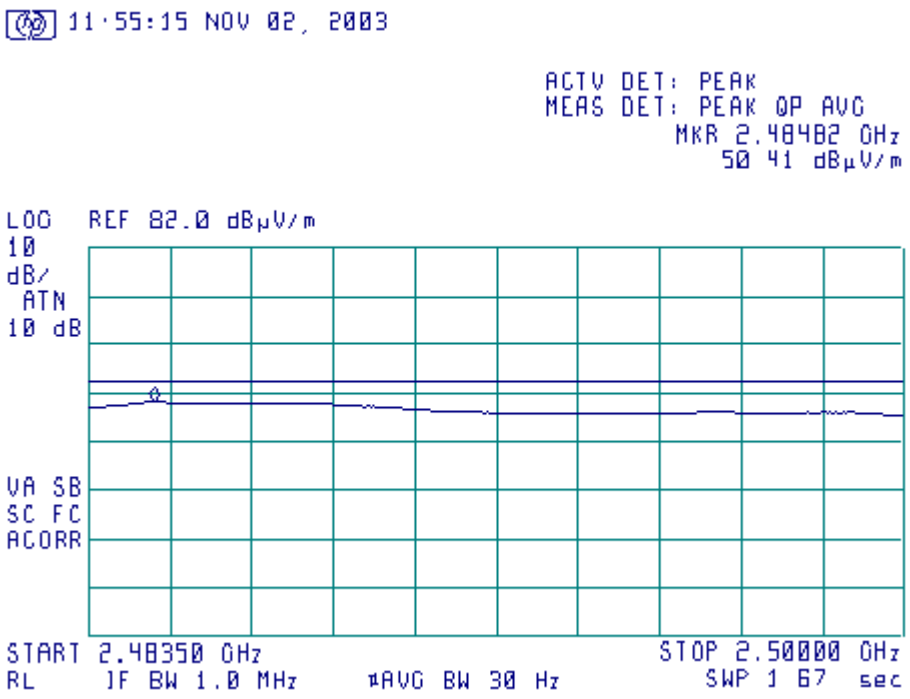
Plot A 55

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



Maximum duty cycle in normal use is 65%
Average factor=20*log(0.65)= -3.74 dB

Average value 50.41 dB(µV/m) -3.74 dB = 46.67 dB(µV/m),
Limit (AVG)=54 dBuV/m

Verdict: Pass

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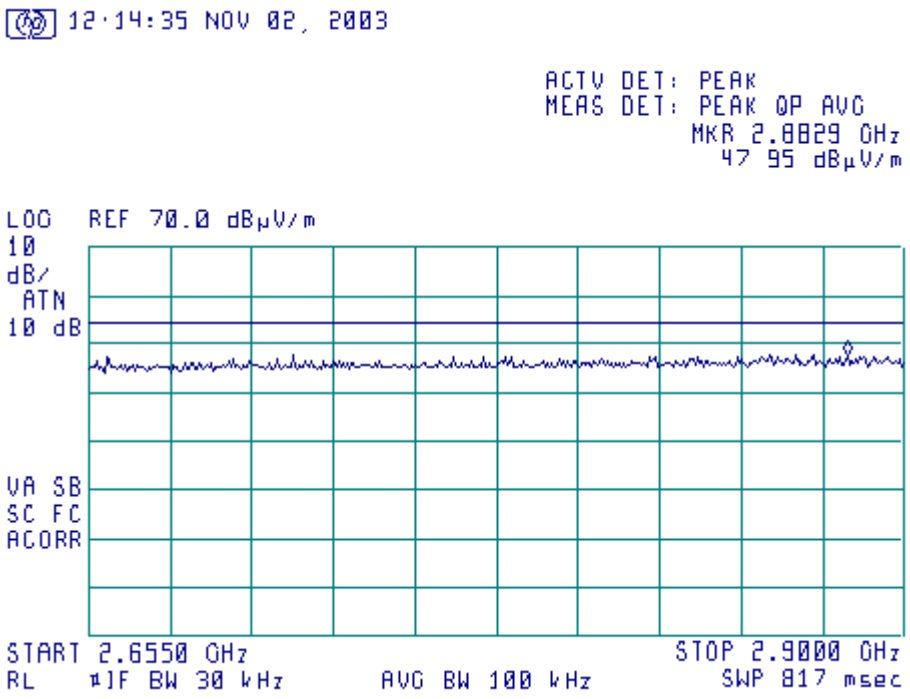
Plot A 56

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



No spurious emissions were found

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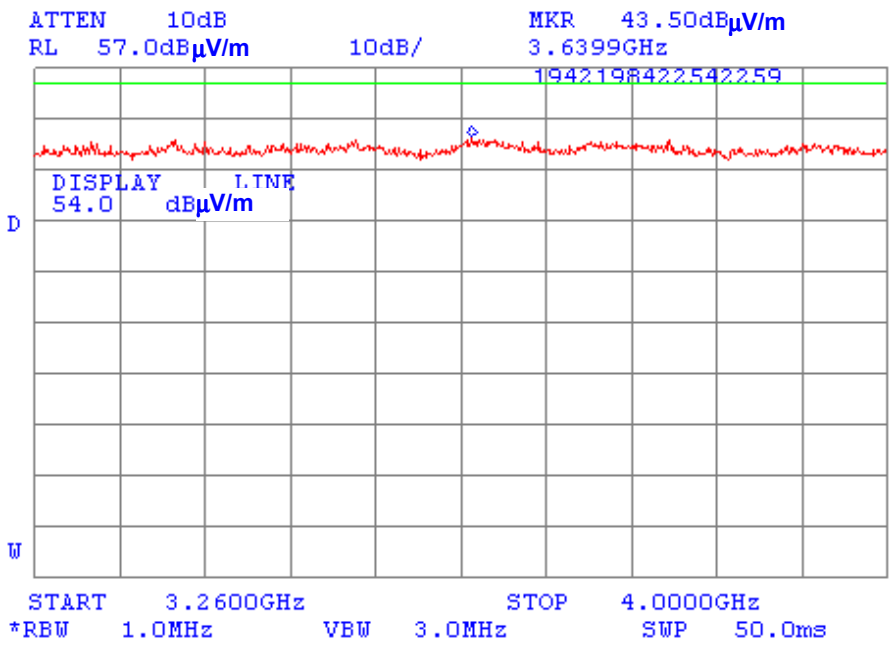
Plot A 57

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



No spurious emissions were found

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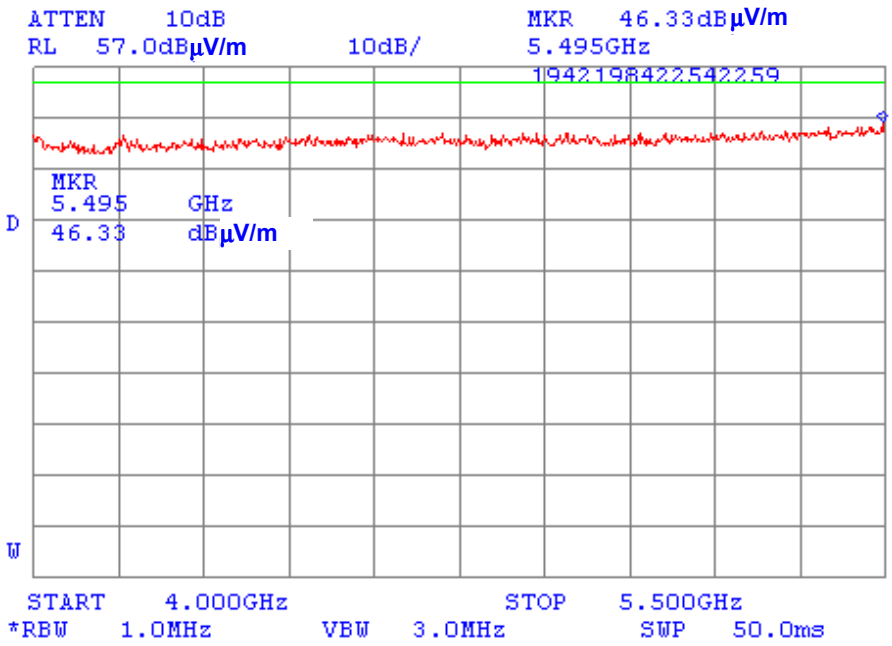
Plot A 58

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



No spurious emissions were found

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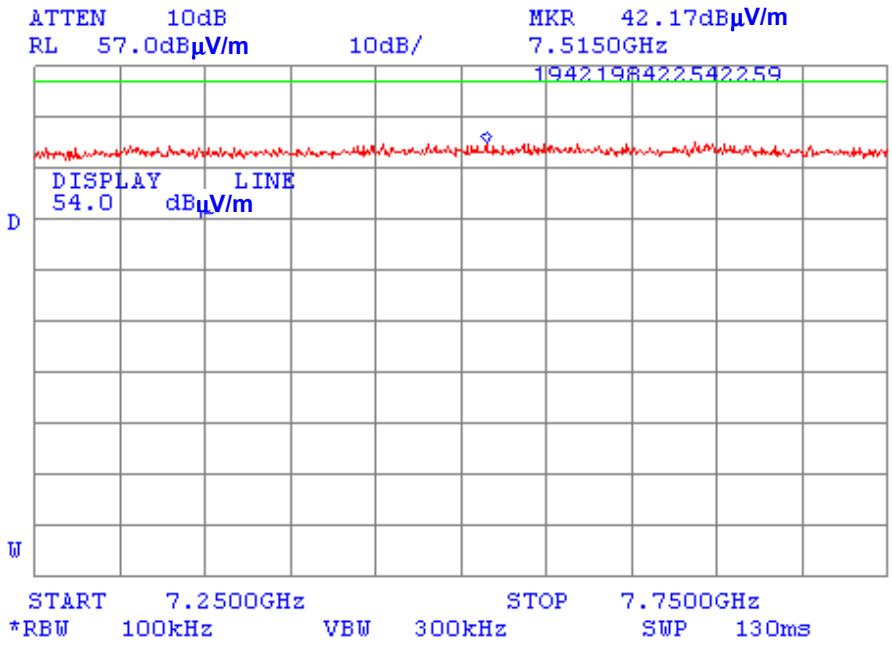
Plot A 59

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



No spurious emissions were found

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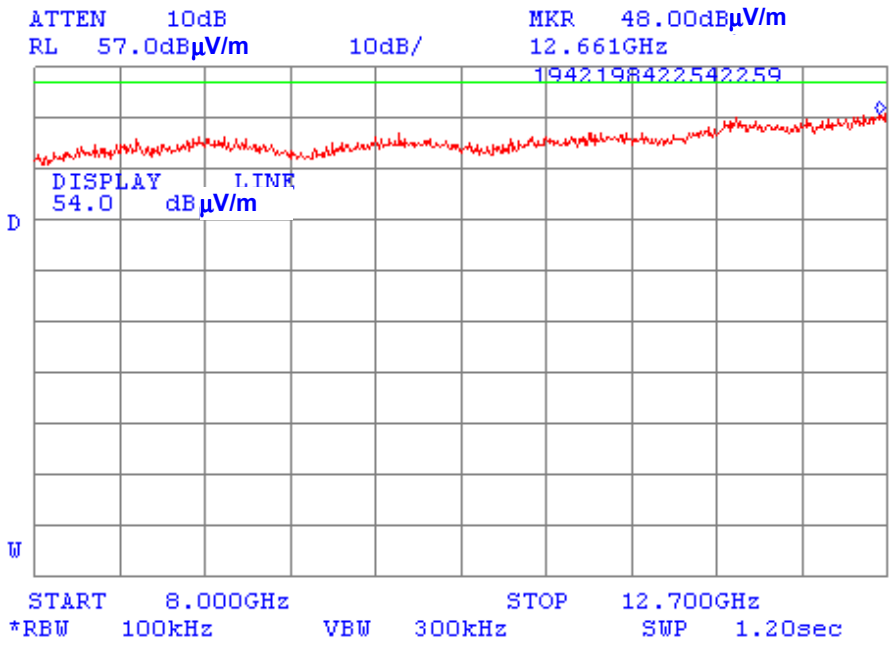
Plot A 60

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



No spurious emissions were found

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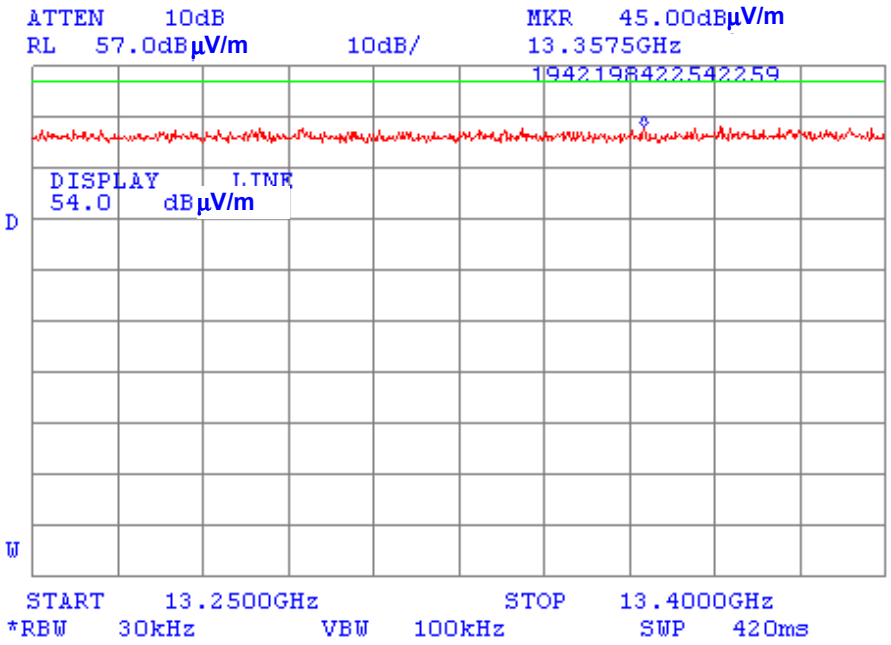
e-mail: *mail@hermonlabs.com*

Plot A 61

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



No spurious emissions were found

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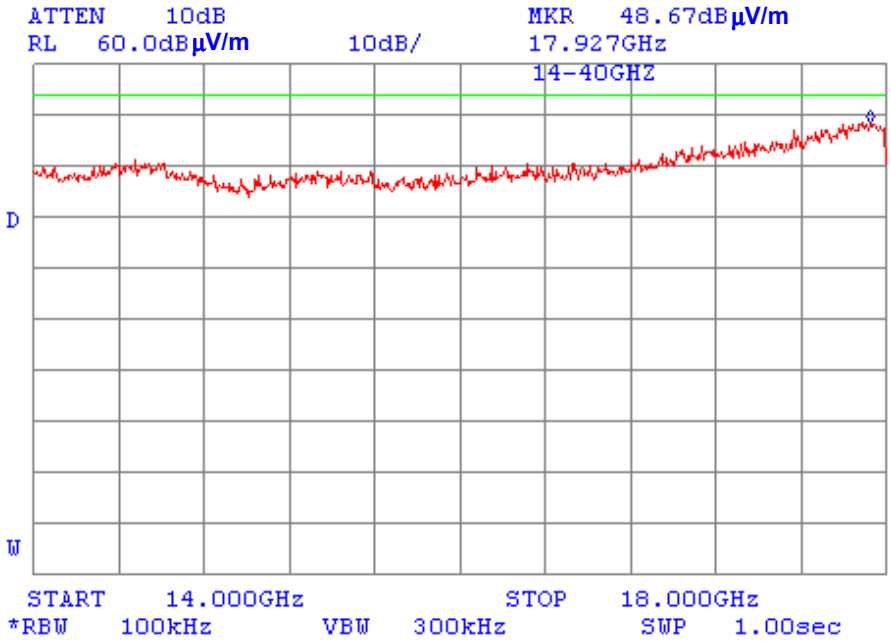
Plot A 62

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



No spurious emissions were found

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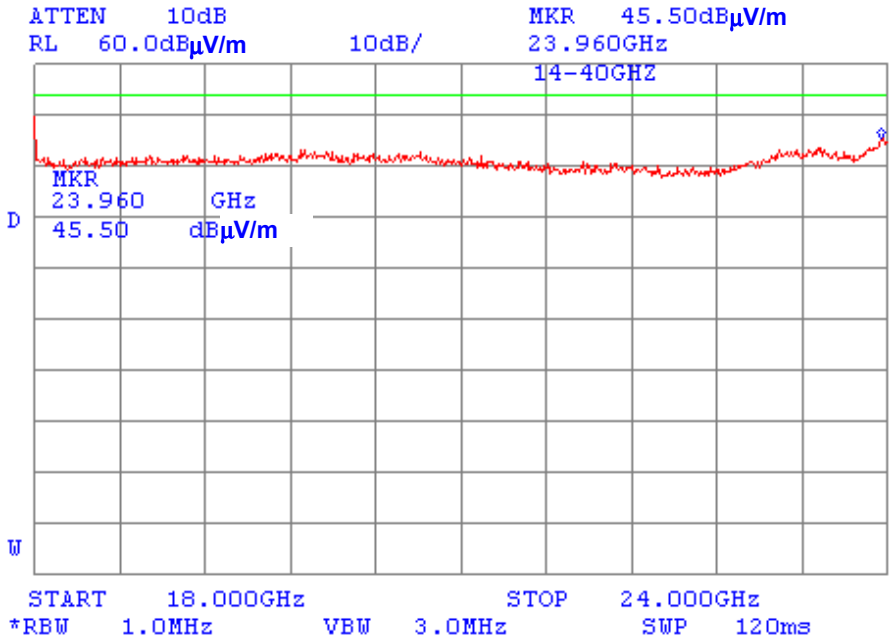
Plot A 63

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2437 MHz



No spurious emissions were found

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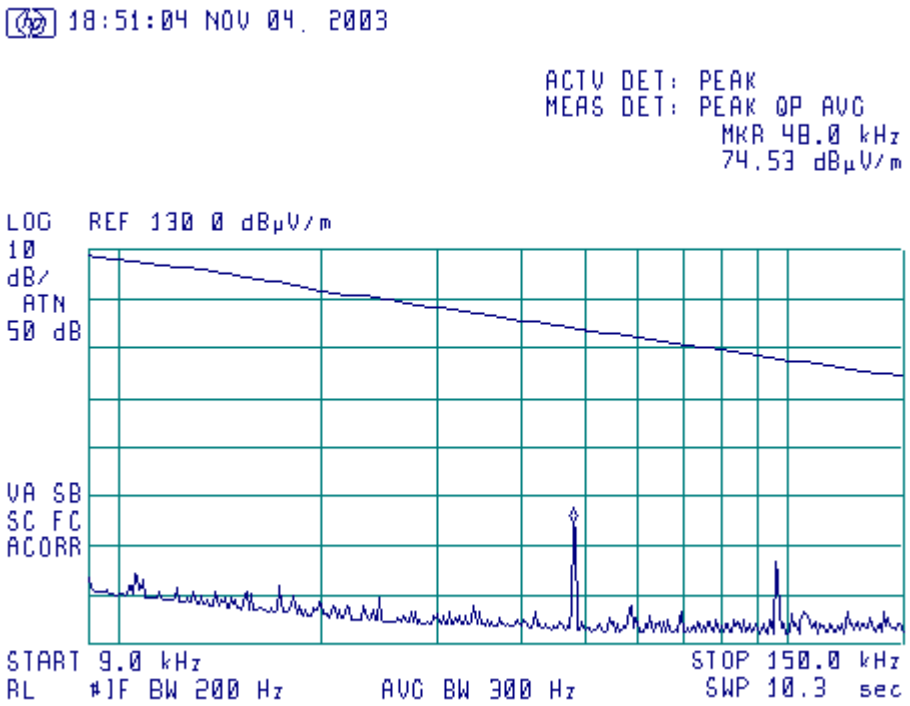
Plot A 64

Radiated spurious emission measurements from 9 kHz to 150 kHz in the anechoic chamber, carrier frequency 2462 MHz



All spurious emissions were found more than 20 dB below the limit.

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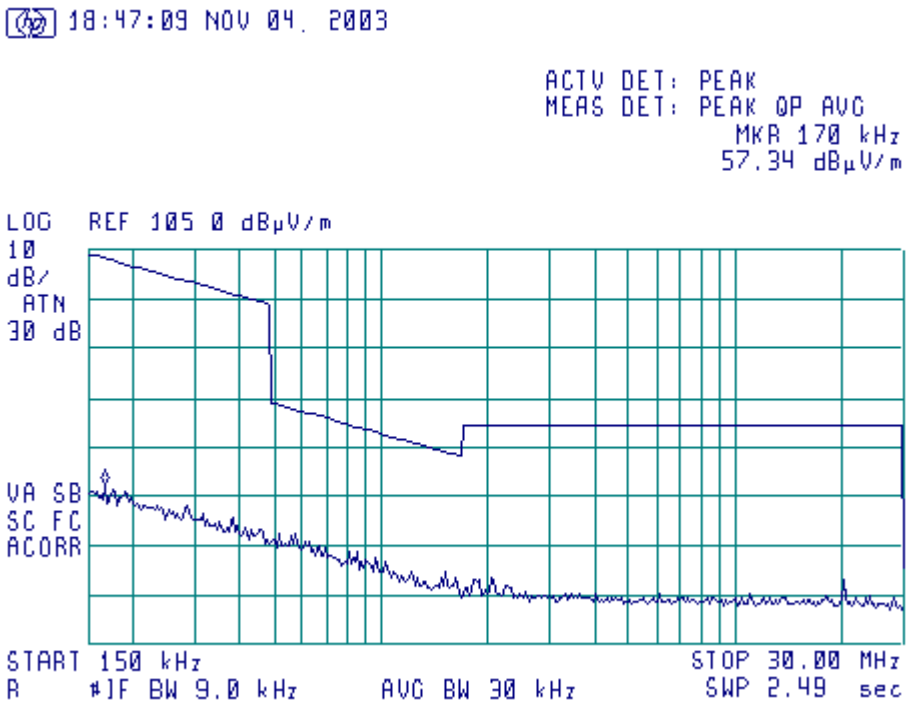
Plot A 65

Radiated spurious emission measurements from 150 kHz to 30 MHz in the anechoic chamber, carrier frequency 2462 MHz



No spurious emissions were found

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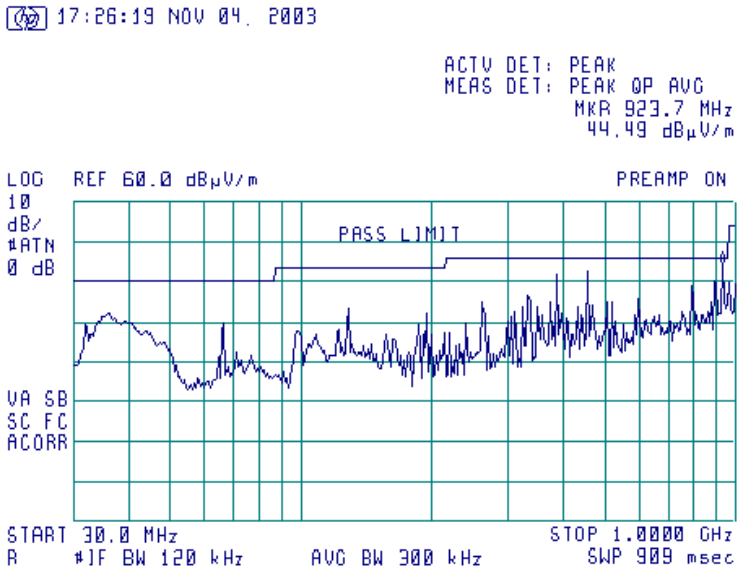
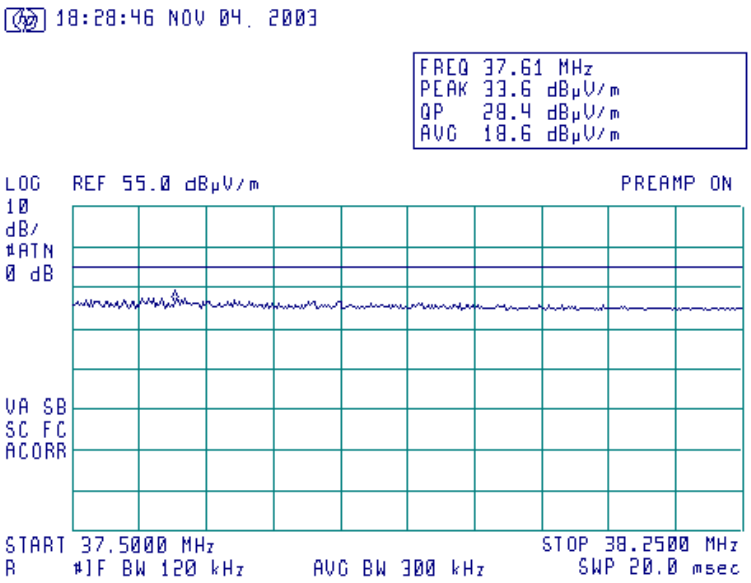
Plot A 66

Radiated spurious emission measurements from 30 MHz to 1 GHz in the anechoic chamber, carrier frequency 2462 MHz

(a)



(b)



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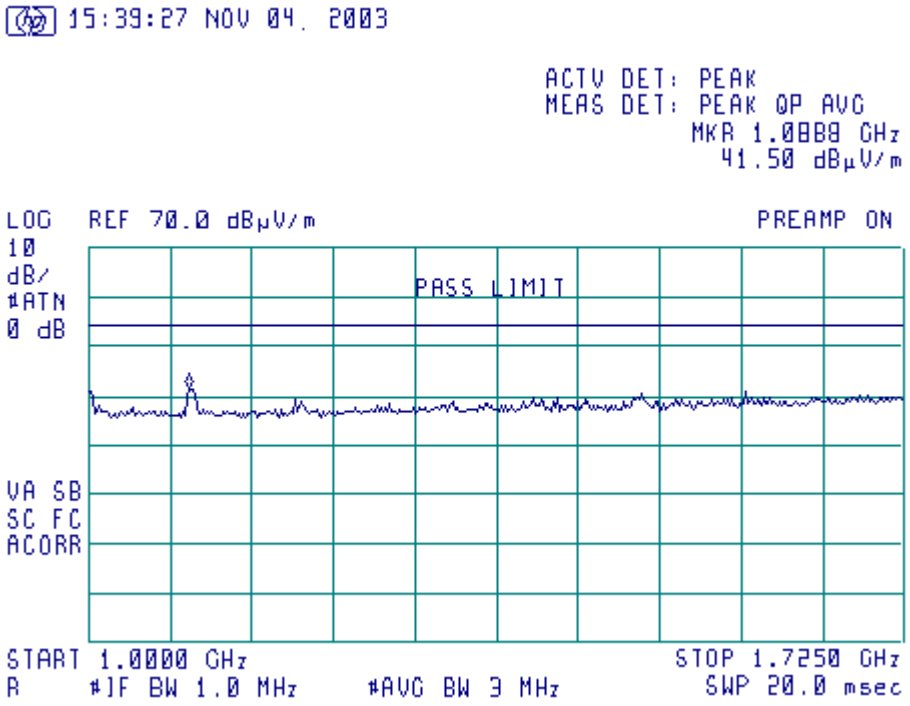
Plot A 67

Radiated spurious emission measurements in restricted bands in the anechoic chamber, carrier frequency 2462 MHz



Laptop emissions (refer to Plot A33)

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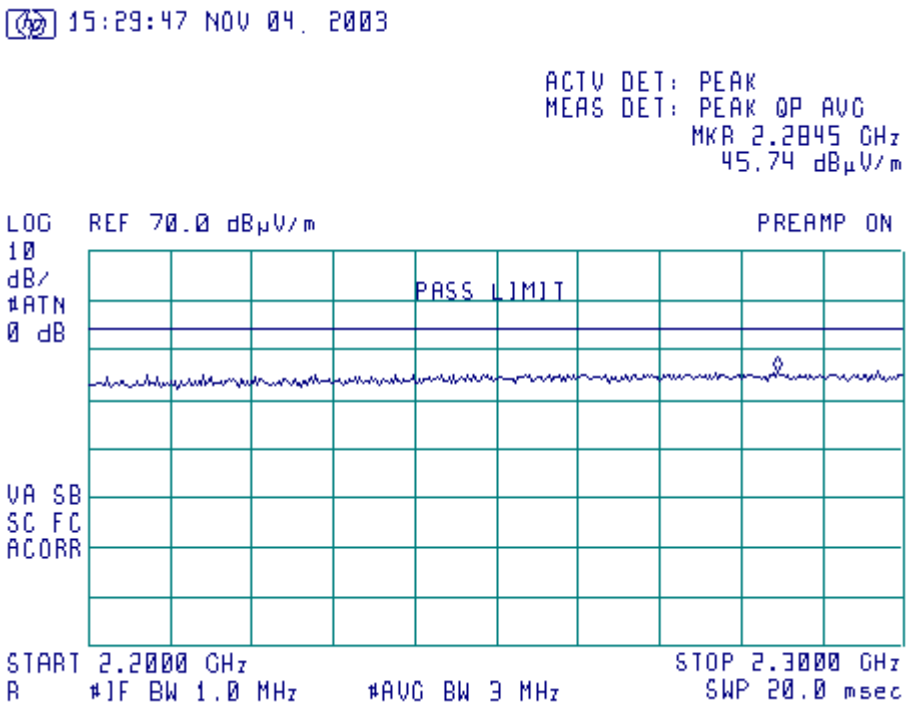
Plot A 68

Radiated spurious emission measurements in restricted bands in the anechoic chamber, carrier frequency 2462 MHz



No spurious emissions were found

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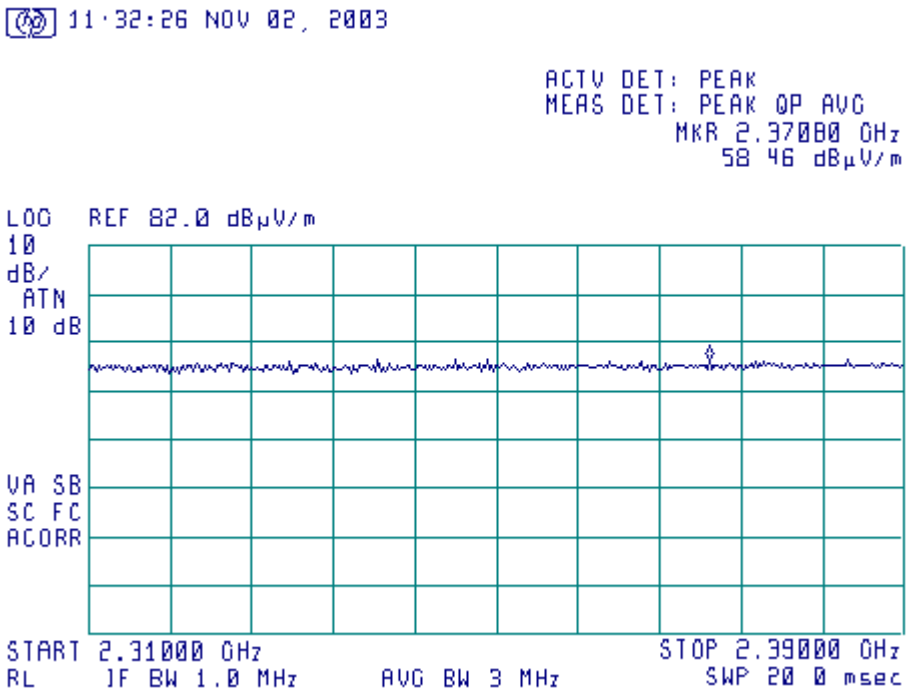
Plot A 69

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



RESTRICTED BAND
Limit: according to §15.209, 15.35
Peak value 58.46 dB(µV/m), limit = 74 dB(µV/m)

Verdict: Pass

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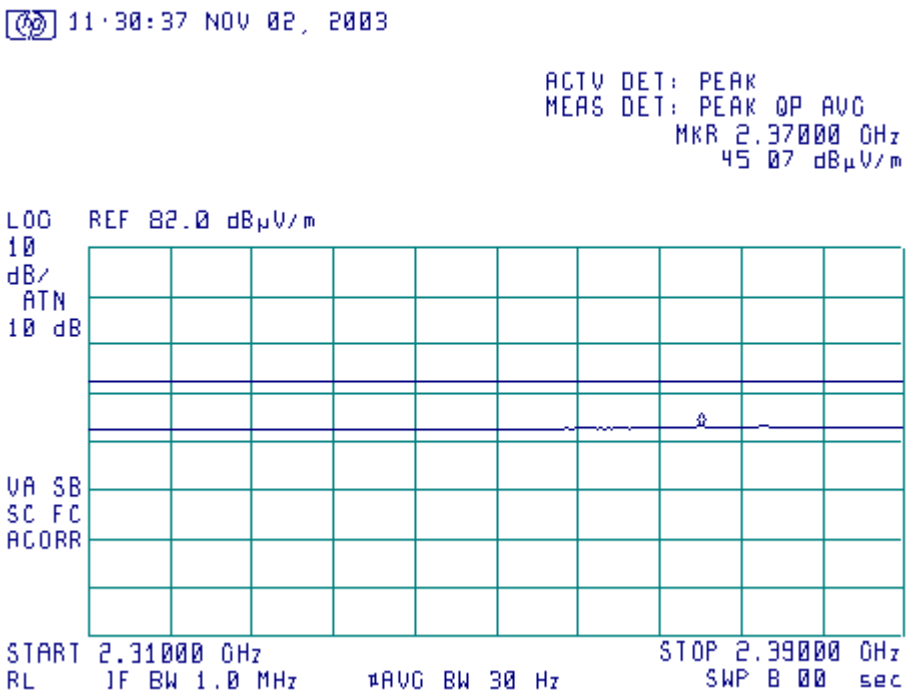
Plot A 70

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



Average value 45.07 dB(µV/m),
Limit (AVG)=54 dBuV/m

Verdict: Pass

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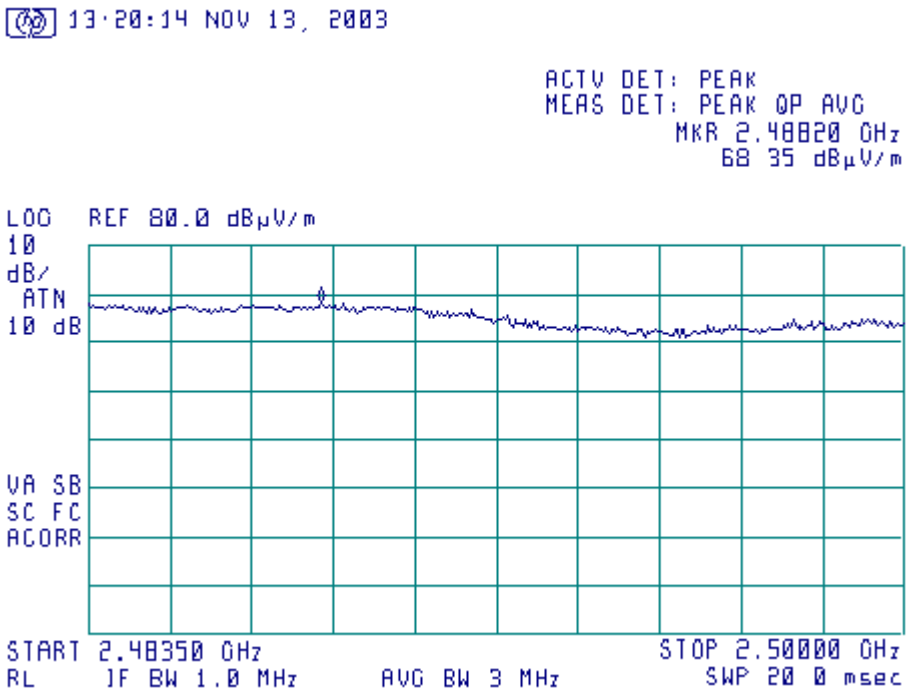
Plot A 71

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



RESTRICTED BAND
Limit: according to §15.209, 15.35
Peak value 68.35 dB(µV/m), limit = 74 dB(µV/m)

Verdict: Pass

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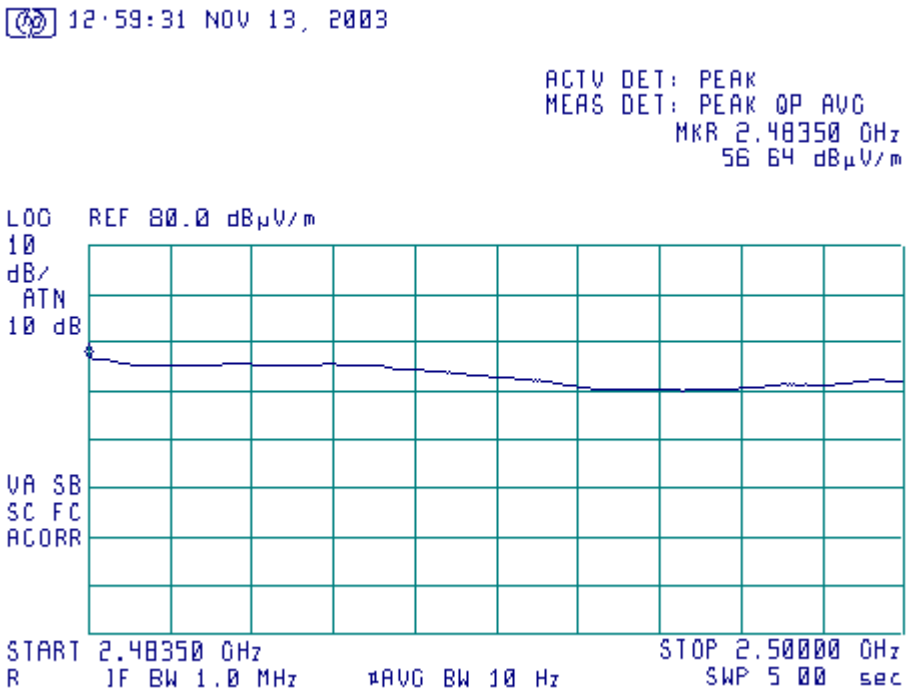
Plot A 72

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



Maximum duty cycle in normal use is 65%
Average factor=20*log(0.65)= -3.74 dB
Average value=56.64 - 3.74 = 52.9 dBuV/m
Limit=54 dBuV/m

Verdict: Pass

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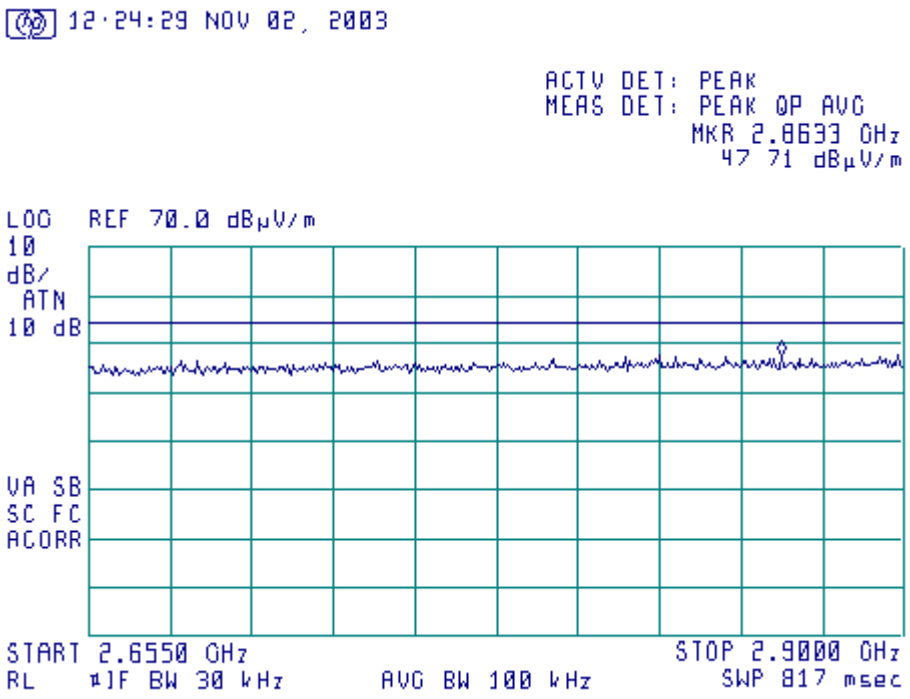
Plot A 73

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



No spurious emissions were found

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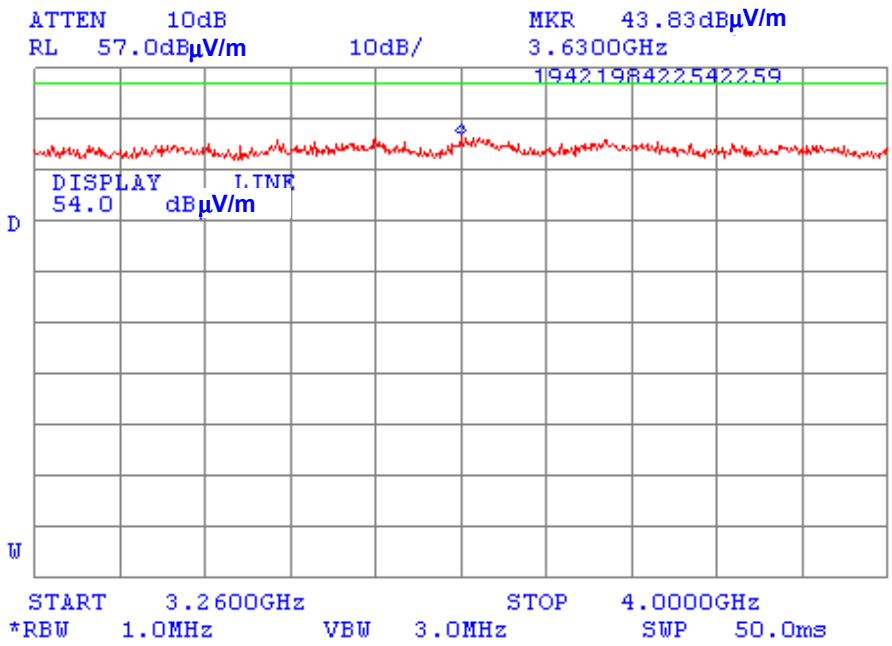
Plot A 74

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



No spurious emissions were found

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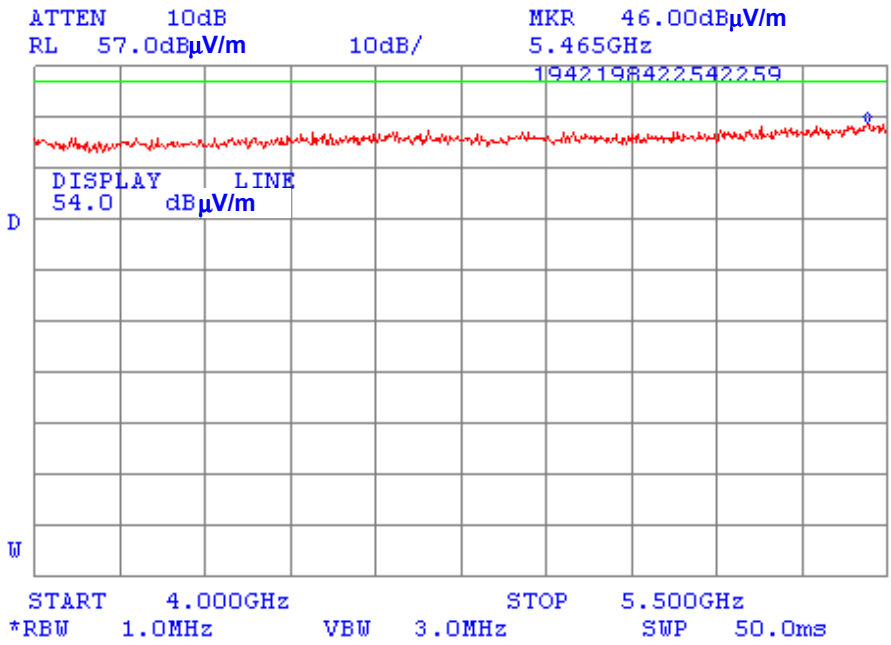
Plot A 75

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



No spurious emissions were found

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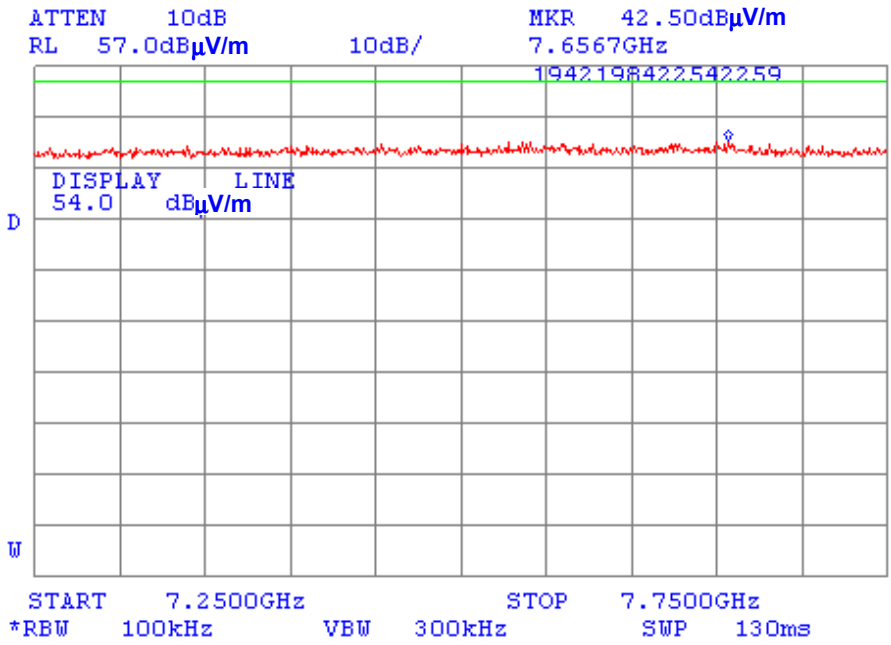
Plot A 76

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



No spurious emissions were found

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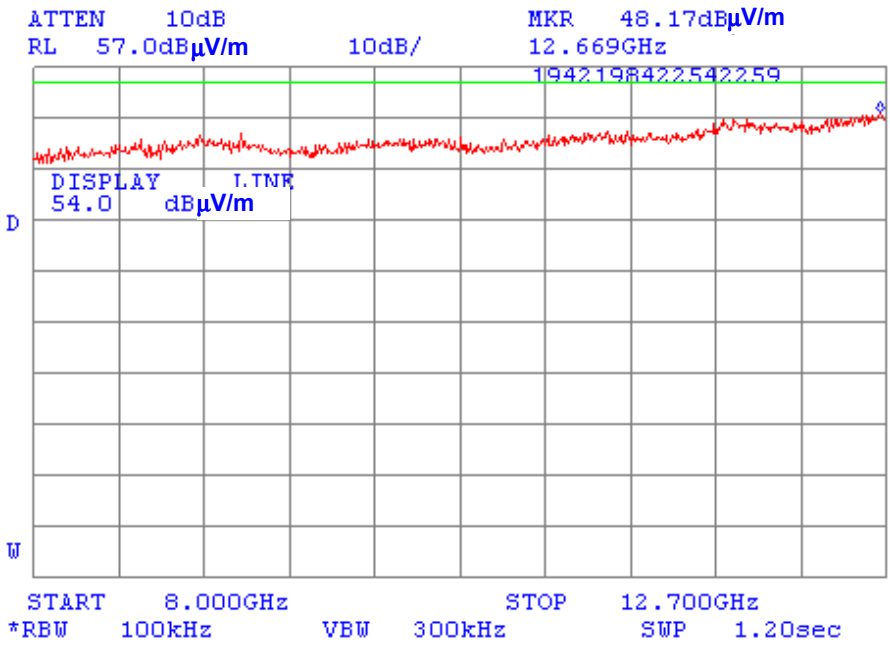
Plot A 77

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



No spurious emissions were found

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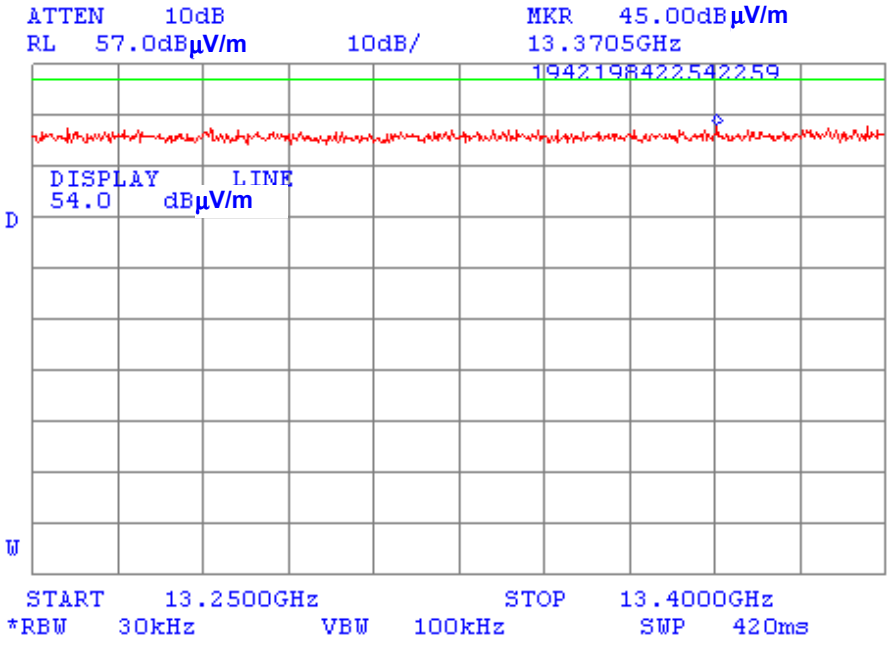
Plot A 78

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



No spurious emissions were found

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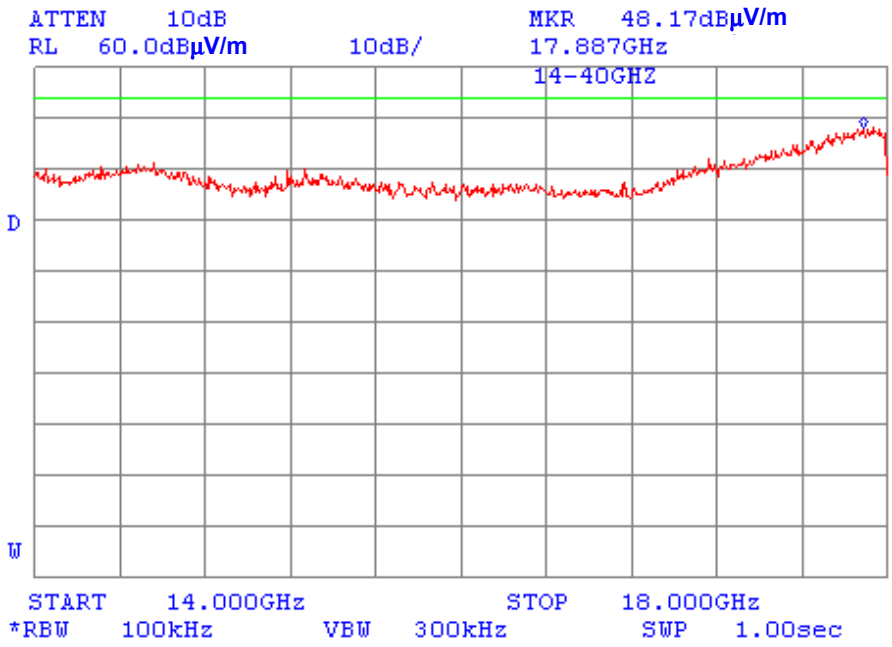
Plot A 79

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



No spurious emissions were found

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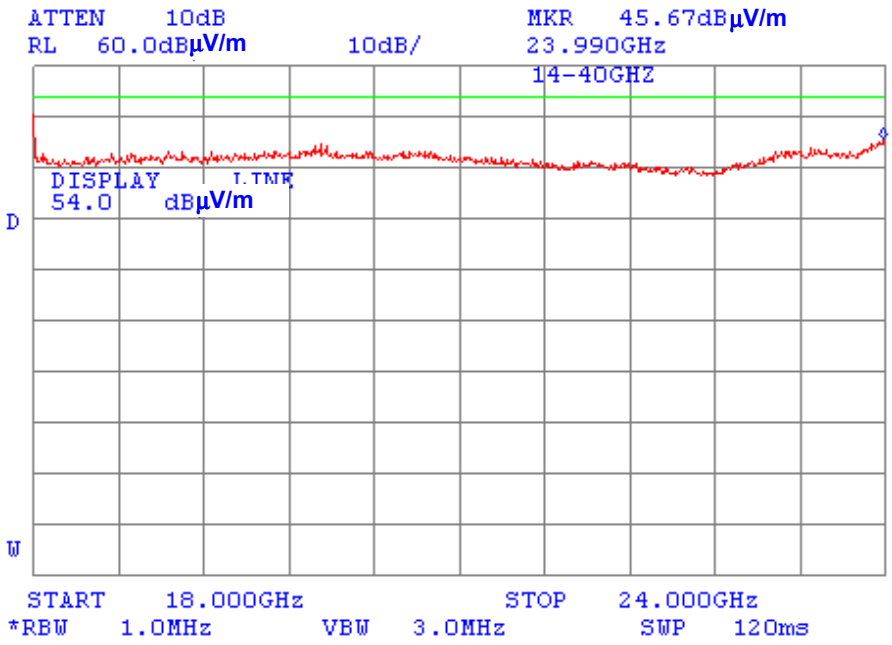
Plot A 80

Radiated spurious emission measurements in restricted bands at the OATS, carrier frequency 2462 MHz



No spurious emissions were found

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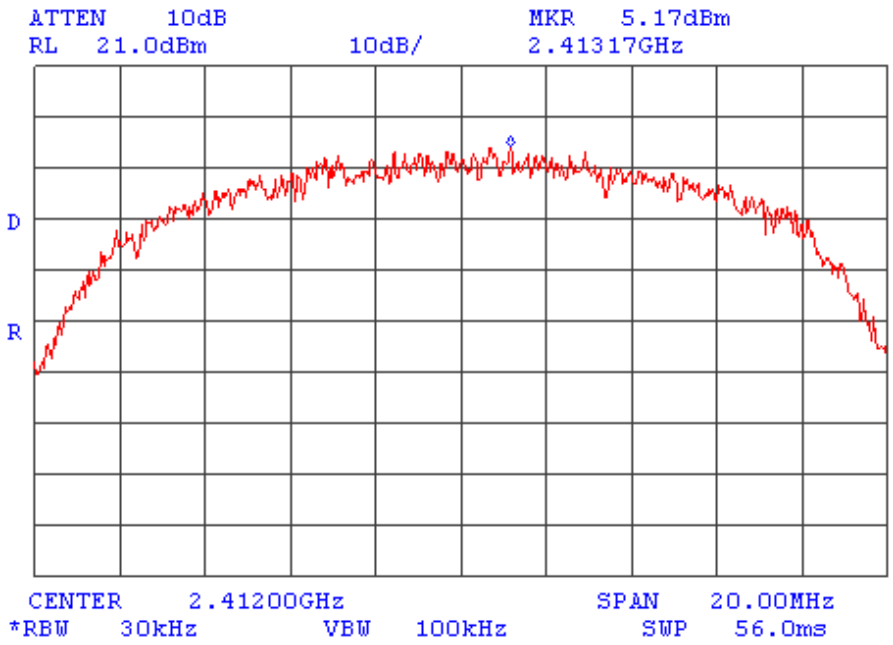
Plot A 81

Peak power spectral density measurements @ 2.412 GHz



External attenuator: 41 dB (reference level offset)

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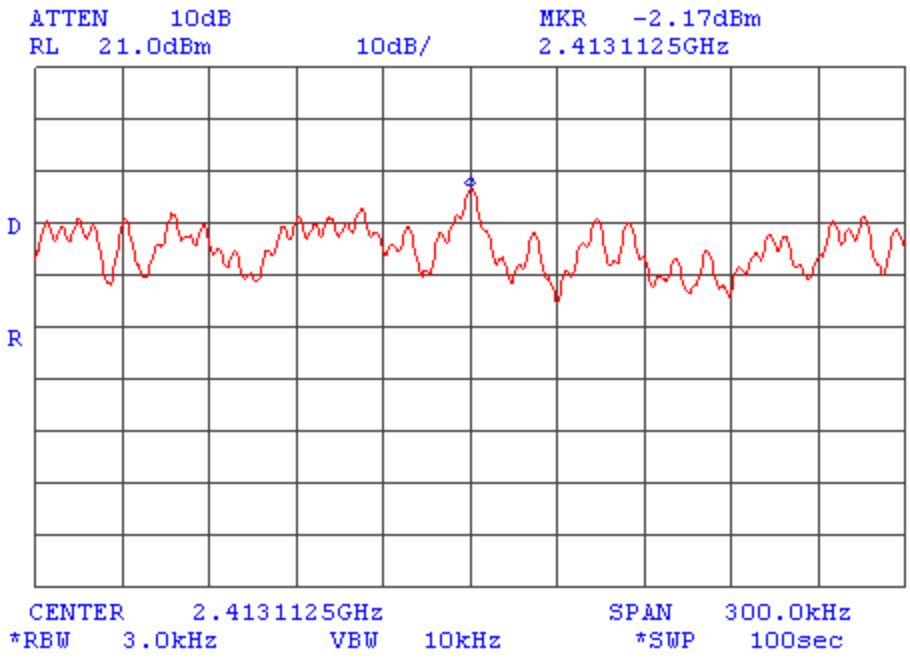
Plot A 82

Peak power spectral density measurements @ 2.412 GHz



External attenuator: 41 dB (reference level offset)

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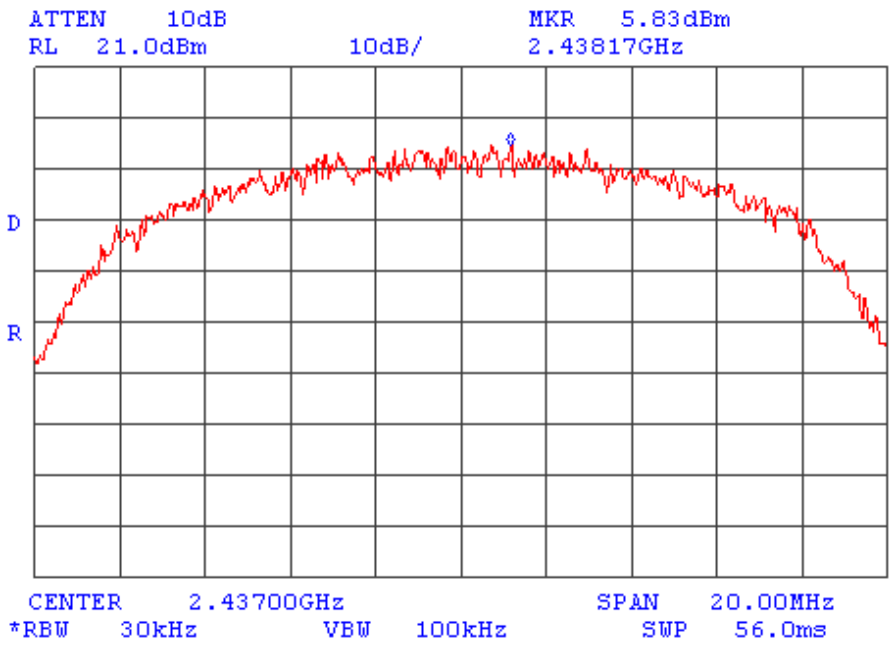
Plot A 83

Peak power spectral density measurements @ 2.437 GHz



External attenuator: 41 dB (reference level offset)

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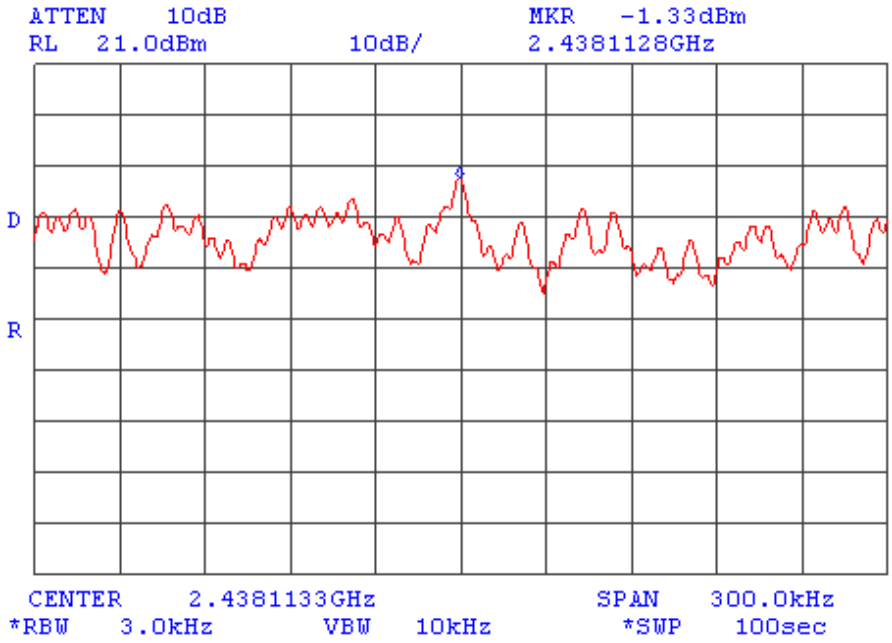
Plot A 84

Peak power spectral density measurements @ 2.437 GHz



External attenuator: 41 dB (reference level offset)

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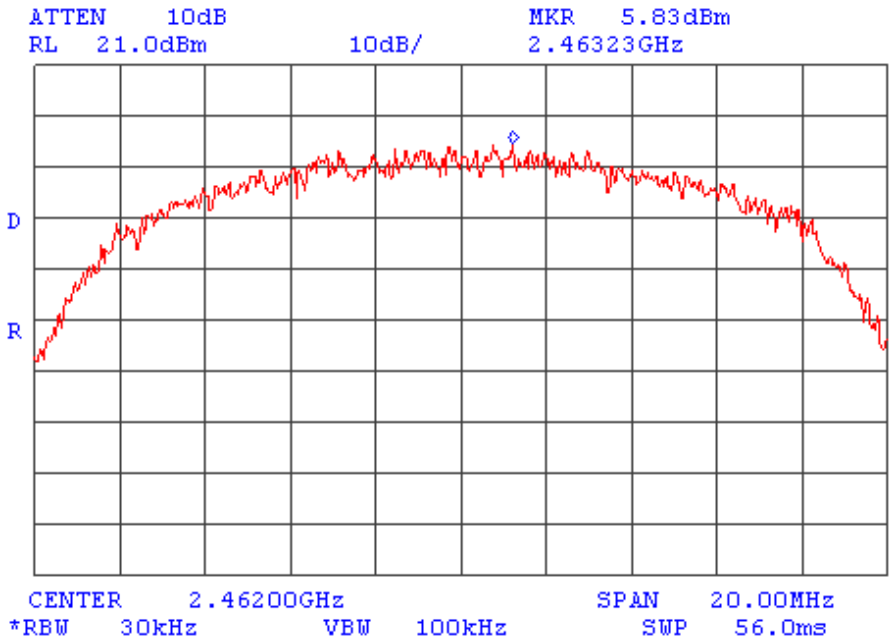
Plot A 85

Peak power spectral density measurements @ 2.462 GHz



External attenuator: 41 dB (reference level offset)

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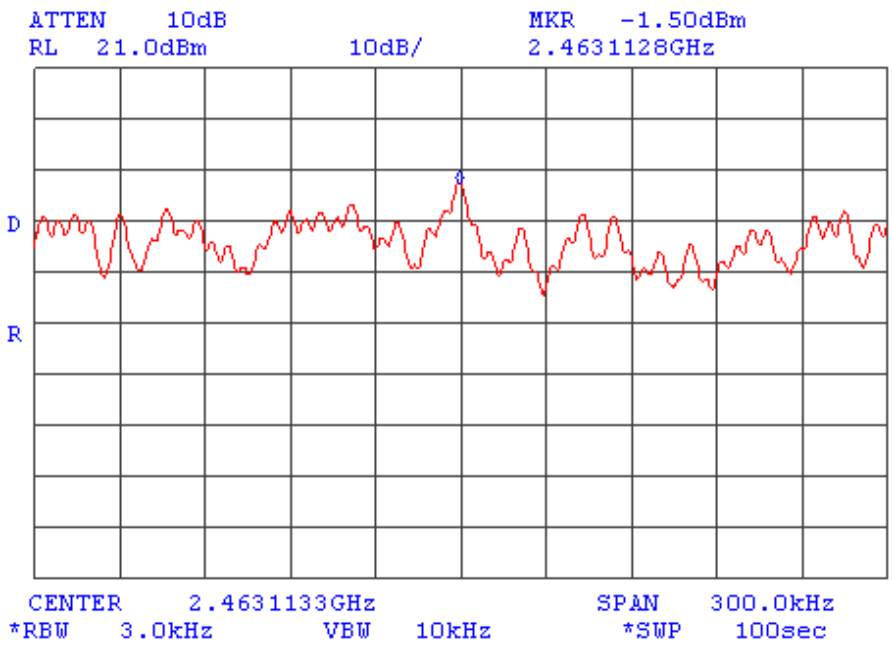
Plot A 86

Peak power spectral density measurements @ 2.462 GHz



External attenuator: 41 dB (reference level offset)

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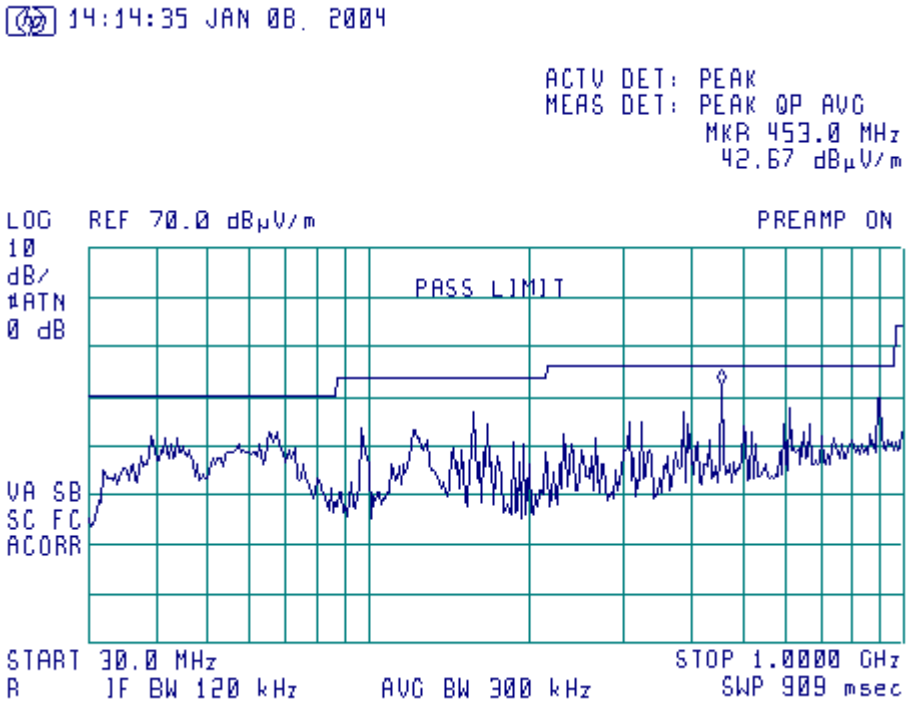
Plot A 87

Radiated emission measurements in the anechoic chamber from 30 MHz to 1 GHz, test distance 3 m, vertical & horizontal antenna polarization



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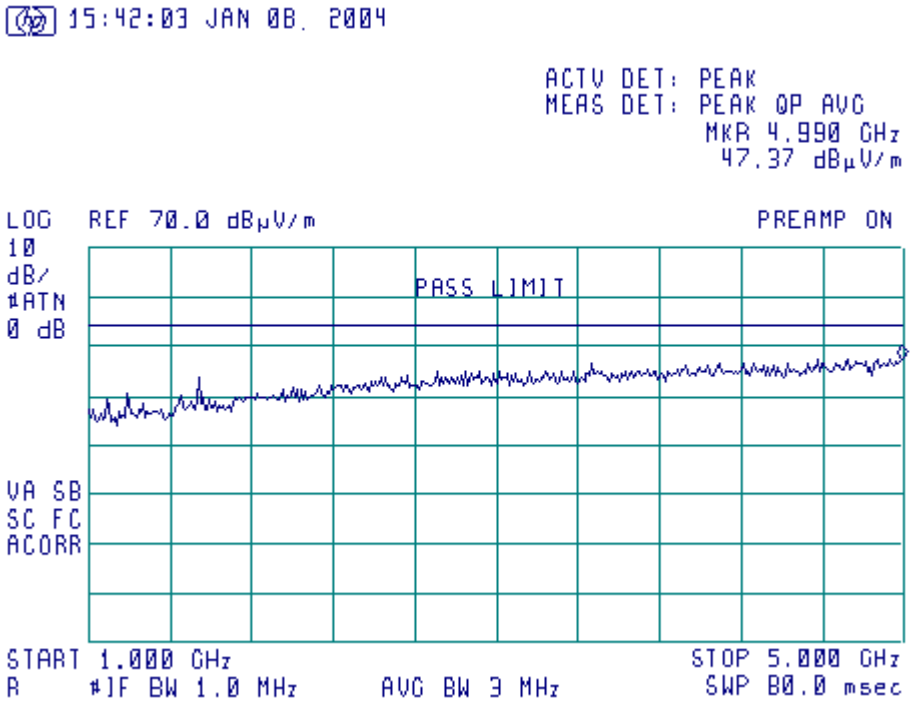
Plot A 88

Radiated emission measurements in the anechoic chamber from 1 GHz to 5 GHz, test distance 3 m, vertical & horizontal antenna polarization



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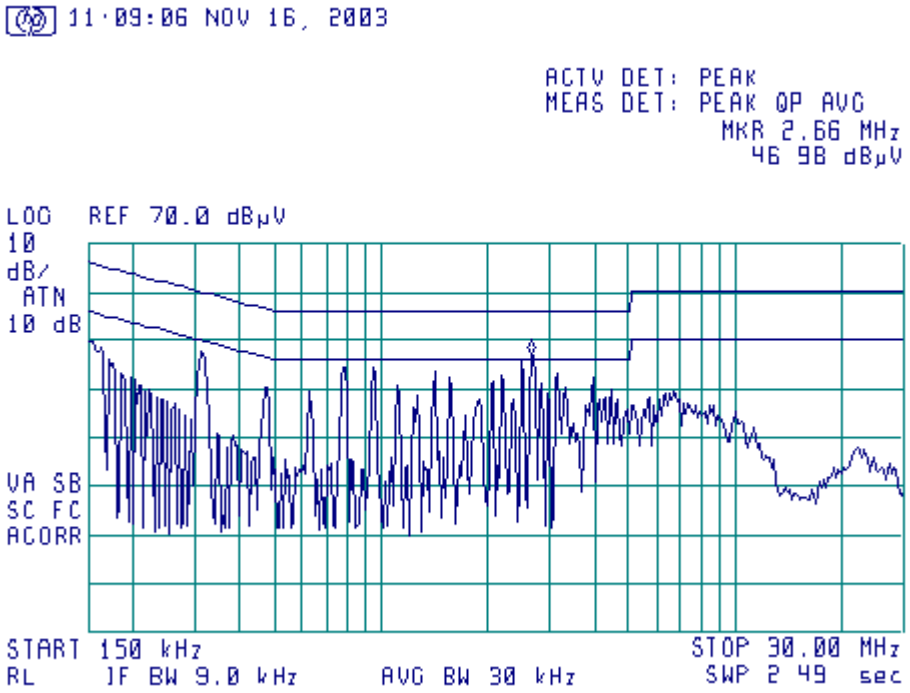
Plot A 89

Conducted emission measurements test results at the AC first line



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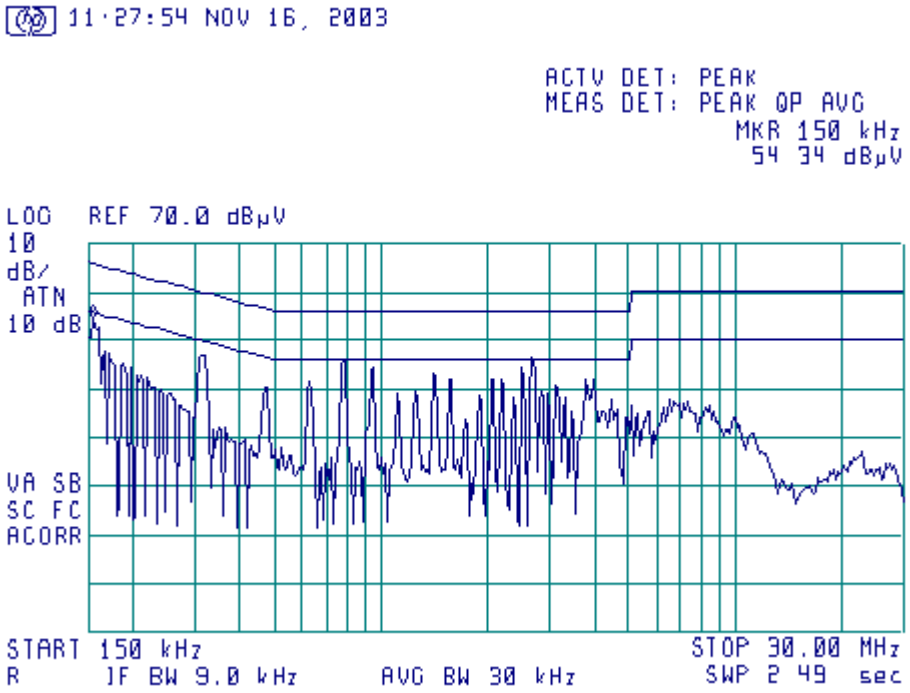
Plot A 90

Conducted emission measurements test results at the AC second line



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Appendix B Test equipment used for tests

HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ year
		Name	Model No.	Serial No.	
0038	Antenna mast, 1-4 m	Hermon Labs	AM-1	028	2/04 check
0091	Position controller for antenna mast + turntable, OFTS	Hermon Labs	CRL-2	091	4/04 check
0163	LISN FCC/VDE/MIL -STD	Electro-Metrics	ANS-25/2	1314	10/04
0287	Turntable, motorized diameter, 2 m	Hermon Labs	TMD-2	042	11/04 check
0446	Active loop antenna, 10 kHz-30 MHz	Electro-Mechanics	6502	2857	10/04
0465	Anechoic chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	10/05 check
0521	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/04
0589	Cable coaxial, GORE A2POL118.2, 3 m	Hermon Labs	GORE-3	589	11/04
0592	Position controller	Hermon Labs	L2-SR3000	100	5/04 check
0593	Antenna mast, 1-4 m/ 1-6 m Pneumatic	Hermon Labs	AM-F1	101	2/04 check
0594	Turntable for Anechoic Chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	102	1/04 check
0604	Antenna biconilog log-periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	1/04
0787	Transient limiter	Hewlett Packard	11947A-8ZE	3107A01877	11/04
1004	Cable, coaxial ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/04
1200	Quadruplexer, 1-12 GHz	Elettronica S.p.A.-Roma	UE 84	0240	4/04 check
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/04
1430	EMI receiver system, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3807A00262	9/04
1502	Cable RF, 6 m	Belden	M17/167 MIL-C-17	1502	12/04 check
1509	Cable RF, 2 m	Telequis	RG-58 C/U	1509	12/04
1510	Cable RF, 8 m	Belden	M17/167 MIL-C-17	1510	12/04
1562	Oscilloscope 100 MHz, DMM	Tektronix	THS720A	B039444	9/04
1650	Attenuators set (2, 3, 5, 20 dB), DC – 18 GHz	M/A –COM	2082	1650	3/04
1651	Attenuators set (2, 3, 5, 20 dB), DC – 18 GHz	M/A –COM	2082	1651	3/04

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HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ year
		Name	Model No.	Serial No.	
1942	Cable 18 GHz, 4 m, blue	Rhophase Microwave Ltd.	SPS-1803A-4000-NPS	T4658	10/04
1947	Cable 18 GHz, 6.5 m, blue	Rhophase Microwave Ltd.	NPS-1803A-6500-NPS	T4974	10/04
1984	Antenna, double ridged waveguide horn, 1-18 GHz, 300 W, N-type	EMC Test Systems	3115	9911-5964	3/04
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	12/04
2227	Crystal detector 0.01-18 GHz	Hewlett Packard	8472A	2227	10/04
2254	Cable 40 GHz, 0.8 m, blue	Rhophase Microwave	KPS-1503A-800-KPS	W4907	11/04
2259	Amplifier low noise 2-20 GHz	Sophia Wireless	LNA0220-C	0223	11/04
2260	Amplifier low noise 14-33 GHz	Sophia Wireless	LNA28-B	0233	11/04
2387	Filter bandpass, 8 – 14 GHz	Hermon Labs	FBP8-14	2387	6/04
2399	Cable 40 GHz, 1.5 m, blue	Rhophase Microwave Ltd.	KPS-1503A-1500-KPS	X2945	6/04
2400	Cable 40 GHz, 1.5 m, green	Rhophase Microwave Ltd.	KPS-1503A-1500-KPS	X2946	6/04
2432	Antenna, double-ridged waveguide horn, 1-18 GHz	EMC Test Systems	3115	000271777	7/04

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Appendix C Antenna factors and cable loss

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

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

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Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011

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).

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

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Antenna factor
Double-ridged guide horn antenna
Model 3115, serial number: 00027177, HL2432

Frequency, MHz	Antenna factor. dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.8
2500.0	28.9
3000.0	30.7
3500.0	31.8
4000.0	33.0
4500.0	32.8
5000.0	34.2
5500.0	34.9
6000.0	35.2
6500.0	35.4
7000.0	36.3
7500.0	37.3
8000.0	37.5
8500.0	38.0
9000.0	38.3
9500.0	38.3
10000.0	38.7
10500.0	38.7
11000.0	38.9
11500.0	39.5
12000.0	39.5
12500.0	39.4
13000.0	40.5
13500.0	40.8
14000.0	41.5
14500.0	41.3
15000.0	40.2
15500.0	38.7
16000.0	38.5
16500.0	39.8
17000.0	41.9
17500.0	45.8
18000.0	49.1

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).

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Cable loss
Cable Coaxial, GORE A2P01POL118, 2.3 m, model:GORE-3, HL 0589
+ Cable Coaxial, ANDREW PSWJ4, 6m, model: ANDREW-6, HL 1004

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	30	0.33	6.5	±0.12
2	50	0.40		
3	100	0.57		
4	300	0.97		
5	500	1.25		
6	800	1.59		
7	1000	1.81		
8	1200	1.97		
9	1400	2.15		
10	1600	2.28		
11	1800	2.43		
12	2000	2.61		
13	2200	2.75		
14	2400	2.89		
15	2600	2.97		
16	2800	3.21	6.5	±0.12
17	3000	3.32		
18	3300	3.47		
19	3600	3.62		
20	3900	3.84		
21	4200	3.92		±0.17
22	4500	4.07		
23	4800	4.36		
24	5100	4.62		
25	5400	4.78		
26	5700	5.16		
27	6000	5.67		
28	6500	5.99		

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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 M17/167 MIL-C-17, HL 1510

No.	Frequency, MHz	Cable loss, dB
1	0.1	0.05
2	1	0.09
3	3	0.16
4	5	0.18
5	10	0.27
6	30	0.44
7	50	0.58
8	80	0.69
9	100	0.82
10	300	1.48
11	500	2.01
12	800	2.65
13	1000	3.12

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Cable loss
Cable 18 GHz, 4 m, blue, model: SPS-1803A-4000-NPS, S/N T4658, HL 1942

Frequency, GHz	Cable loss, dB
0.03	0.21
0.05	0.26
0.10	0.36
0.20	0.50
0.30	0.61
0.40	0.70
0.50	0.78
0.60	0.85
0.70	0.93
0.80	0.99
0.90	1.04
1.00	1.10
1.10	1.16
1.20	1.22
1.30	1.26
1.40	1.31
1.50	1.35
1.60	1.41
1.70	1.45
1.80	1.49
1.90	1.53
2.00	1.57
2.10	1.61
2.20	1.65
2.30	1.69
2.40	1.72
2.50	1.76
2.60	1.79
2.70	1.83
2.80	1.87
2.90	1.90
3.10	1.97
3.30	2.04
3.50	2.11
3.70	2.18
3.90	2.24
4.10	2.31
4.30	2.38
4.50	2.43
4.70	2.53
4.90	2.53
5.10	2.63
5.30	2.65
5.50	2.72
5.70	2.76
5.90	2.79

Frequency, GHz	Cable loss, dB
6.10	2.88
6.30	2.90
6.50	2.97
6.70	3.02
6.90	3.04
7.10	3.07
7.30	3.12
7.50	3.13
7.70	3.19
7.90	3.24
8.10	3.30
8.30	3.36
8.50	3.45
8.70	3.41
8.90	3.45
9.10	3.42
9.30	3.55
9.50	3.48
9.70	3.58
9.90	3.61
10.10	3.66
10.30	3.68
10.50	3.70
10.70	3.70
10.90	3.75
11.10	3.78
11.30	3.86
11.50	3.98
11.70	4.10
11.90	4.12
12.10	4.09
12.40	4.13
13.00	4.23
13.50	4.35
14.00	4.40
14.50	4.44
15.00	4.57
15.50	4.66
16.00	4.64
16.50	4.66
17.00	4.75
17.50	4.85
18.00	4.93

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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

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Cable loss
RF cable 8 m, model RG-214, HL 2009

No.	Frequency, MHz	Cable loss, dB	Tolerance (Specification), dB	Measurement uncertainty, dB
1	1	0.10	NA	±0.12
2	10	0.14		
3	30	0.25		
4	50	0.34		
5	100	0.53		
6	300	0.99		
7	500	1.31		
8	800	1.73		
9	1000	1.98		
10	1100	2.11		
11	1200	2.21		
12	1300	2.35		
13	1400	2.46		
14	1500	2.55		
15	1600	2.68		
16	1700	2.78		
17	1800	2.88		
18	1900	2.98		
19	2000	3.09		

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Cable loss
Cable 40 GHz, 0.8 m, blue, model: KPS-1503A-800-KPS, S/N W4907, HL 2254

Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB
0.03	0.04	5.10	0.80	15.00	1.49
0.05	0.07	5.30	0.83	15.50	1.49
0.10	0.09	5.50	0.83	16.00	1.46
0.20	0.15	5.70	0.84	16.50	1.47
0.30	0.19	5.90	0.87	17.00	1.50
0.40	0.25	6.10	0.86	17.50	1.57
0.50	0.29	6.30	0.89	18.00	1.63
0.60	0.33	6.50	0.90	18.50	1.57
0.70	0.37	6.70	0.89	19.00	1.63
0.80	0.41	6.90	0.93	19.50	1.65
0.90	0.44	7.10	0.92	20.00	1.64
1.00	0.45	7.30	0.95	20.50	1.75
1.10	0.48	7.50	0.96	21.00	1.72
1.20	0.51	7.70	0.97	21.50	1.78
1.30	0.53	7.90	1.01	22.00	1.76
1.40	0.54	8.10	1.00	22.50	1.72
1.50	0.57	8.30	1.05	23.00	1.83
1.60	0.59	8.50	1.04	23.50	1.80
1.70	0.04	8.70	1.07	24.00	1.90
1.80	0.07	8.90	1.11	24.50	1.81
1.90	0.09	9.10	1.09	25.00	1.98
2.00	0.15	9.30	1.14	25.50	1.91
2.10	0.19	9.50	1.12	26.00	2.02
2.20	0.25	9.70	1.15	26.50	1.92
2.30	0.29	9.90	1.16	27.00	1.97
2.40	0.33	10.10	1.16	28.00	2.02
2.50	0.37	10.30	1.19	29.00	1.95
2.60	0.41	10.50	1.14	30.00	1.94
2.70	0.44	10.70	1.19	31.00	2.11
2.80	0.45	10.90	1.17	32.00	2.17
2.90	0.48	11.10	1.13	33.00	2.27
3.10	0.61	11.30	1.20	34.00	2.27
3.30	0.64	11.50	1.13	35.00	2.29
3.50	0.65	11.70	1.20	36.00	2.35
3.70	0.68	11.90	1.18	37.00	2.37
3.90	0.69	12.10	1.14	38.00	2.40
4.10	0.71	12.40	1.19	39.00	2.57
4.30	0.73	13.00	1.34	40.00	2.36
4.50	0.75	13.50	1.33		
4.70	0.77	14.00	1.48		
4.90	0.79	14.50	1.45		

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Cable loss
Cable coaxial, 40GHz, 1.5 m, Blue, Rhophase Microwave Limited, model: KPS-1503A-1500-KPS, HL 2399

Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB
0.03	0.07	6.5	1.57	15.50	2.50
0.05	0.10	6.7	1.60	16.00	2.51
0.1	0.16	6.9	1.55	16.50	2.58
0.2	0.26	7.1	1.65	17.00	2.65
0.3	0.33	7.3	1.65	17.50	2.73
0.5	0.38	7.5	1.70	18.00	2.74
0.7	0.41	7.7	1.71	18.50	2.67
0.9	0.58	7.9	1.73	19.00	2.67
1.1	0.64	8.1	1.79	19.50	2.74
1.3	0.70	8.3	1.81	20.00	2.69
1.5	0.75	8.5	1.84	20.50	2.80
1.7	0.79	8.7	1.85	21.00	2.82
1.9	0.83	8.9	1.90	21.50	2.87
2.1	0.88	9.1	1.95	22.00	2.87
2.3	0.93	9.3	1.93	22.50	2.92
2.5	0.97	9.5	1.98	23.50	3.04
2.7	1.01	9.7	1.96	24.00	3.05
2.9	1.04	9.9	2.03	24.50	3.03
3.1	1.08	10.1	1.99	25.00	3.11
3.3	1.14	10.30	2.02	25.50	3.10
3.5	1.17	10.50	2.02	26.00	3.17
3.7	1.21	10.70	2.02	26.50	3.11
3.9	1.24	10.90	2.08	27.00	3.16
4.1	1.26	11.10	2.02	28.00	3.19
4.3	1.26	11.30	2.09	29.00	3.19
4.5	1.29	11.50	2.05	30.00	3.30
4.7	1.34	11.70	2.11	31.00	3.31
4.9	1.34	11.90	2.11	32.00	3.35
5.1	1.40	12.10	2.12	33.00	3.46
5.3	1.43	12.40	2.17	34.00	3.45
5.5	1.45	13.00	2.29	35.00	3.49
5.7	1.47	13.50	2.31	36.00	3.54
5.9	1.40	14.00	2.43	37.00	3.62
6.1	1.53	14.50	2.43	39.00	3.69
6.3	1.55	15.00	2.46	40.00	3.75

HERMON LABORATORIES

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Cable loss
Cable coaxial, 40GHz, 1.5 m, green, Rhophase Microwave Limited, model: KPS-1503A-1500-KPS, HL 2400

Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB	Frequency, GHz	Cable loss, dB
0.03	0.06	6.5	1.46	15.50	2.34
0.05	0.08	6.7	1.49	16.00	2.34
0.1	0.15	6.9	1.50	16.50	2.40
0.2	0.23	7.1	1.51	17.00	2.46
0.3	0.29	7.3	1.55	17.50	2.54
0.5	0.37	7.5	1.56	18.00	2.61
0.7	0.46	7.7	1.58	18.50	2.59
0.9	0.53	7.9	1.60	19.00	2.59
1.1	0.58	8.1	1.61	19.50	2.67
1.3	0.65	8.3	1.68	20.00	2.62
1.5	0.66	8.5	1.68	20.50	2.73
1.7	0.72	8.7	1.75	21.00	2.71
1.9	0.76	8.9	1.74	21.50	2.78
2.1	0.79	9.1	1.81	22.00	2.83
2.3	0.85	9.3	1.79	22.50	2.81
2.5	0.90	9.5	1.86	23.50	2.91
2.7	0.91	9.7	1.85	24.00	2.97
2.9	0.97	9.9	1.87	24.50	2.98
3.1	0.97	10.1	1.88	25.00	2.97
3.3	1.03	10.30	1.82	25.50	3.03
3.5	1.06	10.50	1.92	26.00	3.04
3.7	1.10	10.70	1.86	26.50	3.11
3.9	1.13	10.90	1.96	27.00	2.97
4.1	1.16	11.10	1.90	28.00	3.15
4.3	1.18	11.30	1.99	29.00	3.07
4.5	1.21	11.50	1.95	30.00	3.13
4.7	1.23	11.70	2.00	31.00	3.13
4.9	1.26	11.90	2.01	32.00	3.18
5.1	1.28	12.10	1.99	33.00	3.31
5.3	1.31	12.40	2.06	34.00	3.32
5.5	1.32	13.00	2.11	35.00	3.37
5.7	1.36	13.50	2.17	36.00	3.36
5.9	1.37	14.00	2.36	37.00	3.46
6.1	1.38	14.50	2.32	39.00	3.49
6.3	1.44	15.00	2.30	40.00	3.52

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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, 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) 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, environmental, 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) and approved by Israel Ministry of environmental protection, radiation hazards department (Permit number 1158).

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Abbreviations and acronyms

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

AC	alternating current
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
LNA	low noise amplifier
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
P-to-MP	point-to-multipoint
P-to-P	point-to-point
RF	radio frequency
RE	radiated emission
rms	root mean square
s	second
V	volt
W	width

Specification references

47CFR part 15: 2003	Radio Frequency Devices
ANSI C63.2:96	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4:2001	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.