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Electrical

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ELECTROMAGNETIC EMISSIONS TEST REPORT

ACCORDING TO FCC CFR 47 PART 15 SUBPART B, PART 90 SUBPART I

for

Miltel Communications Ltd.

EQUIPMENT UNDER TEST:

Transmitter for meter reading system and data collection
Models: Galaxy Remote, SpeedRead, Irriwise

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Contents

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1 Project information

Description of equipment under test

Test items	: Transmitter for meter reading system and data collection
Manufacturer	: Miltel Communications Ltd.
Types (Models)	: 1) Galaxy Remote 2) SpeedRead 3) Irriwise

Applicant information

Applicant's responsible person	: Mr. Erez Sharabi, V.P. engineering
Company	: Miltel Communications Ltd.
Address	: 7 Leshem street
P.O.Box	: 7374
City	: Petach Tikva
Postal code	: 49170
Country	: Israel
Telephone number	:+972 3926 9550
Telefax number	:+972 3924 6550

Test performance

Project Number:	: 15703
Location	: Hermon Laboratories
Receipt date	: October 08, 2003
Test started	: October 09, 2003
Test completed	: December 25, 2003
Purpose of test	: Apparatus compliance verification in accordance with emission requirements
Test specification(s)	47CFR part 90, §§90.217(b), part 15 §15.109

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2 Summary and signatures

The EUT, transmitter of automatic meter reading system, was tested according to FCC part 90 subpart I §90.217(b), part 15 §15.109 and found to comply with the standard requirements.

Test description	Specification reference	Tested by	Date tested	Test report paragraph	Verdict
RF output power	90.217, 2.1046	Mr. Y. Neuman, test engineer	December 25, 2003	4.1	Tested
Occupied bandwidth	90.209, 2.1049	Mr. Y. Neuman, test engineer	December 25, 2003	4.2	Tested
Transient frequency behavior	90.214	Mr. Y. Neuman, test engineer	December 11, 2003	4.3	Tested
Emission mask	90.217(b)	Mr. Y. Neuman, test engineer	December 25, 2003	4.4	Pass
Radiated spurious emissions	90.210, 2.1053	Mr. I. Fershtater, test engineer	December 9, 2003	4.5	Pass
Radiated emissions	15.109	Mr. I. Fershtater, test engineer	December 2, 2003	4.6	Pass
Frequency stability	90.213, 2.1055	Mr. I. Fershtater, test engineer	December 9, 2003	4.7	Tested

Test report prepared by:

Mr. Yuri Neuman, MScEE, test 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 transmitter of automatic meter reading system, operating in 450-470 MHz frequency band with FSK modulation and utilizing an integral antenna (models Galaxy Remote and SpeedRead) or external antenna with SMA connector (model Irriwise). Data bit rate is 600 bps. The device is powered by 3.6 V internal battery. The frequencies generated or used in the EUT are: 20 MHz, 4 MHz.

Galaxy Remote general view

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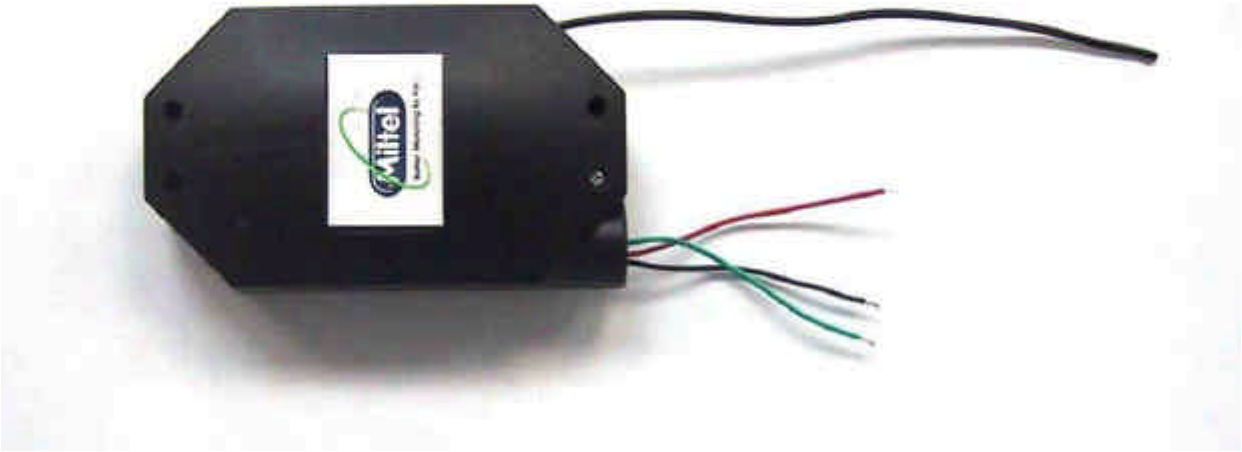
SpeedRead general view



Irriwise general view

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4 Test results

4.1 Peak output power

4.1.1 General

This test was performed to measure maximum peak output power, which must not exceed 120 mW.

4.1.2 Test procedure

Radiated test

4.1.2.1 The EUT was set up on a wooden 80 cm height turntable at the OATS as shown in Figure 4.1.1, energized and its proper operation was checked.

4.1.2.2 The measurements were performed at 3 m test distance with log periodic antenna. 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.

4.1.2.3 The EUT was replaced with a substitution dipole antenna connected to a signal generator.

4.1.2.4 The measuring antenna height was changed from 1 to 4 m to find a maximum radiation. The level of the signal generator output was adjusted until the previously recorded field strength maximum reading was obtained as depicted in Table 4.1.1 (a).

4.1.2.5 The equivalent power was calculated using the equation:

$$ERP\ (dBm) = P_{out\ gen}\ (dBm) - cable\ loss\ (dB) + G_a\ (dBd),\ where$$

$P_{out\ gen}$ is the generator output power
G_a is the gain of the substitution antenna used relative to an ideal half-wave dipole antenna.

Conducted test

4.1.2.6 The EUT was connected to the spectrum analyzer through the RF cable with 0.3 dB loss and 30 dB attenuator and the radio transmission was activated. RF output power was measured at 3 carrier frequencies (low, middle, high) 450 MHz, 460 MHz and 470 MHz. The measured result was corrected for external attenuator and cable loss, for test results refer to Table 4.1.1 (b).

The transmitter, models Galaxy Remote, Speedread and Irriwise, has output power not exceeding 120 mW and, therefore, is exempt from the technical requirements of subpart I, but must instead comply with provisions of the §90.217(b).

TEST EQUIPMENT USED FOR RADIATED TEST:

HL 0034	HL 0038	HL 0091	HL 0287	HL 0415	HL 0661	HL 0812
HL 1430	HL 1565	HL 1947	HL 2400			

TEST EQUIPMENT USED FOR CONDUCTED TEST:

HL 1424	HL 1991	HL 2254					

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Table 4.1.1
Peak output power test results

TEST SPECIFICATION: FCC part 90, §90.217
DATE of TEST: December 25, 2003
AMBIENT TEMPERATURE: 25°C
RELATIVE HUMIDITY: 39 %
AIR PRESSURE: 1015 hPa
MEASUREMENT UNCERTAINTY: ±3.5 dB

a) Radiated test:

model Galaxy Remote

Carrier frequency, MHz	Radiated measured result, dB(uV/m)	Generator P_{out}, dBm	Cable loss, dB	Antenna gain, dBd	ERP, dBm	Limit for spurious emissions upon §90.217(b), dBm
450	111.2	15.8	0.4+1.3	-1.2	12.9	-17.1
460	111.9	16.5	0.4+1.3	-1.4	13.4	-16.6
470	111.0	15.8	0.4+1.3	-1.6	12.5	-17.5

model SpeedRead

Carrier frequency, MHz	Radiated measured result, dB(uV/m)	Generator P_{out}, dBm	Cable loss, dB	Antenna gain, dBd	ERP, dBm	Limit for spurious emissions upon §90.217(b), dBm
450	112.4	16.3	0.4+1.3	-1.2	13.4	-16.6
460	112.5	16.7	0.4+1.3	-1.4	13.6	-16.4
470	112.1	16.3	0.4+1.3	-1.6	13.0	-17

The results recorded in the table were obtained throughout measurements with log periodic antenna in vertical polarization.

b) Conducted test:

model Irriwise

Carrier frequency, MHz	Output power, dBm	Limit for spurious emissions upon §90.217(b), dBm
450	14.7	-15.3
460	14.3	-15.7
470	14.2	-15.8

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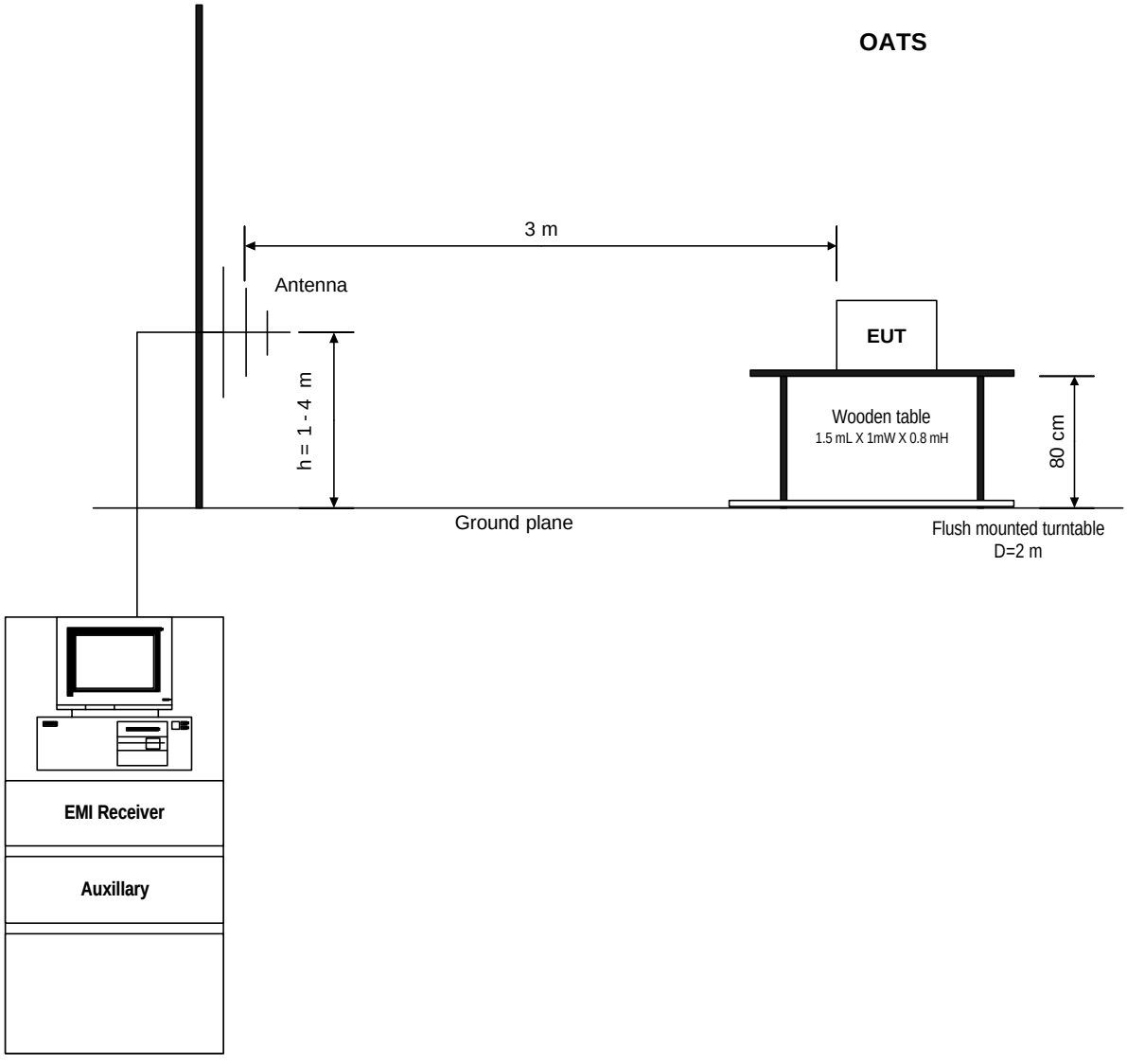
Figure 4.1.1

Setup for radiated emissions test



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4.2 Occupied bandwidth

4.2.1 General

This test was performed to measure occupied bandwidth by conductive method.

4.2.2 Test procedure

4.2.2.1 The EUT was connected to the spectrum analyzer, which settings are shown in plots, through the RF cable with 0.3 dB loss and 30 dB attenuator and the radio transmission was activated.

4.2.2.2 The measurements were performed at carrier frequency in continuous transmit mode of operation at frequency band between 23 dBc points.

4.2.2.3 The test results are shown in Table 4.2.1.

TEST EQUIPMENT USED:

HL 1424	HL 1991	HL 2254					

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Table 4.2.1

Occupied bandwidth measurement results

METHOD OF MEASUREMENTS	ANSI C63.4 §13.1.7
DATE of TEST:	December 25, 2003
AMBIENT TEMPERATURE:	25°C
RELATIVE HUMIDITY:	39 %
AIR PRESSURE:	1015 hPa
MEASUREMENT UNCERTAINTY:	±168 Hz

Conducted test – for Irriwise model only

Carrier frequency, MHz	Modulation	Measured 23 dB bandwidth, kHz	Reference to plot in Appendix A
450	All “0”	14.63	A1
	All “1”	11.2	A2
	Alternate	12.8	A3
460	All “0”	14.8	A4
	All “1”	11.17	A5
	Alternate	12.9	A6
470	All “0”	14.6	A7
	All “1”	11.17	A8
	Alternate	12.83	A9

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4.3 Transient frequency behavior

4.3.1 General

This test was performed to measure carrier frequency drift as function of time during transmitter start up and shut down. Specification test limits are given in Table 4.3.1. The test results are provided in the associated plots.

Table 4.3.1

Transient frequency limits

REFERENCE STANDARD: ANSI/TIA-603A

Carrier frequency tolerance, kHz	Duration, ms	Time interval*
±12.5	10.0 ms	t_1
±6.25	25.0 ms	t_2
±12.5	10.0 ms	t_3

* - t_{on} is the instant when a 1 kHz test signal is completely suppressed;
t_1 is the time period immediately following t_{on};
t_2 is the time period immediately following t_1;
t_3 is the time period from the instant when the transmitter is turned off until t_{off};
t_{off} is the instant when the 1 kHz test signal starts to rise.

4.3.2 Test procedure

4.3.2.1 The EUT was set up as shown in Figure 4.3.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

4.3.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 25 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

4.3.2.3 The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

4.3.2.4 The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.

Reference numbers of test equipment used

HL 0539	HL 0788	HL 0793	HL 1518	HL 1556	HL 1562	HL 1956
HL 2227	HL 2429					

Full description is given in Appendix A.

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Figure 4.3.1

Transient frequency test setup

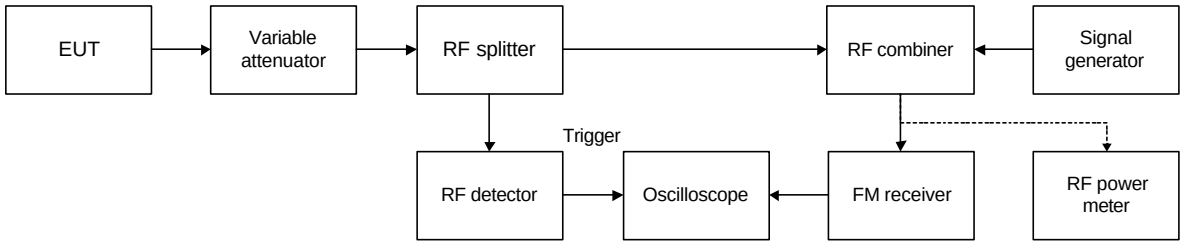

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Table 4.3.2

Transient frequency behavior test results

TEST SPECIFICATION:	47 CFR part 90, section 90.214
DATE:	December 11, 2003
RELATIVE HUMIDITY:	47%
AMBIENT TEMPERATURE:	23°C
AIR PRESSURE:	1021 hPa
OPERATING FREQUENCY RANGE:	450-470 MHz
MODULATION:	Unmodulated

Conducted test – for Irriwise model only

Carrier frequency, MHz	Frequency tolerance, kHz	Time interval	Duration, ms	Refer to plot in Appendix A
450	±12.5*	t_1	0.2	A10
	±6.25	t_2	NA	A10
	±12.5*	t_3	<0.2	A11
460	±12.5*	t_1	0.2	A12
	±6.25	t_2	NA	A12
	±12.5*	t_3	<0.2	A13
470	±12.5*	t_1	0.12	A14
	±6.25	t_2	NA	A14
	±12.5*	t_3	<0.2	A15

*Note: the frequency difference during this time period may exceed the maximum frequency difference for this time period because the transmitter carrier output power rating is less than 6 watts

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4.4 Emission mask test according to part 90 §90.217(b)

4.4.1 General

This test was performed to measure emission mask and spurious emissions at RF antenna connector. For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.
The test results are provided in Table 4.4.1, Table 4.4.2 and plots A16-A51.

4.4.2 Test procedure

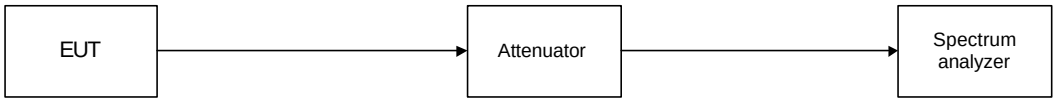
4.4.2.1 The EUT was set up as shown in Figure 4.4.1, energized and its proper operation was checked.

4.4.2.2 The alternate (“0” and “1”) modulation was applied to provide the worst case of RF spectrum mask. The spectrum analyzer’s resolution bandwidth was set to a value greater than 5% of the bandwidth requirements. The spectrum analyzer was put in "Maximum hold" mode and the measurements were made under normal test conditions. The frequencies of the lower (f_1) and upper (f_2) points, where the displayed power envelope of modulation equals the spurious emission level (see paragraph 4.1) are provided in Table 4.4.1. and plots A16-A21. The frequencies f_{LOW} and f_{HIGH} were calculated upon the formulas: f_{LOW}= f_1-maximum negative frequency deviation; f_{HIGH}= f_2+maximum positive frequency deviation and found within 25 kHz removed from the assigned frequency.

4.4.2.3 The “all 0” modulation was applied to provide the worst case of spurious emission. The test was performed with spectrum analyzer as provided in Table 4.4.2 and plots A22-A51.

Figure 4.4.1

Emission mask and spurious emission test setup



Reference numbers of test equipment used

HL 1424	HL 1651	HL 2399				

Full description is given in Appendix A

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Table 4.4.1

Emission mask test results

DATE of TEST:	December 25, 2003
AMBIENT TEMPERATURE:	23°C
RELATIVE HUMIDITY:	38%
AIR PRESSURE:	1015 hPa
FREQUENCY RANGE:	9 kHz – 5 GHz
MEASUREMENT UNCERTAINTY:	±4.5 dB
REFERENCE STANDARD:	47CFR Part 90, §90.217
OPERATING FREQUENCY RANGE:	450-470 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	1 kHz
VIDEO BANDWIDTH:	3 kHz
MODULATION:	FSK
MODULATING SIGNAL:	Alternate (“0” and “1”)
MAXIMUM POSITIVE FREQUENCY DEVIATION (SEE PARAGRAPH 4.7)	0.36 kHz
MAXIMUM NEGATIVE FREQUENCY DEVIATION (SEE PARAGRAPH 4.7)	2.8 kHz

Carrier frequency, MHz	f_1, kHz	f_2, kHz	f_{LOW}, kHz	f_{HIGH}, kHz	Assigned frequency ±25 kHz	Verdict	Refer to plots in Appendix A
450	449993.40	450008.83	449990.60	450009.19	449975-450025 kHz	Pass	A16, A17
460	459993.57	460009.03	459990.77	460009.39	459975-460025 kHz	Pass	A18, A19
470	469993.60	470009.13	469990.80	470009.49	469975-470025 kHz	Pass	A20, A21

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Table 4.4.2

Spurious emission test results

REFERENCE STANDARD: 47CFR Part 90, §90.217
OPERATING FREQUENCY RANGE: 450-470 MHz
DETECTOR USED: Peak
MODULATION: FSK
MODULATING SIGNAL: All “0”

Carrier frequency, MHz	Spurious frequency, MHz	Spurious emission, dBm	Spurious attenuation, dBc	Spurious emission limit, dBm	Spurious attenuation limit, dBc	Margin, dB	Verdict
450	449.9439	-34.0	48.7	-15.3	30	18.7	Pass
	449.9556	-17.0	31.7	-15.3	30	1.7	Pass
	449.9580	-15.7	30.4	-15.3	30	0.4	Pass
	449.9604	-16.8	31.5	-15.3	30	1.5	Pass
	450.0418	-17.2	31.9	-15.3	30	1.9	Pass
	450.0442	-15.5	30.2	-15.3	30	0.2	Pass
	450.0466	-17.0	31.7	-15.3	30	1.7	Pass
	450.0573	-33.5	48.2	-15.3	30	18.2	Pass
	900	-42.2	56.9	-15.3	30	26.9	Pass
460	459.9405	-35.3	49.6	-15.7	30	19.6	Pass
	459.9548	-19.5	33.8	-15.7	30	3.8	Pass
	459.9572	-17.8	32.1	-15.7	30	2.1	Pass
	459.9596	-19.5	33.8	-15.7	30	3.8	Pass
	460.0430	-19.7	34.0	-15.7	30	4.0	Pass
	460.0454	-18.0	32.3	-15.7	30	2.3	Pass
	460.0478	-19.7	34.0	-15.7	30	4.0	Pass
	460.0556	-34.5	48.8	-15.7	30	18.8	Pass
	920	-42.5	56.8	-15.7	30	26.8	Pass
470	469.9432	-35.2	49.4	-15.8	30	19.4	Pass
	469.9518	-18.7	32.9	-15.8	30	2.9	Pass
	469.9542	-16.8	31.0	-15.8	30	1.0	Pass
	469.9566	-18.7	32.9	-15.8	30	2.9	Pass
	470.0460	-19.0	33.2	-15.8	30	3.2	Pass
	470.0484	-17.3	31.5	-15.8	30	1.5	Pass
	470.0508	-19.0	33.2	-15.8	30	3.2	Pass
	470.0560	-34.3	48.5	-15.8	30	18.5	Pass
	940	-42.3	56.5	-15.8	30	26.5	Pass

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4.5 Radiated spurious emission measurements

4.5.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 4.5.1.

Table 4.5.1

Radiated spurious emission test limits

REFERENCE STANDARD: 47CFR, part 90, §90.217(b)

Frequency, MHz	Model	Carrier frequency, MHz	Attenuation below the unmodulated carrier, dBc	ERP of spurious (see paragraph 4.1), dBm	Equivalent field strength limit @ 3m, dB(mV/m)
0.009 – 10th harmonic	Galaxy Remote	450	30	-17.1	80.3
		460	30	-16.6	80.8
		470	30	-17.5	79.9
	SpeedRead	450	30	-16.6	80.8
		460	30	-16.4	81.0
		470	30	-17	80.4
	Irriwise	450	30	-15.3	82.1
		460	30	-15.7	81.7
		470	30	-15.8	81.6

NOTE 1: Radiated spurious emission limits do not apply to emissions within ± 50 kHz from the edge of the authorized bandwidth.
NOTE 2: Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: E= sqrt(30×ERP×1.64)/r, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters (3 m).

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

4.5.2.1 The EUT was set up as shown in Figure 4.5.1, energized and the performance check was conducted.

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

4.5.2.3 The worst test results (the lowest margins) were recorded in Table 4.5.2 and shown in the associated plots.

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

4.5.3.1 The EUT was set up as shown in Figure 4.5.2, energized and the performance check was conducted.

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

4.5.3.3 The worst test results (the lowest margins) were recorded in Table 4.5.2 and shown in the associated plots.

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Figure 4.5.1

Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

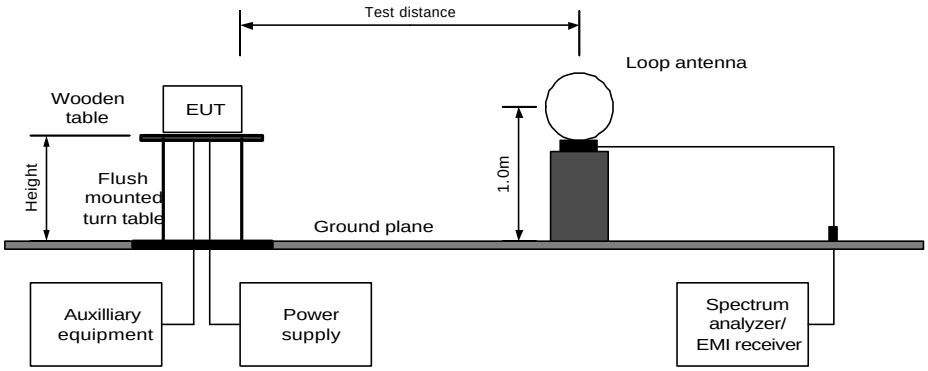
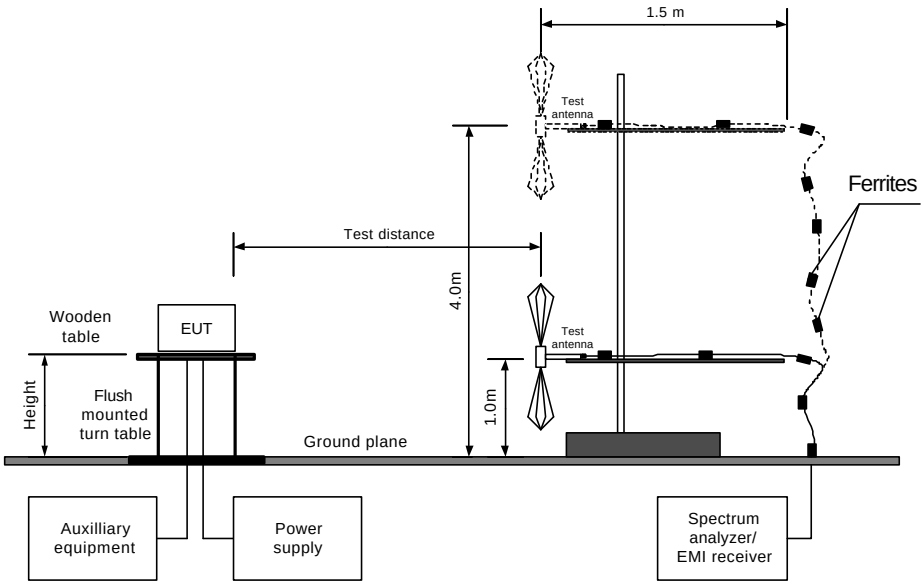


Figure 4.5.2

Setup for spurious emission field strength measurements above 30 MHz



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4.5.4 Test procedure for substitution ERP measurements of spurious

4.5.4.1 The test equipment was set up as shown in Figure 4.5.3 and energized.

4.5.4.2 RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as was measured from EUT.

4.5.4.3 The test antenna height was swept to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as was measured from EUT.

4.5.4.4 The above procedure was repeated at the rest of investigated frequencies.

4.5.4.5 The worst test results (the lowest margins) were recorded in Table 4.5.3 and shown in the associated plots.

Figure 4.5.3

Setup for substitution ERP measurements of spurious

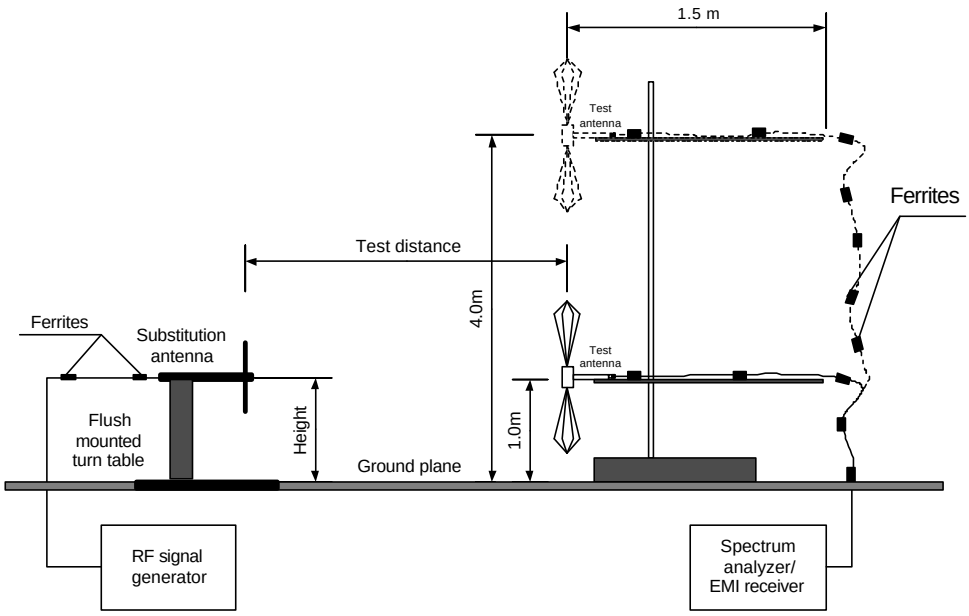

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Table 4.5.2
Spurious emission field strength test results

REFERENCE STANDARD: 47CFR, part 90, §90.217(b)
TEST METHOD: ANSI / TIA / EIA-603-A-2001
TEST SITE: OATS / ANECHOIC CHAMBER
TEST DISTANCE: 3 m
INVESTIGATED FREQUENCY RANGE: 0.009 MHz-4800 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
9.0 kHz (150 kHz – 30 MHz)
120 kHz (30 MHz – 1000 MHz)
1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH: RESOLUTION BANDWIDTH
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconical (30 MHz – 200 MHz)
Log periodic (200 MHz – 1000 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
MODULATION: Unmodulated

model Galaxy Remote

Frequency, MHz	Field strength of spurious, dB(mV/m)	Limit, dB(mV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turntable position**, degrees	Verdict
Low carrier frequency 450 MHz							
900	62.3	80.3	18.0	Vertical	1	97	Pass
1350	58.4	80.3	21.9	Vertical	1	34	Pass
1800	59.7	80.3	20.6	Vertical	1	167	Pass
2250	57.2	80.3	23.1	Vertical	1.24	358	Pass
2700	54.2	80.3	26.1	Vertical	1	21	Pass
3150	62.7	80.3	17.6	Horizontal	1.06	105	Pass
3600	62.5	80.3	17.8	Horizontal	1.19	201	Pass
4050	54.0	80.3	26.3	Horizontal	1.21	150	Pass
4500	57.2	80.3	23.1	Horizontal	1	303	Pass
Mid carrier frequency 460 MHz							
920	61.3	80.8	19.5	Vertical	1	121	Pass
1380	58.0	80.8	22.8	Vertical	1	188	Pass
1840	59.6	80.8	21.2	Vertical	1	198	Pass
2300	58.8	80.8	22	Vertical	1.99	222	Pass
2760	58.7	80.8	22.1	Horizontal	1.15	90	Pass
3220	65.7	80.8	15.1	Horizontal	2.02	183	Pass
3680	63.8	80.8	17.0	Horizontal	1	66	Pass
4140	50.5	80.8	30.3	Horizontal	1.16	243	Pass
4600	55.2	80.8	25.6	Horizontal	1.25	151	Pass
High carrier frequency 470 MHz							
940	61.4	79.9	18.5	Vertical	1	344	Pass
1410	53.8	79.9	26.1	Vertical	1	99	Pass
1880	57.1	79.9	22.8	Vertical	1	138	Pass
2350	48.7	79.9	31.2	Vertical	1.53	217	Pass
2820	54.2	79.9	25.7	Vertical	1.32	169	Pass
3290	56.0	79.9	23.9	Horizontal	1.03	50	Pass
3760	58.7	79.9	21.2	Horizontal	1.2	84	Pass
4700	51.3	79.9	28.6	Horizontal	1.13	127	Pass

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

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model SpeedRead

Frequency, MHz	Field strength of spurious, dB(mV/m)	Limit, dB(mV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
Low carrier frequency 450 MHz							
900	61.5	80.8	19.3	Vertical	1	97	Pass
1350	61.8	80.8	19.0	Vertical	1	345	Pass
1800	58.3	80.8	22.5	Vertical	1	175	Pass
2250	60.8	80.8	20.0	Horizontal	1.1	199	Pass
2700	54.5	80.8	26.3	Horizontal	1	311	Pass
3150	60.7	80.8	20.1	Vertical	2.96	47	Pass
3600	61.7	80.8	19.1	Horizontal	1	48	Pass
4050	58.2	80.8	22.6	Horizontal	1	58	Pass
4500	55.5	80.8	25.3	Vertical	1	166	Pass
Mid carrier frequency 460 MHz							
920	63.3	81	17.7	Vertical	1	121	Pass
1380	54.3	81	26.7	Vertical	1	257	Pass
1840	56.7	81	24.3	Vertical	1	99	Pass
2300	49.2	81	31.8	Vertical	1.2	78	Pass
2760	53.7	81	27.3	Vertical	1.02	202	Pass
3220	51.3	81	29.7	Vertical	1.77	180	Pass
3680	55.7	81	25.3	Horizontal	1.09	91	Pass
4600	56.7	81	24.3	Horizontal	1.13	184	Pass
High carrier frequency 470 MHz							
940	61.2	80.4	19.2	Vertical	1	121	Pass
1410	52.0	80.4	28.4	Vertical	1	207	Pass
1880	56.8	80.4	23.6	Vertical	1	92	Pass
2350	44.8	80.4	35.6	Vertical	1.52	344	Pass
2820	49.5	80.4	30.9	Vertical	1.17	160	Pass
3290	49.7	80.4	30.7	Vertical	1	170	Pass
3760	53.7	80.4	26.7	Horizontal	1.58	95	Pass
4230	48.8	80.4	31.6	Vertical	1.06	35	Pass
4700	51.8	80.4	28.6	Vertical	1.19	288	Pass

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

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model Irriwise (antenna connector terminated with 50 Ohm dummy load)

Frequency, MHz	Field strength of spurious, dB(mV/m)	Limit, dB(mV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
Low carrier frequency 450 MHz							
900	61.0	82.1	21.1	Vertical	1	345	Pass
1350	56.6	82.1	25.5	Vertical	1	108	Pass
1800	52.4	82.1	29.7	Vertical	1	119	Pass
2250	56.3	82.1	25.8	Vertical	1	211	Pass
2700	49.0	82.1	33.1	Horizontal	1.13	56	Pass
3150	43.3	82.1	38.8	Vertical	1.32	202	Pass
3600	54.2	82.1	27.9	Vertical	1.05	159	Pass
4050	49.3	82.1	32.8	Vertical	1	296	Pass
4500	56.2	82.1	25.9	Vertical	1.2	311	Pass
Mid carrier frequency 460 MHz							
920	61.8	81.7	19.9	Vertical	1	327	Pass
1380	55.0	81.7	26.7	Vertical	1.16	48	Pass
1840	56.8	81.7	24.9	Vertical	1.42	134	Pass
2300	49.5	81.7	32.2	Vertical	1	73	Pass
2760	48.0	81.7	33.7	Horizontal	1.11	156	Pass
3220	42.8	81.7	38.9	Vertical	1.07	214	Pass
3680	46.8	81.7	34.9	Vertical	1	95	Pass
4140	44.3	81.7	37.4	Vertical	1.42	197	Pass
High carrier frequency 470 MHz							
940	61.5	81.6	20.1	Vertical	1	204	Pass
1410	53.3	81.6	28.3	Vertical	1.11	322	Pass
1880	57.1	81.6	24.5	Vertical	1.08	29	Pass
2350	45.0	81.6	36.6	Vertical	1.14	34	Pass
2820	46.8	81.6	34.8	Horizontal	1	65	Pass
3290	49.7	81.6	31.9	Horizontal	1.82	33	Pass
3760	58.5	81.6	23.1	Horizontal	1.39	91	Pass
4230	48.3	81.6	33.3	Vertical	1.08	164	Pass
4700	59.2	81.6	22.4	Vertical	1	195	Pass

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

Reference numbers of test equipment used

HL 0446	HL 0465	HL 0566	HL 0589	HL 0592	HL 0593	HL 0594
HL 0604	HL 1004	HL 1425	HL 1553	HL 1566	HL 1826	HL 1849
HL 1850	HL 1947	HL 2009	HL 2109	HL 2432		

Full description is given in Appendix A.

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Table 4.5.3

Substitution ERP of spurious test results

TEST METHOD:	ANSI / TIA / EIA-603-A-2001
TEST SITE:	OATS / SEMI ANECHOIC CHAMBER
TEST DISTANCE:	3 m
INVESTIGATED FREQUENCY RANGE:	MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	0.2 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz) 1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH:	RESOLUTION BANDWIDTH
SUBSTITUTION ANTENNA TYPE:	Tunable dipole (30 MHz – 1000 MHz) Double ridged guide (above 1000 MHz)

model Galaxy Remote

Frequency, MHz	Field strength, dB(µV/m)	RF generator output, dBm	Antenna gain, dBd	Cable loss, dB	Spurious emission, dBm	Att below carrier, dBc	Limit, dBc	Margin, dB	Verdict
Low carrier frequency 450 MHz									
900	62.3	-36.9	-0.5	2.4	-39.8	52.7	30	22.7	Pass
1800	59.7	-42.4	4.8	3.4	-41	53.9	30	23.9	Pass
3150	62.7	-43.2	6.2	4.5	-41.5	54.4	30	24.4	Pass
3600	62.5	-40.9	5.8	4.9	-40	52.9	30	22.9	Pass
Mid carrier frequency 460 MHz									
920	61.3	-38.2	-0.4	2.4	-41	54.4	30	24.4	Pass
1840	59.6	-41.7	4.7	3.4	-40.4	53.8	30	23.8	Pass
3220	65.7	-35.2	6.5	4.4	-33.1	46.5	30	16.5	Pass
3680	63.8	-37.2	5.5	4.9	-36.6	50	30	20	Pass
High carrier frequency 470 MHz									
940	61.4	-38.4	-0.3	2.4	-41.1	53.6	30	23.6	Pass
3760	58.7	-40.6	5.1	5.0	-40.5	53	30	23	Pass

model SpeedRead

Frequency, MHz	Field strength, dB(µV/m)	RF generator output, dBm	Antenna gain, dBd	Cable loss, dB	Spurious emission, dBm	Att below carrier, dBc	Limit, dBc	Margin, dB	Verdict
Low carrier frequency 450 MHz									
900	61.5	-37.8	-0.5	2.4	-40.7	54.1	30	24.1	Pass
1350	61.8	-40.6	4.8	2.9	-38.7	52.1	30	22.1	Pass
2250	60.8	-41.0	4.7	3.7	-40	53.4	30	23.4	Pass
3150	60.7	-45.5	6.2	4.5	-43.8	57.2	30	27.2	Pass
3600	61.7	-41.3	5.8	4.9	-40.4	53.8	30	23.8	Pass
Mid carrier frequency 460 MHz									
920	63.3	-35.5	-0.4	2.4	-38.3	51.9	30	21.9	Pass
High carrier frequency 470 MHz									
940	61.2	-38.8	-0.3	2.4	-41.5	54.5	30	24.5	Pass

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model Irriwise (antenna connector terminated with 50 Ohm dummy load)

Frequency, MHz	Field strength, dB(mV/m)	RF generator output, dBm	Antenna gain, dBd	Cable loss, dB	Spurious emission, dBm	Att below carrier, dBc	Limit, dBc	Margin, dB	Verdict
Low carrier frequency 450 MHz									
900	61.0	-38.4	-0.5	2.4	-41.3	56	30	26	Pass
Mid carrier frequency 460 MHz									
920	61.8	-37.8	-0.4	2.4	-40.6	54.9	30	24.9	Pass
High carrier frequency 470 MHz									
940	61.5	-38.4	-0.3	2.4	-41.1	55.3	30	25.3	Pass

Reference numbers of test equipment used

HL 0614	HL 0661	HL 1565	HL 1947	HL 2400		

Full description is given in Appendix A.

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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
TEST PERFROMED AT:	Anechoic chamber
DATE of TEST:	December 2, 2003
AMBIENT TEMPERATURE:	22°C
RELATIVE HUMIDITY:	57 %
AIR PRESSURE:	1018 hPa
DISTANCE BETWEEN ANTENNA AND EUT:	3 m
THE EUT WAS TESTED AS:	Table-top
FREQUECNY RANGE:	30 MHz – 1 GHz
DETECTOR TYPE:	Peak
MEASUREMENT UNCERTAINTY:	± 6 dB max

For test procedure and setup refer to section 4.5.3.

For full test results refer to plots A115 – A117. No radiated emissions from EUT were found.

LIMIT (§ 15.109)

Frequency, MHz	**Class B equipment @ 3 m dB(μV/m)**
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 - 5000	54.0

TEST EQUIPMENT USED:

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

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4.7 Frequency stability test

4.7.1 General

This test was performed to measure frequency stability of transmitter RF carrier. The test results are provided in Table 4.7.1.

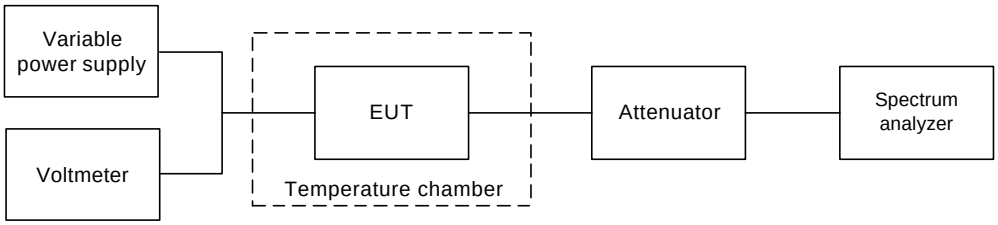
4.7.2 Test procedure

4.7.2.1 The EUT was setup as shown in Figure 4.7.1, energized and its proper operation was checked.

4.7.2.2 Frequency displacement was measured with spectrum analyzer as a difference between carrier frequency under normal and extreme power supply and ambient temperature conditions.

Figure 4.7.1

Frequency stability test setup



Reference numbers of test equipment used

HL 0025	HL 0810	HL 1097	HL 1424	HL 1451	HL 1457	HL 1651	HL 1870

Full description is given in Appendix A.

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Table 4.7.1

Frequency stability test results

DATE of TEST:	December 4 and 9, 2003
AMBIENT TEMPERATURE:	22°C
RELATIVE HUMIDITY:	37 %
AIR PRESSURE:	1019 hPa
REFERENCE STANDARD:	47CFR part 90, section 90.213
OPERATING FREQUENCY RANGE:	450-470 MHz
RESOLUTION BANDWIDTH:	300 Hz
VIDEO BANDWIDTH:	1 kHz
MODULATION:	Unmodulated
NOMINAL POWER SUPPLY VOLTAGE:	3.6 V

Conducted test – for model "Irriwise" only

Frequency stability with respect to ambient temperature

Temperature, °C	Lower channel frequency, MHz	Maximum frequency drift, Hz	Middle channel frequency, MHz	Maximum frequency drift, Hz	Higher channel frequency, MHz	Maximum frequency drift, Hz
-30	450005240	-1680	460004680	-2520	470004680	-2800
-20	450005840	-1080	460006160	-1040	470006200	-1280
-10	450006720	-200	460007080	-120	470007320	-160
0	450006920	0	460007200	0	470007480	0
10	450006920	0	460007240	40	470007520	40
20	450006920*	0	460007200*	0	470007480*	0
30	450006920	0	460007200	0	470007480	0
40	450006880	-40	460007200	0	470007480	0
50	450007280	360	460007480	280	470007800	320

* - Reference frequency

Frequency stability with respect to input voltage

Power supply voltage, V	Lower channel frequency, MHz	Maximum frequency drift, Hz	Middle channel frequency, MHz	Maximum frequency drift, Hz	Higher channel frequency, MHz	Maximum frequency drift, Hz
3.2	450001050	-33	460001192	-8	470001258	-75
3.6	450001083*	0	460001200*	0	470001333*	0
3.65	450001099	16	460001183	-17	470001250	-83

* - Reference frequency

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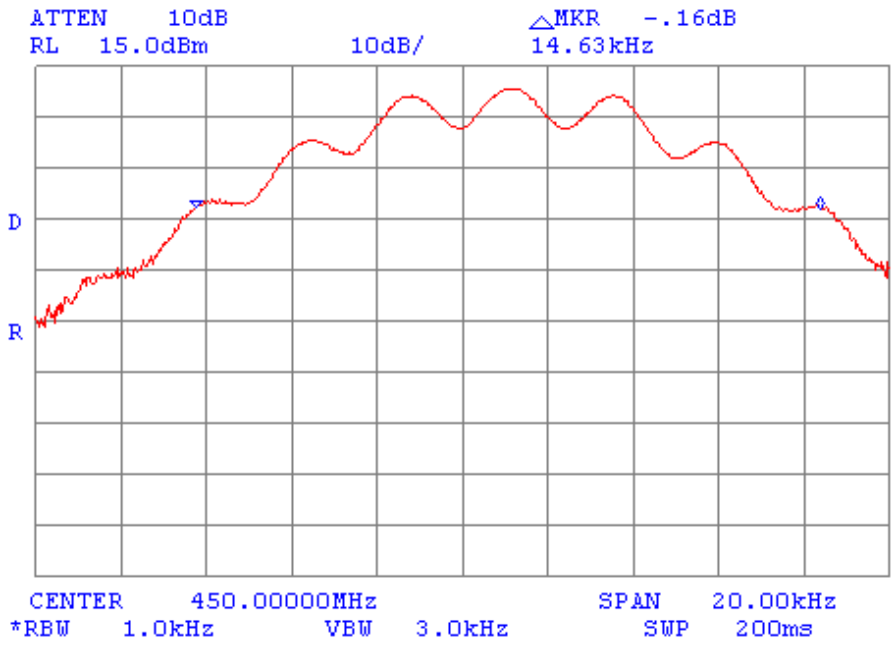
Appendix A Plots

Plot A 1

23 dB bandwidth measurement result @450 MHz carrier frequency, all "0" modulation



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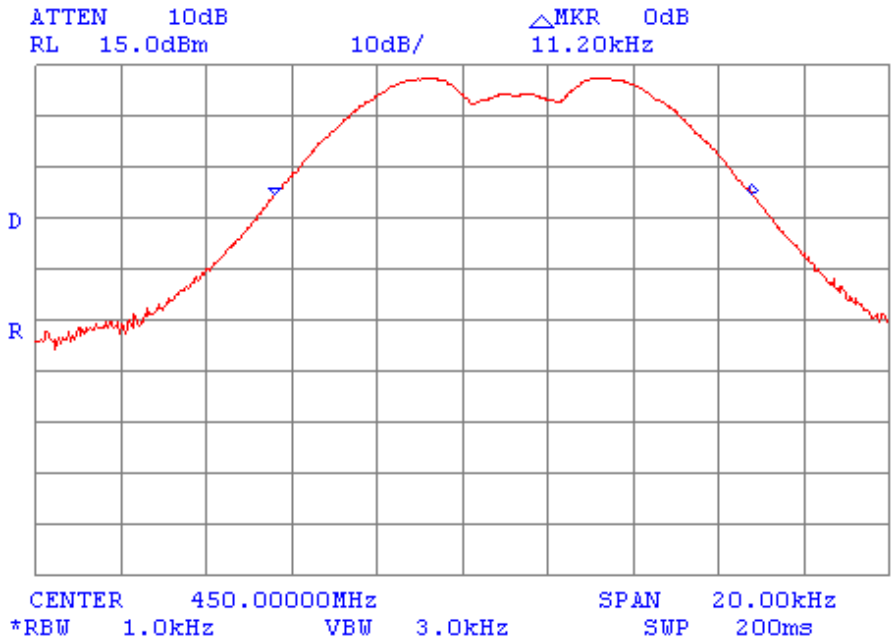
Plot A 2

23 dB bandwidth measurement result @450 MHz carrier frequency, all "1" modulation



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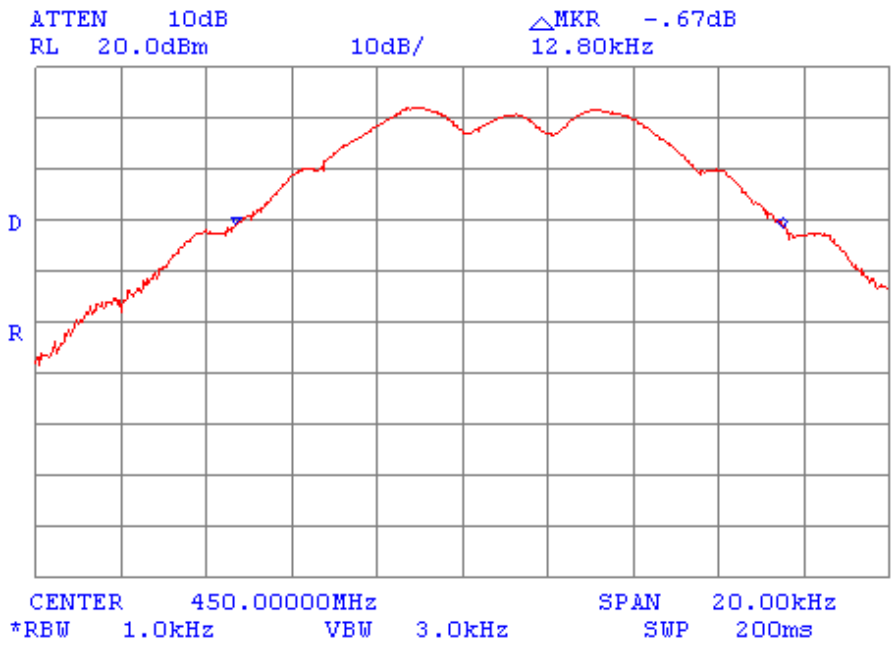
Plot A 3

23 dB bandwidth measurement result @450 MHz carrier frequency, alternate modulation



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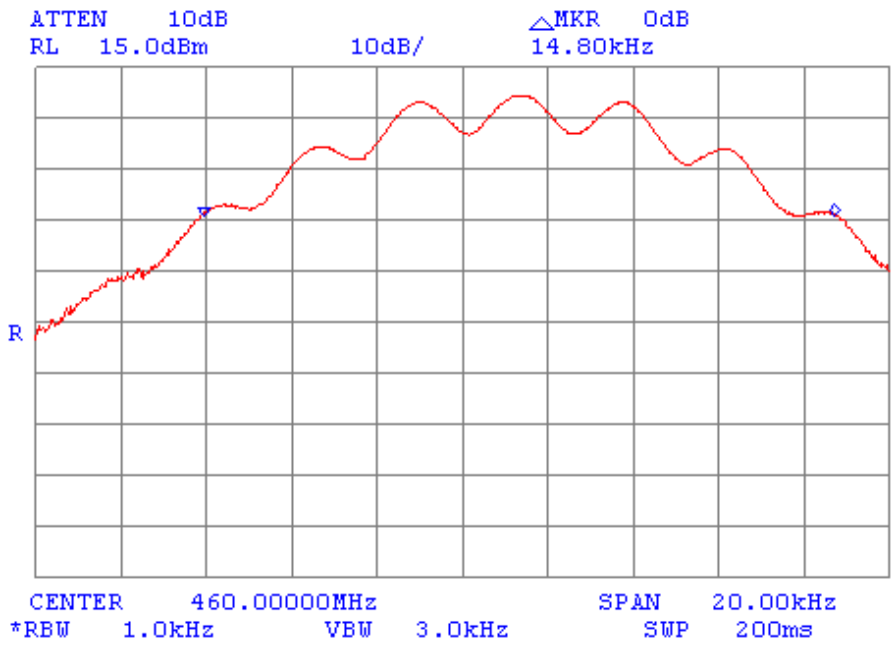
Plot A 4

23 dB bandwidth measurement result @460 MHz carrier frequency, all "0" modulation



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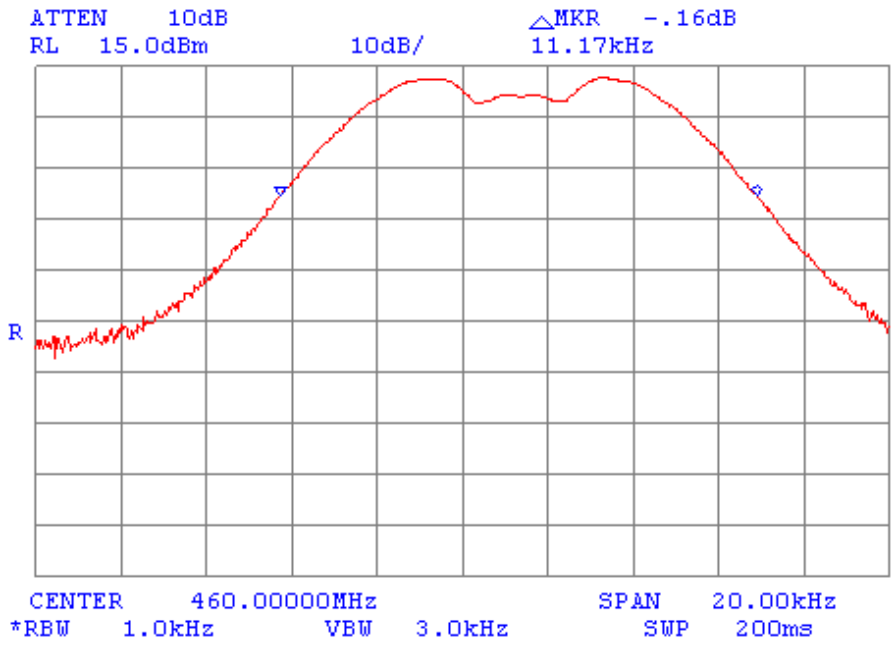
Plot A 5

23 dB bandwidth measurement result @460 MHz carrier frequency, all "1" modulation



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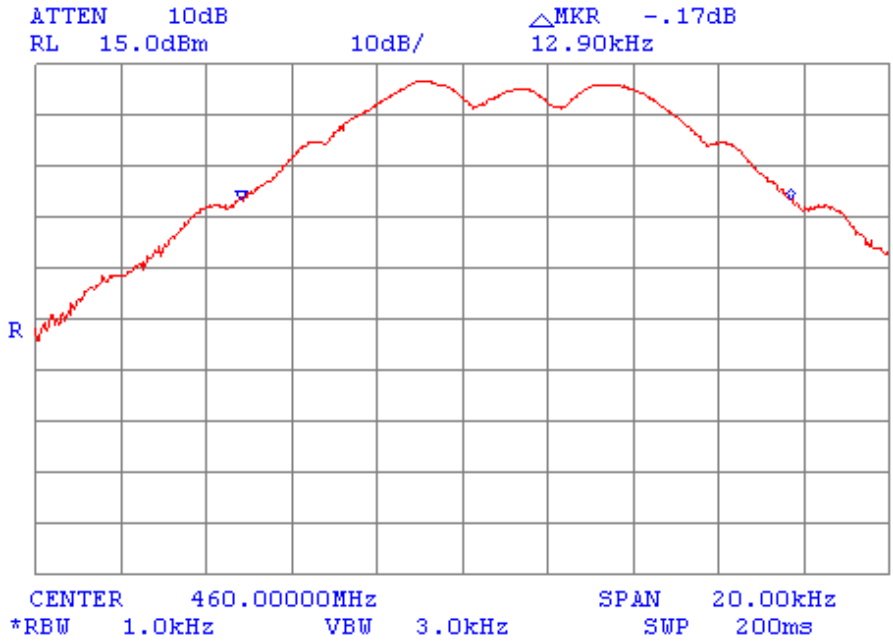
Plot A 6

23 dB bandwidth measurement result @460 MHz carrier frequency, alternate modulation



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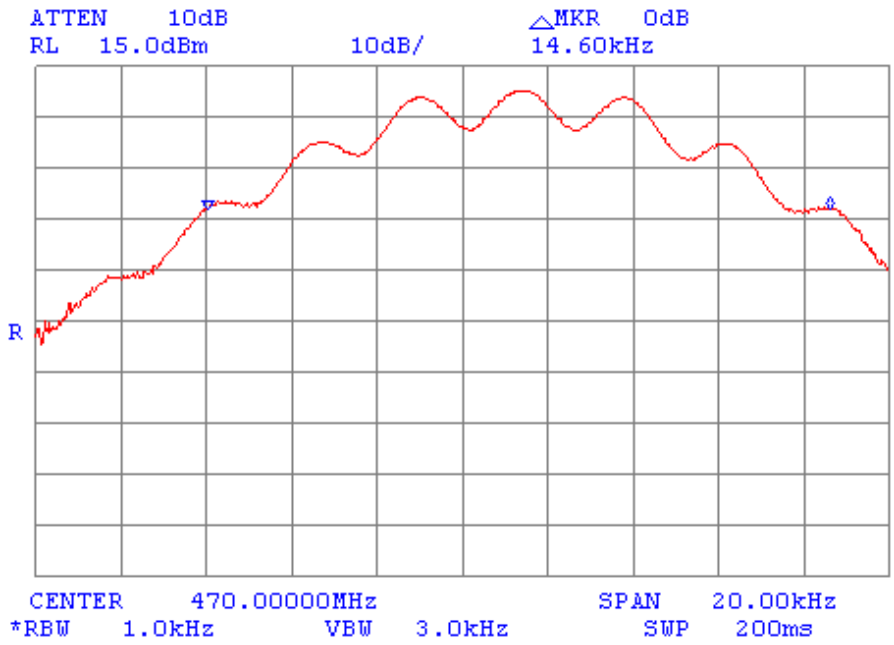
Plot A 7

23 dB bandwidth measurement result @470 MHz carrier frequency, all "0" modulation



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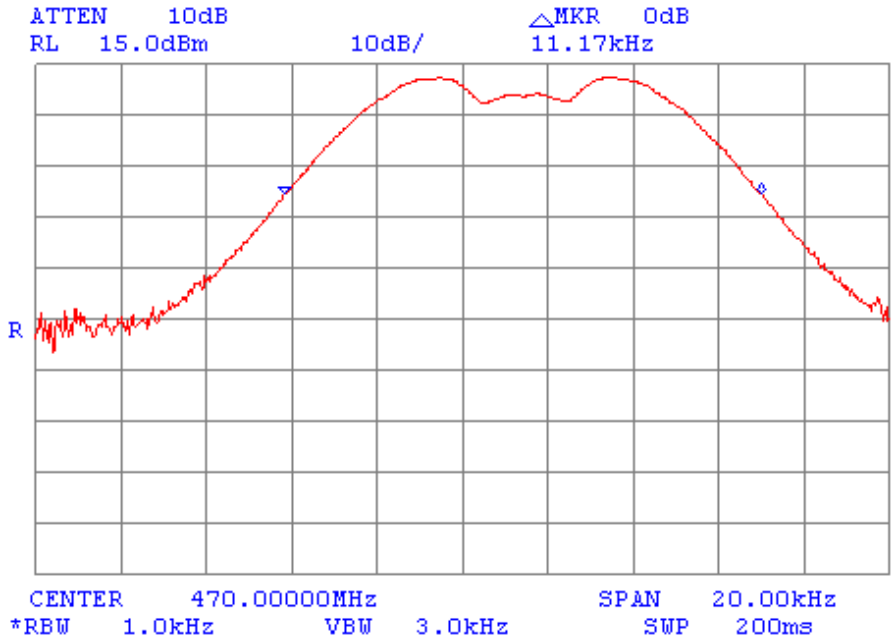
Plot A 8

23 dB bandwidth measurement result @470 MHz carrier frequency, all "1" modulation



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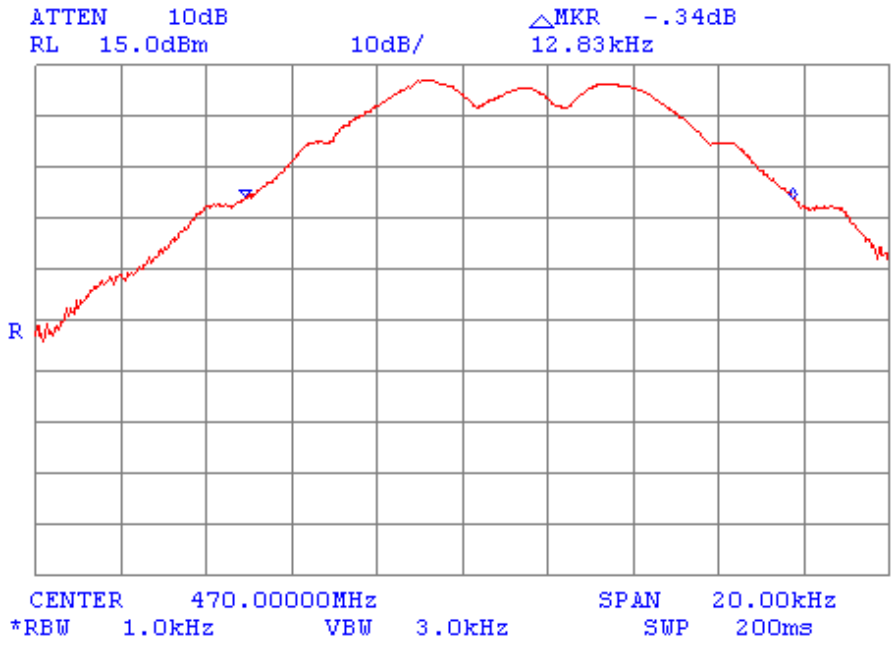
Plot A 9

23 dB bandwidth measurement result @470 MHz carrier frequency, alternate modulation



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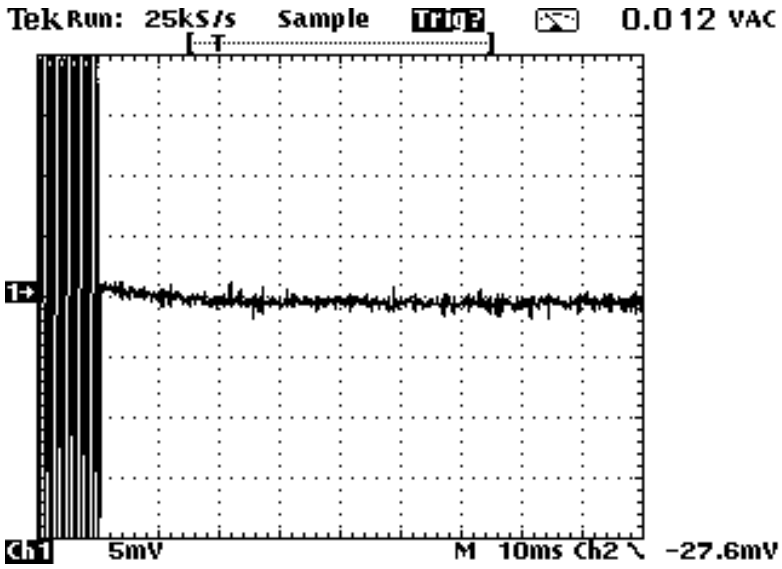
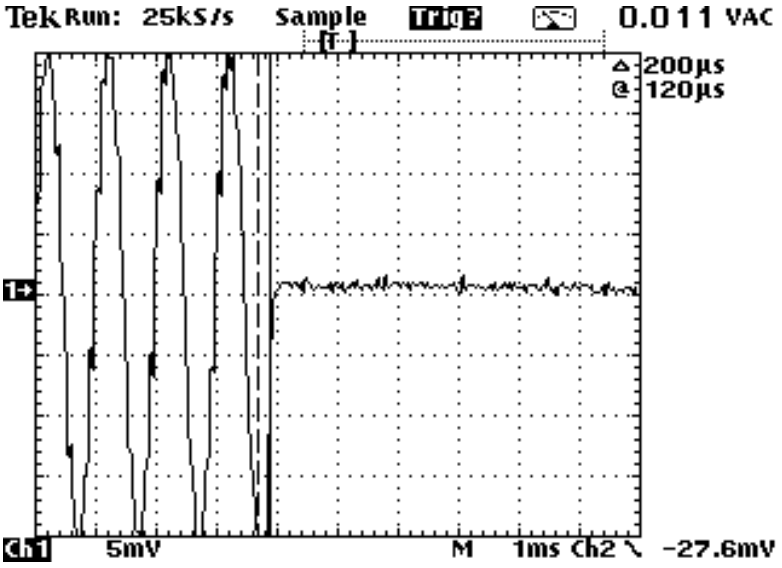
Plot A 10

Transient frequency behavior test results @ 450 MHz carrier frequency, t_1 and t_2 time intervals

a)



b)



Limits: t_1=10 ms (±12.5 kHz); t_2=25 ms (±6.25 kHz); t_3=10 ms (±12.5 kHz);
One division=25 kHz/4=6.25 kHz

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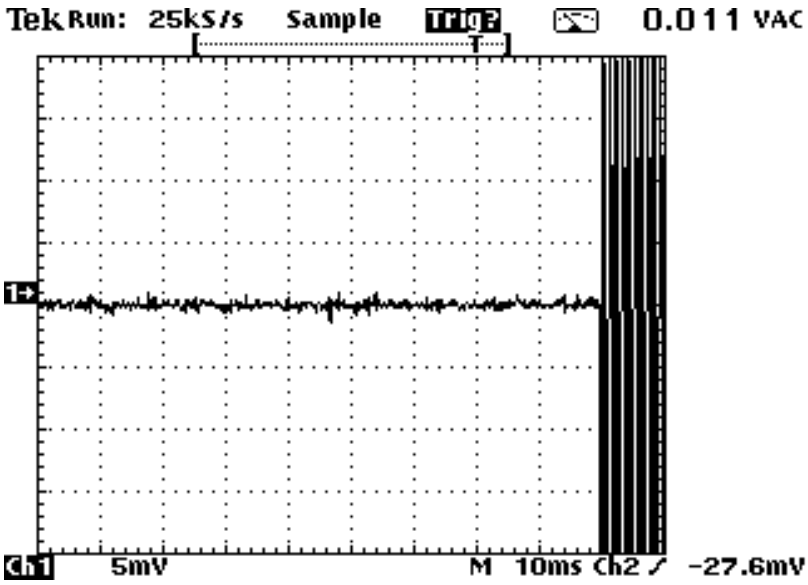
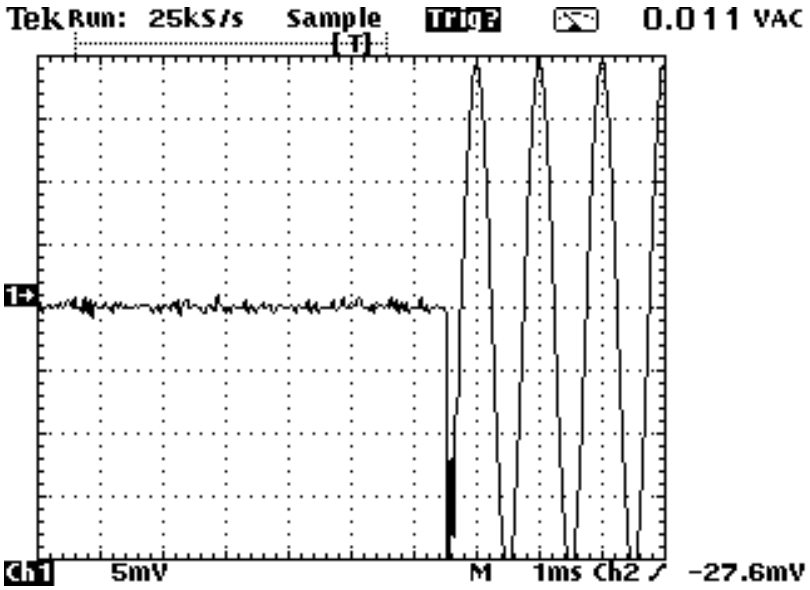
Plot A 11

Transient frequency behavior test results @ 450 MHz carrier frequency, t_3 time interval

a)



b)



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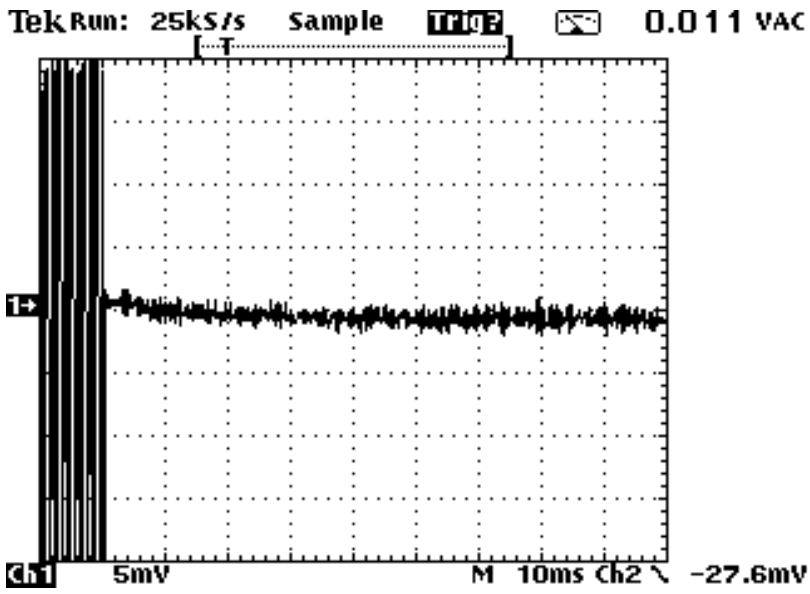
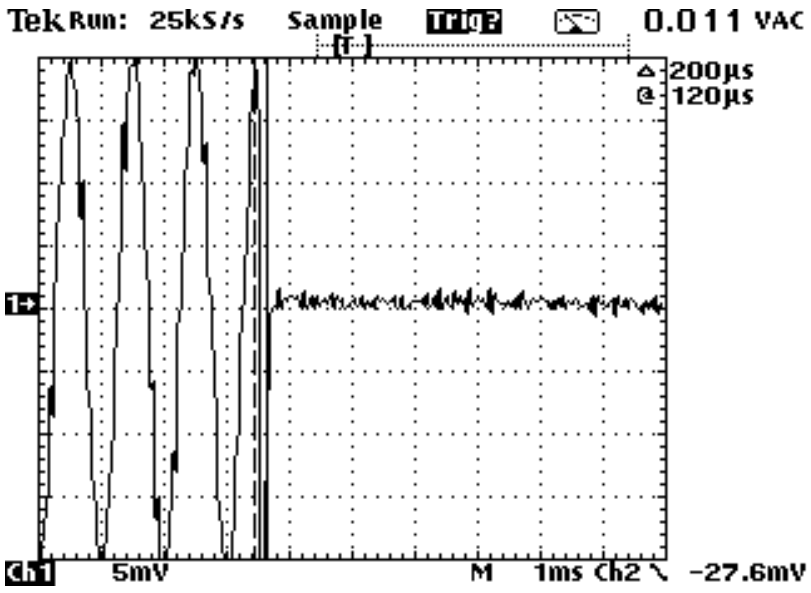
Plot A 12

Transient frequency behavior test results @ 460 MHz carrier frequency, t_1 and t_2 time intervals

a)



b)



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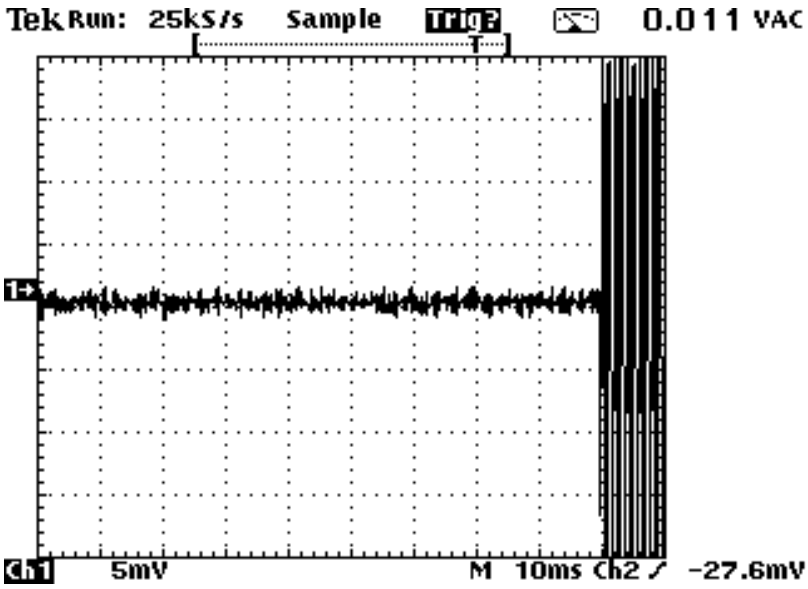
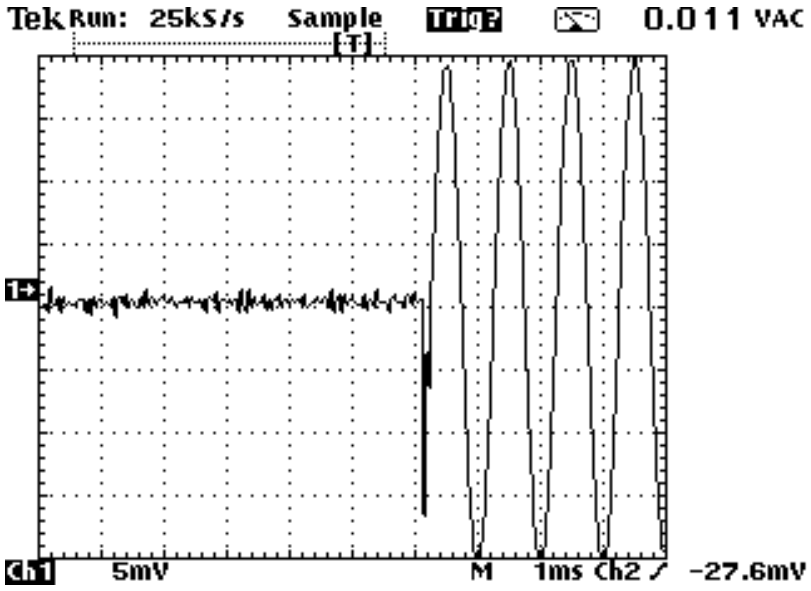
Plot A 13

Transient frequency behavior test results @ 460 MHz carrier frequency, t_3 time interval

a)



b)



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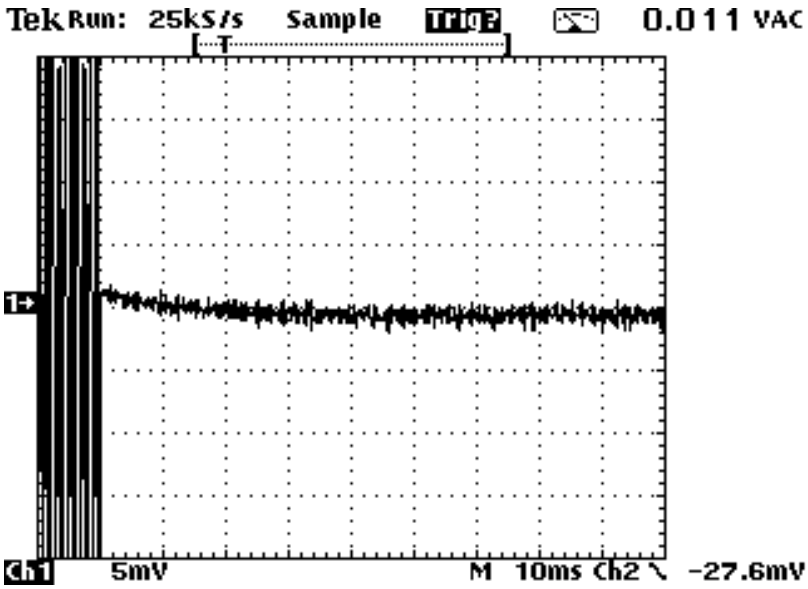
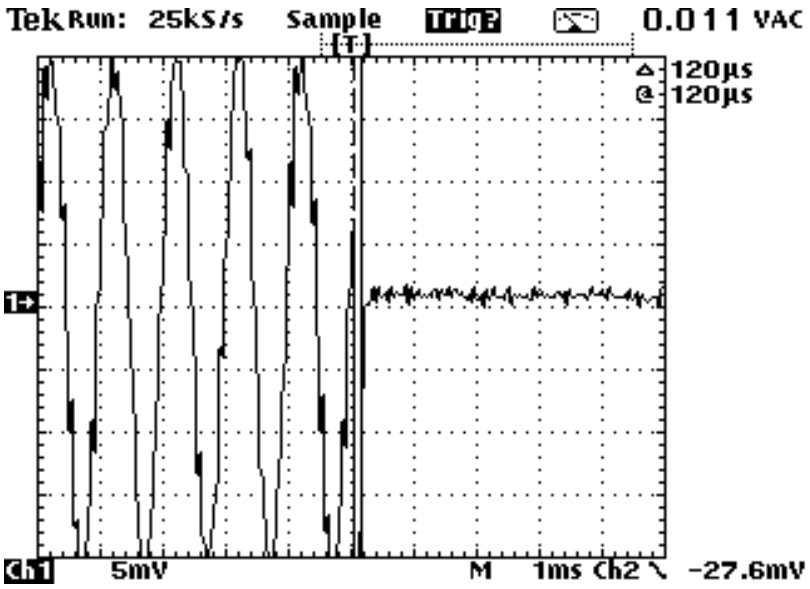
Plot A 14

Transient frequency behavior test results @ 470 MHz carrier frequency, t_1 and t_2 time intervals

a)



b)



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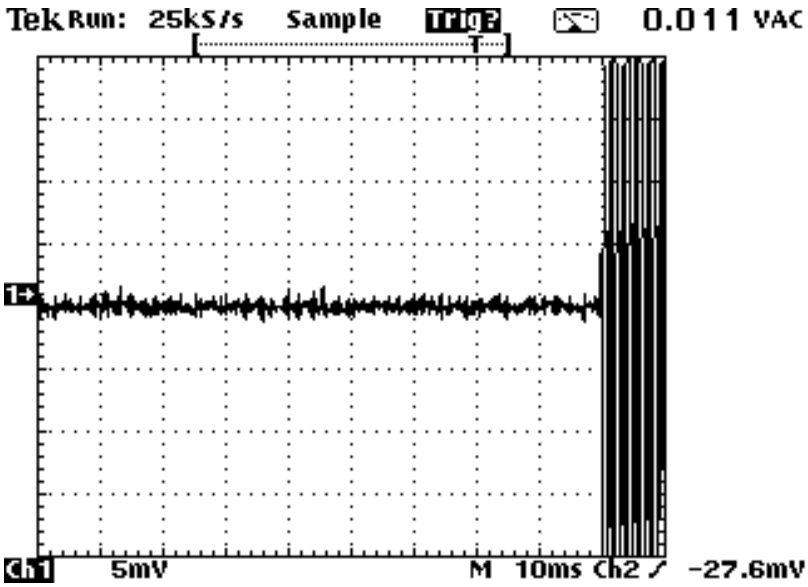
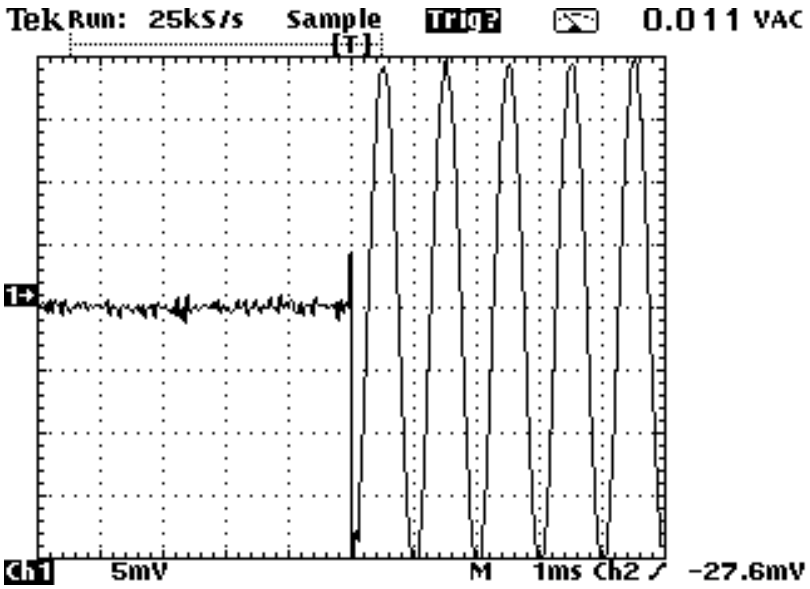
Plot A 15

Transient frequency behavior test results @ 470 MHz carrier frequency, t_3 time interval

a)



b)



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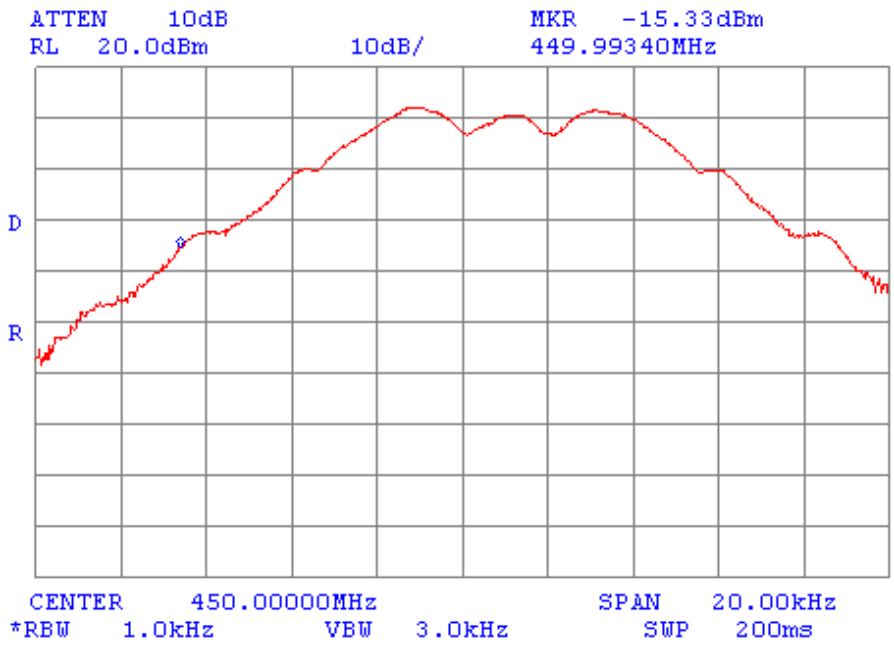
Plot A 16

Low frequency of assigned band measurement for 450 MHz carrier



30 dB below unmodulated carrier

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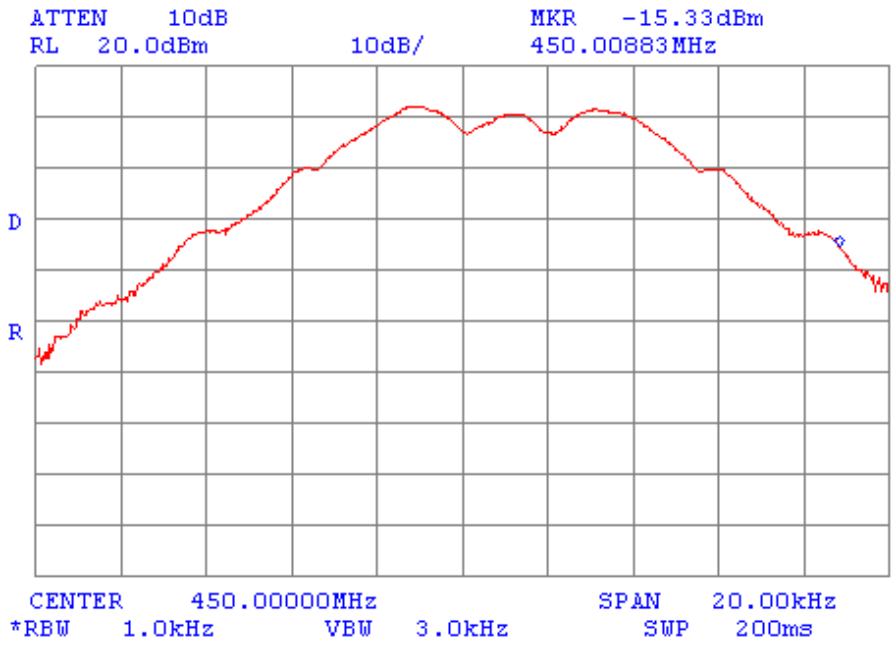
Plot A 17

High frequency of assigned band measurement for 450 MHz carrier



30 dB below unmodulated carrier

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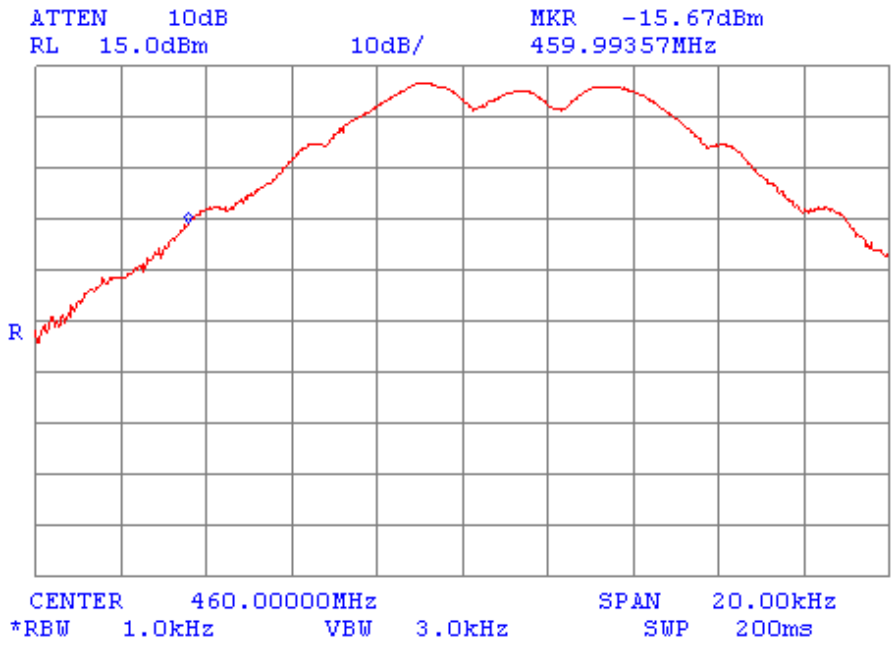
Plot A 18

Low frequency of assigned band measurement for 460 MHz carrier



30 dB below unmodulated carrier

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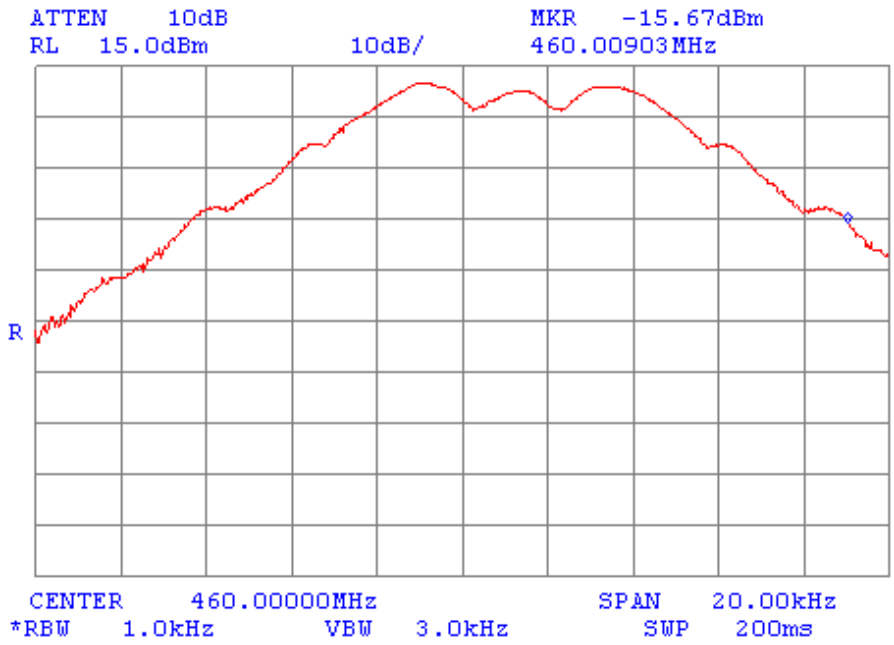
Plot A 19

High frequency of assigned band measurement for 460 MHz carrier



30 dB below unmodulated carrier

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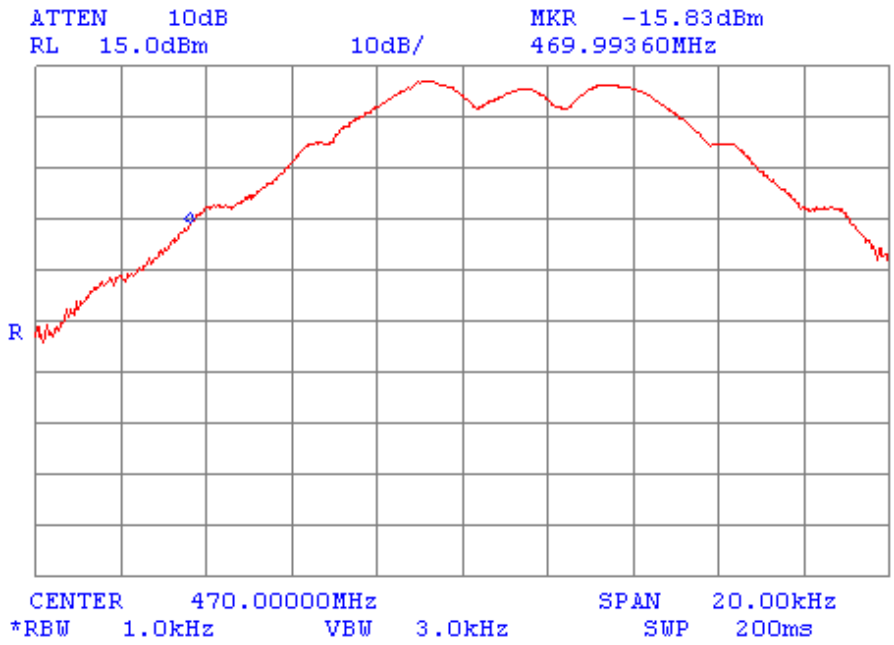
Plot A 20

Low frequency of assigned band measurement for 470 MHz carrier



30 dB below unmodulated carrier

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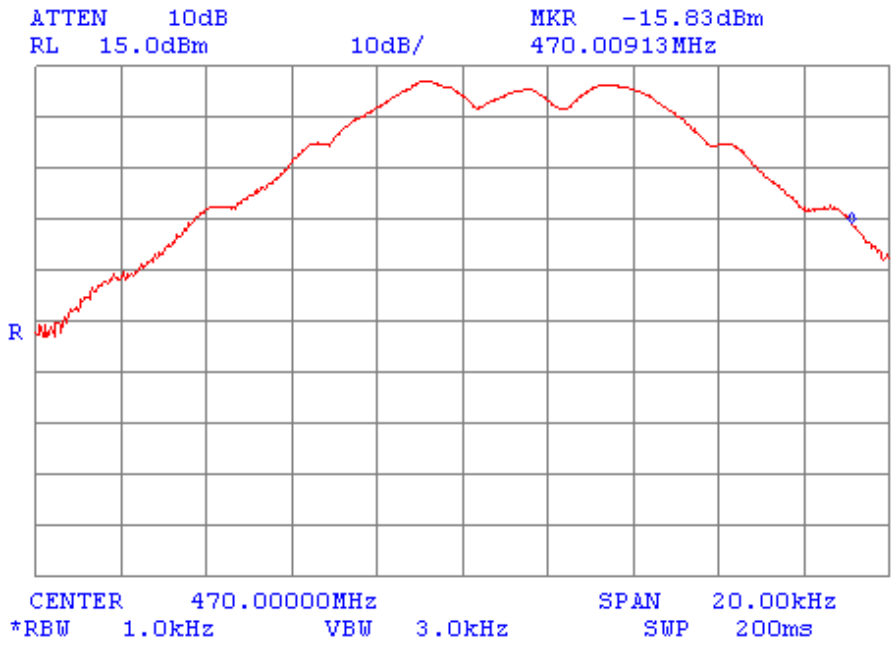
Plot A 21

High frequency of assigned band measurement for 470 MHz carrier



30 dB below unmodulated carrier

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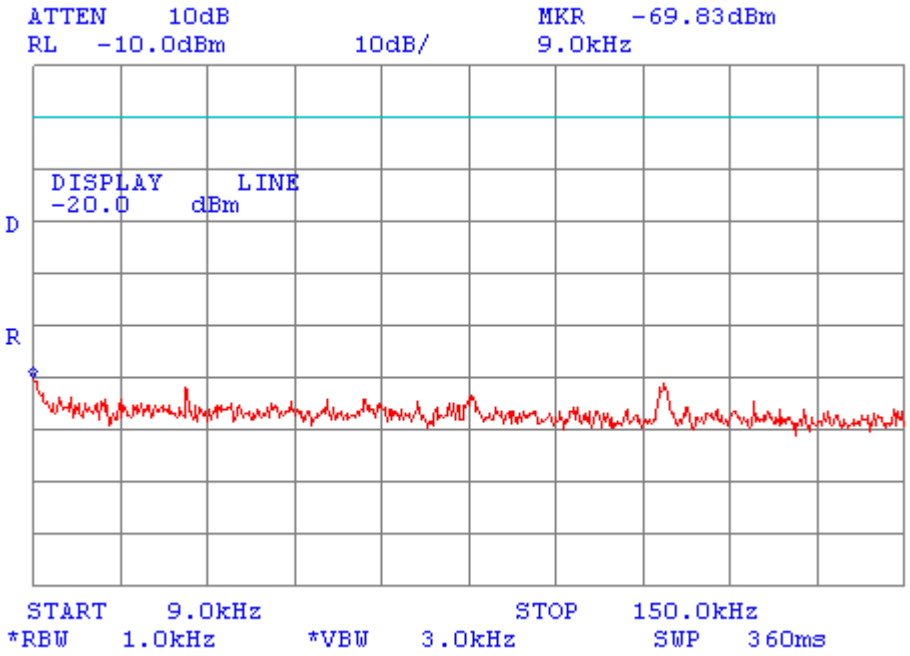
Plot A 22

Conducted spurious emission measurements from 9 kHz to 150 kHz
@ 450 MHz carrier, all "0" modulation



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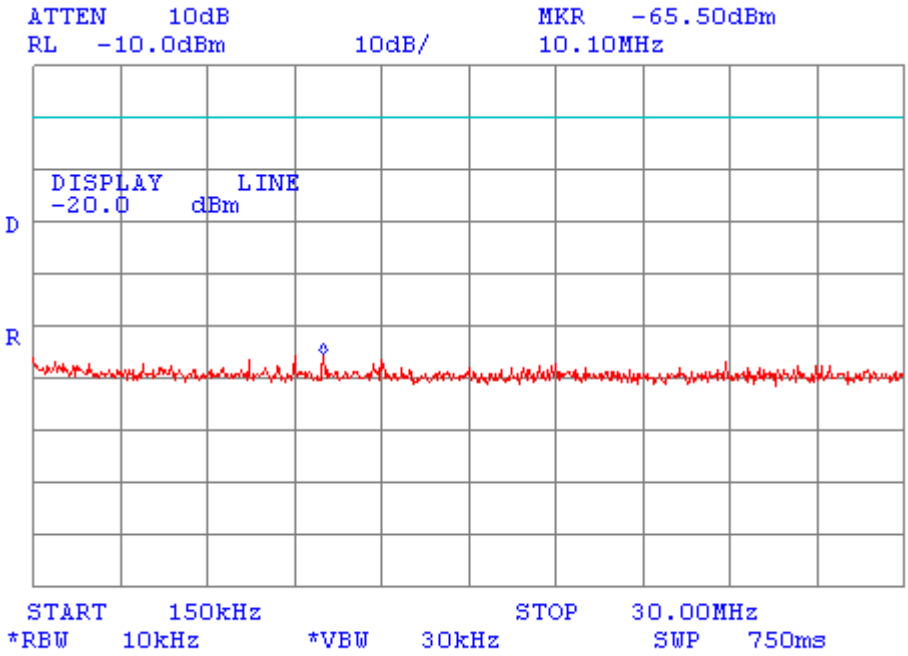
Plot A 23

Conducted spurious emission measurements from 150 kHz to 30 MHz
@ 450 MHz carrier, all "0" modulation



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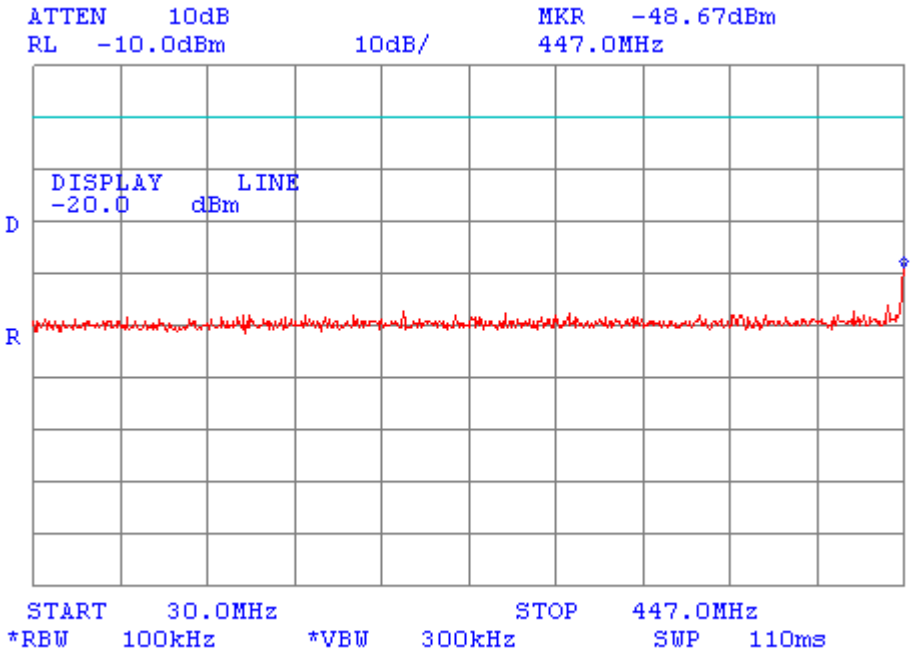
Plot A 24

Conducted spurious emission measurements from 30 MHz to 447 MHz
@ 450 MHz carrier, all "0" modulation



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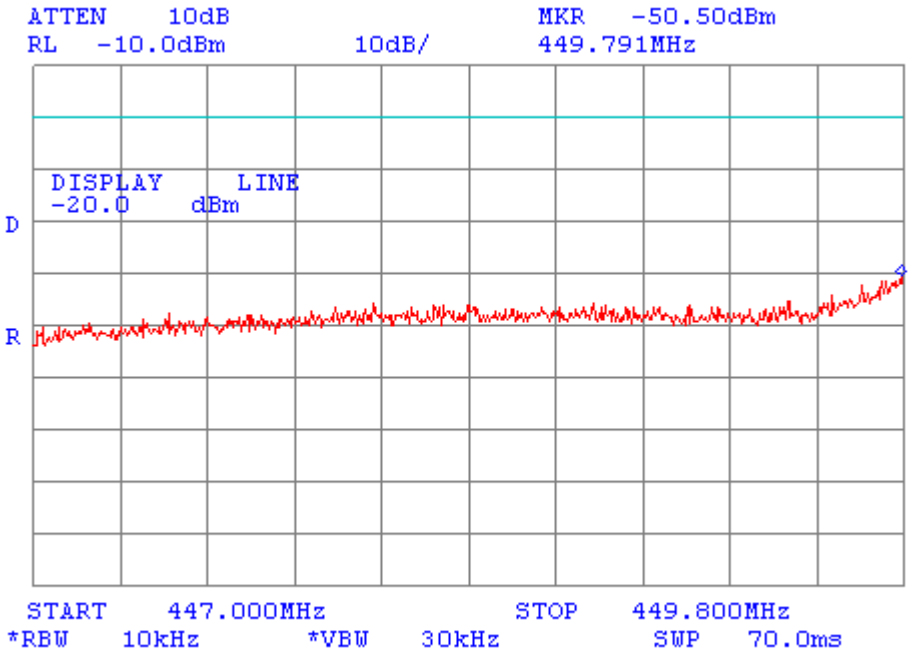
Plot A 25

Conducted spurious emission measurements from 447 MHz to 449.800 MHz @ 450 MHz carrier, all "0" modulation



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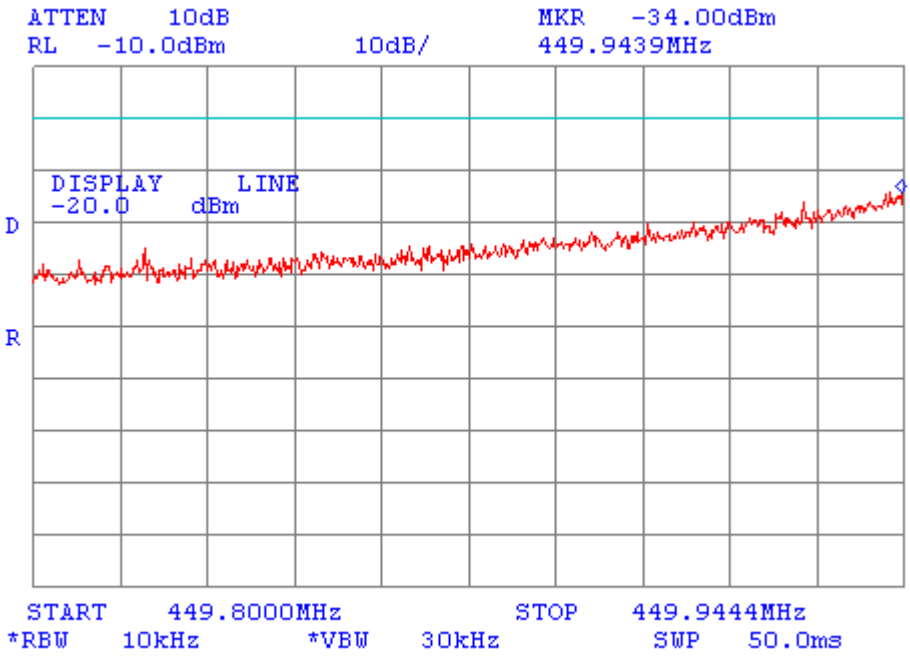
Plot A 26

Conducted spurious emission measurements from 449.800 MHz to 449.9444 MHz @ 450 MHz carrier, all "0" modulation



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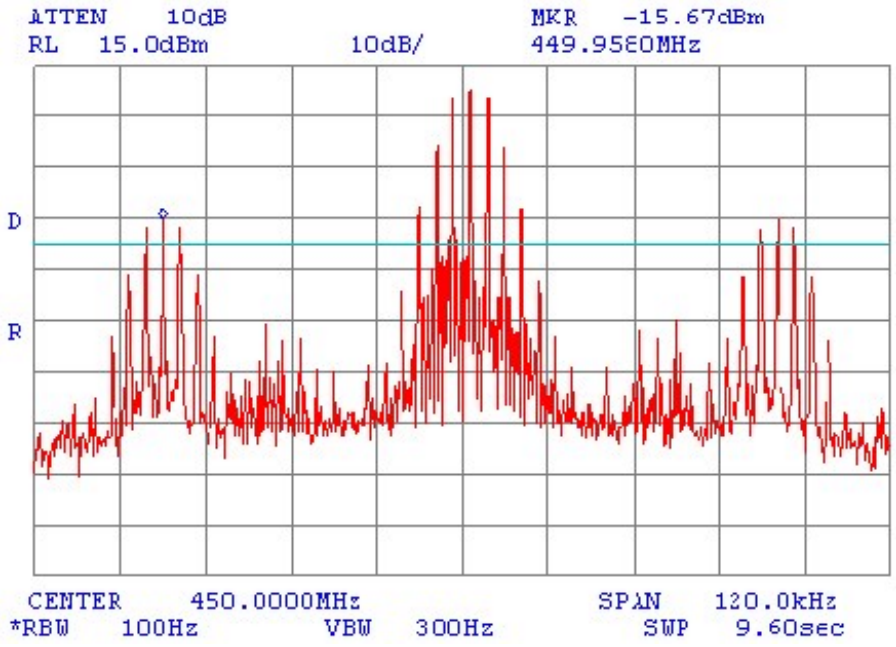
Plot A 27

Conducted spurious emission measurements in assigned band
@ 450 MHz carrier, all "0" modulation



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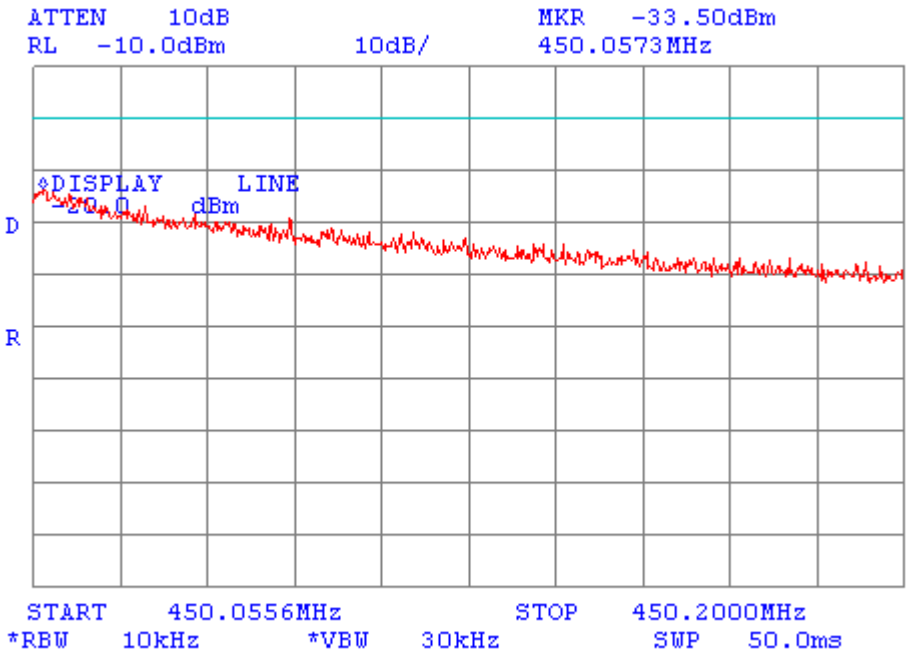
Plot A 28

Conducted spurious emission measurements from 450.0556 MHz to 450.200 MHz @ 450 MHz carrier, all "0" modulation



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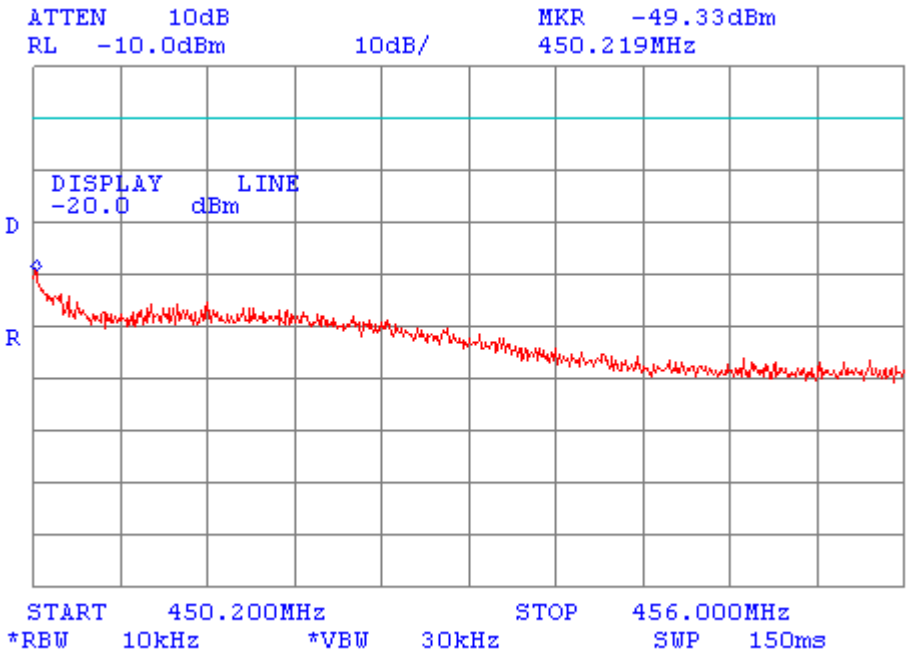
Plot A 29

Conducted spurious emission measurements from 450.200 MHz to 456.000 MHz @ 450 MHz carrier, all "0" modulation



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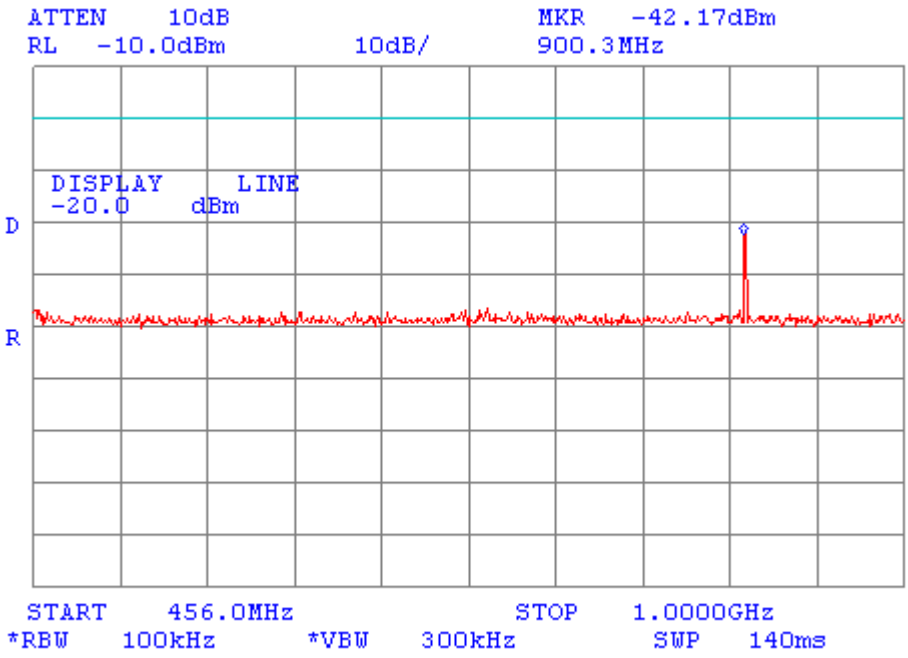
Plot A 30

Conducted spurious emission measurements from 456.000 MHz to 1 GHz @ 450 MHz carrier, all "0" modulation



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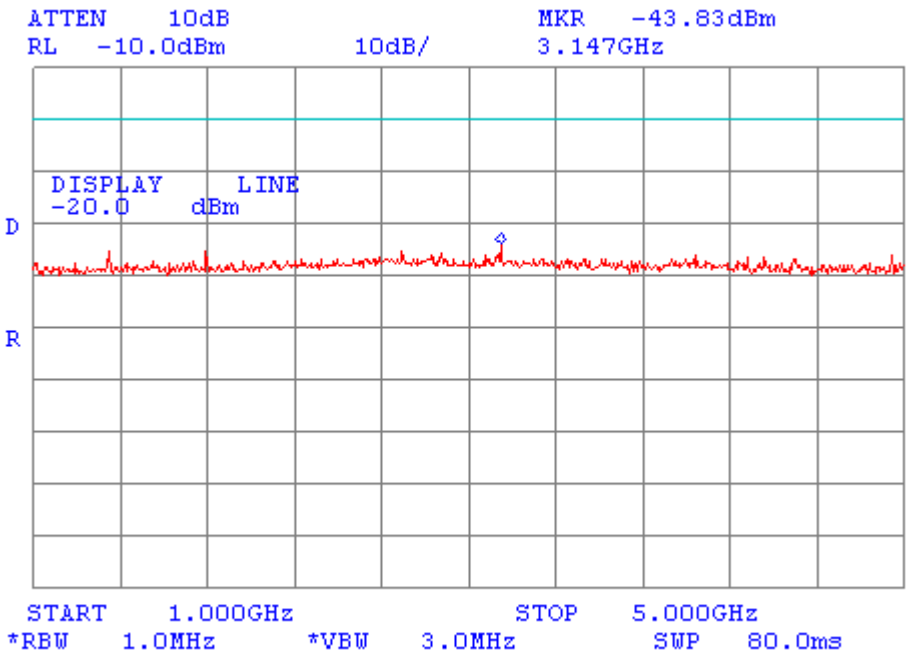
Plot A 31

Conducted spurious emission measurements from 1 GHz to 5 GHz
@ 450 MHz carrier, all "0" modulation



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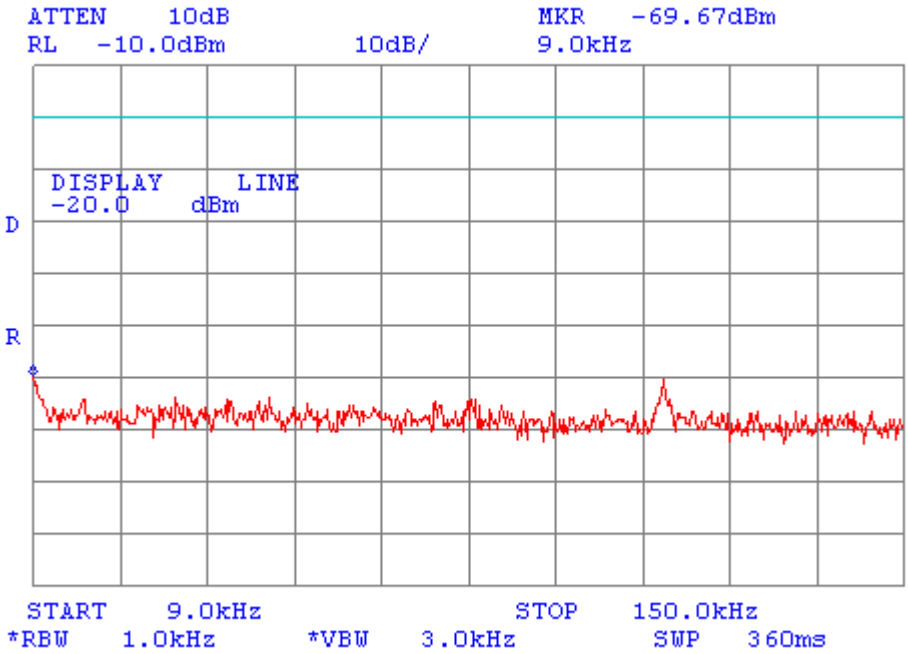
Plot A 32

Conducted spurious emission measurements from 9 kHz to 150 kHz
@ 460 MHz carrier, all "0" modulation



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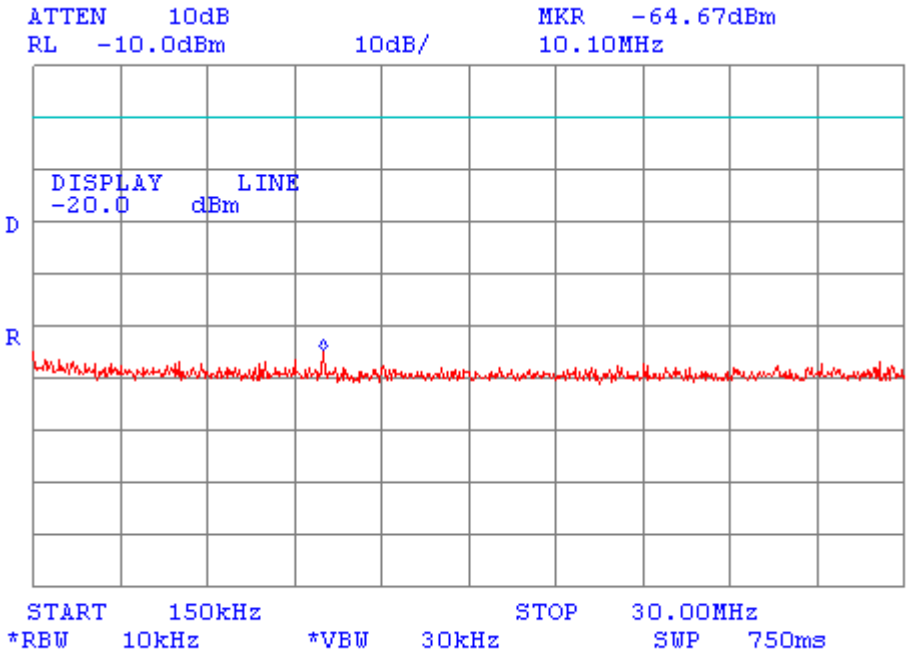
Plot A 33

Conducted spurious emission measurements from 150 kHz to 30 MHz
@ 460 MHz carrier, all "0" modulation



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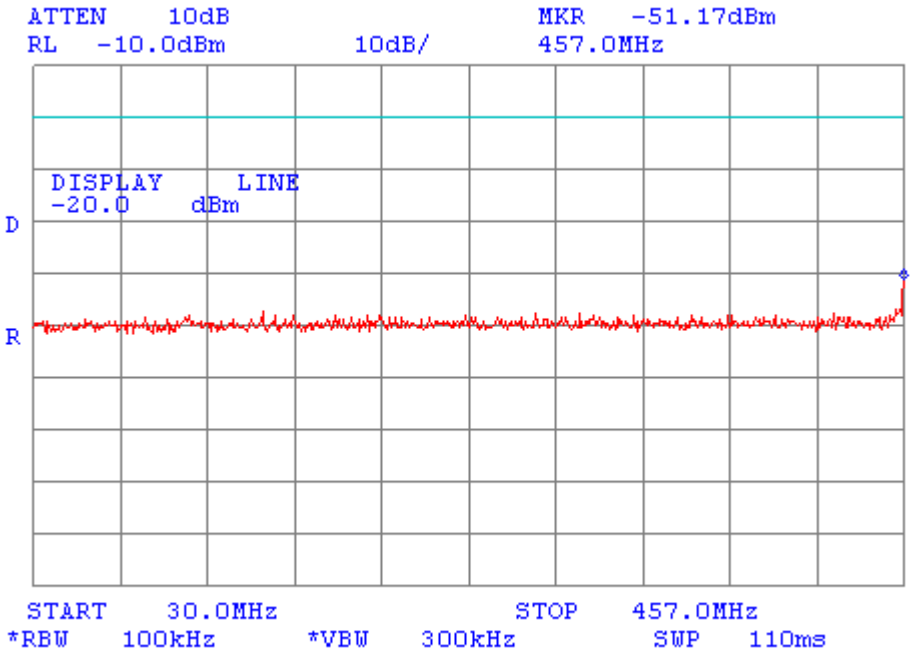
Plot A 34

Conducted spurious emission measurements from 30 MHz to 457 MHz
@ 460 MHz carrier, all "0" modulation



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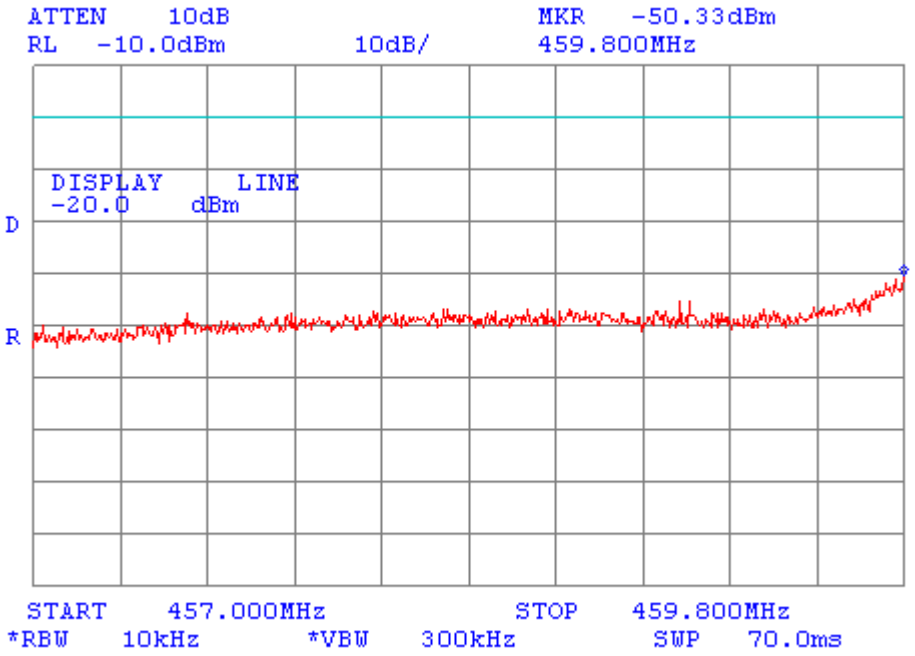
Plot A 35

Conducted spurious emission measurements from 457 MHz to 459.800 MHz @ 460 MHz carrier, all "0" modulation



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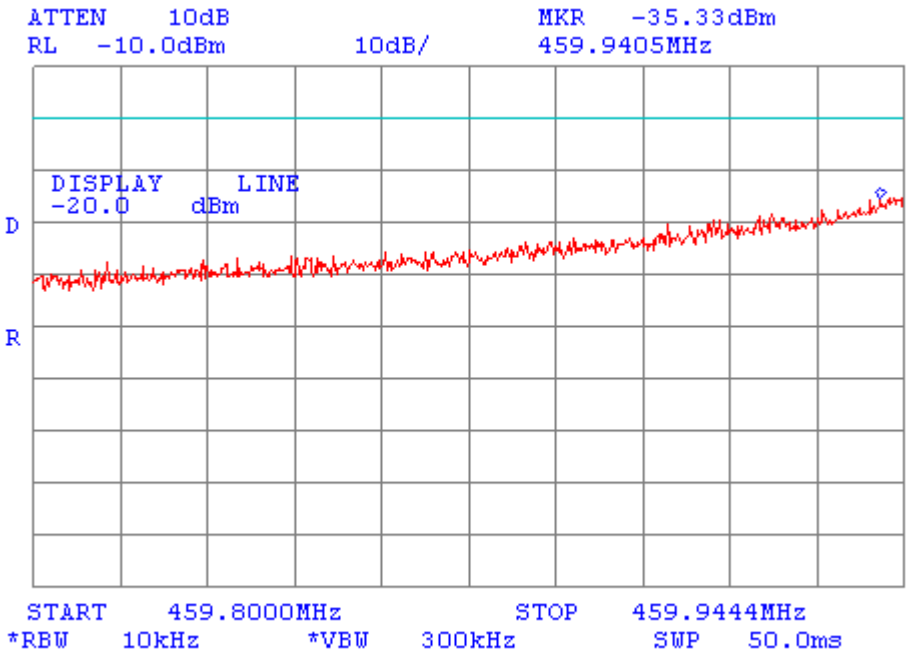
Plot A 36

Conducted spurious emission measurements from 459.800 MHz to 459.9444 MHz @ 460 MHz carrier, all "0" modulation



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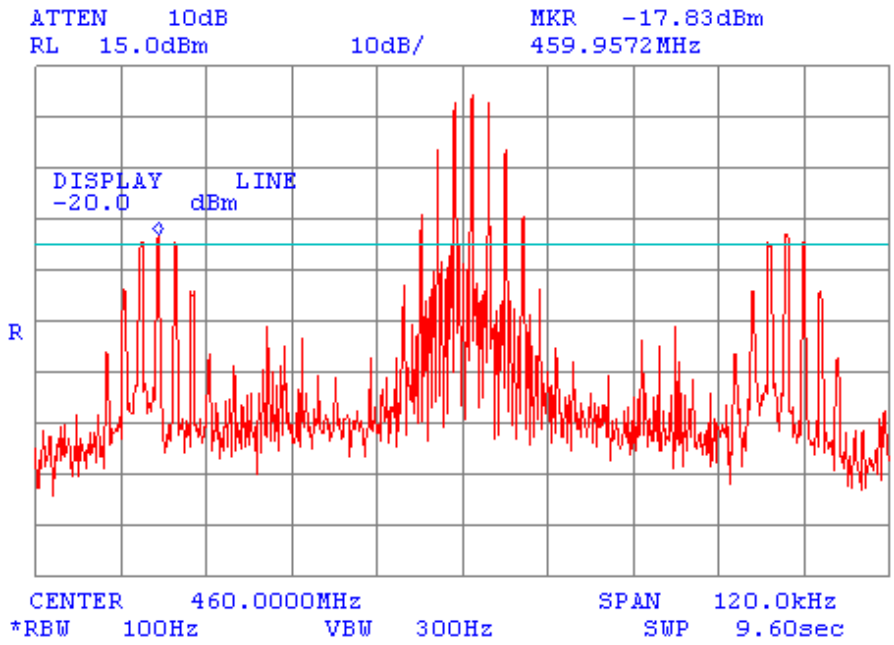
Plot A 37

Conducted spurious emission measurements in assigned band
@ 460 MHz carrier, all "0" modulation



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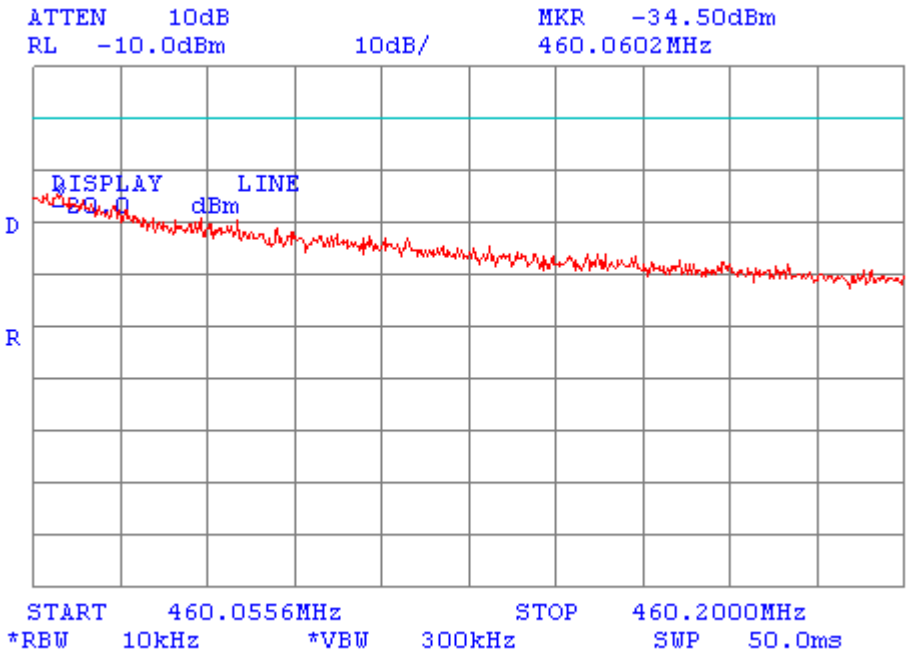
Plot A 38

Conducted spurious emission measurements from 460.0556 MHz to 460.200 MHz @ 460 MHz carrier, all "0" modulation



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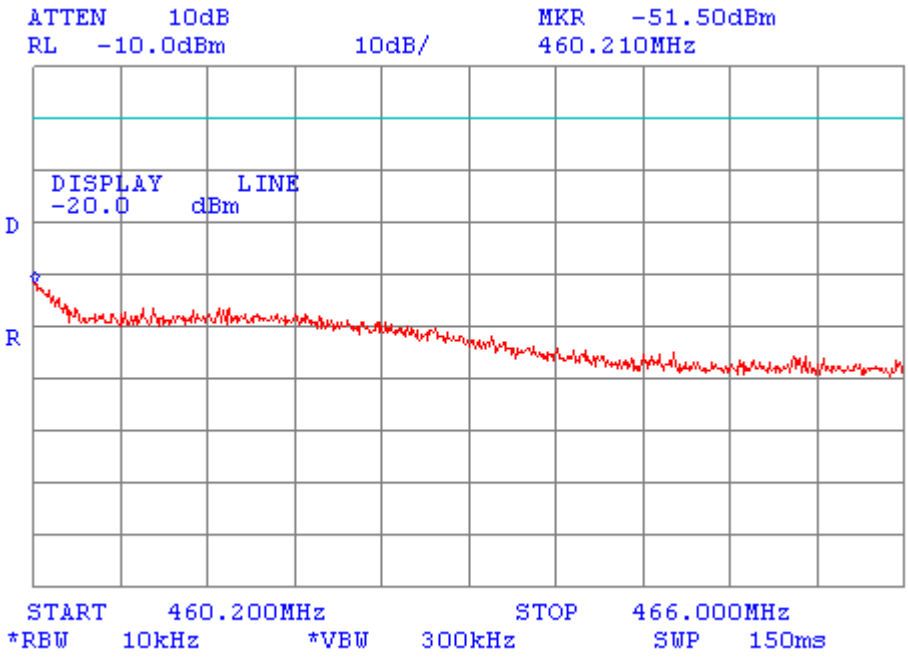
Plot A 39

Conducted spurious emission measurements from 460.200 MHz to 466.000 MHz @ 460 MHz carrier, all "0" modulation



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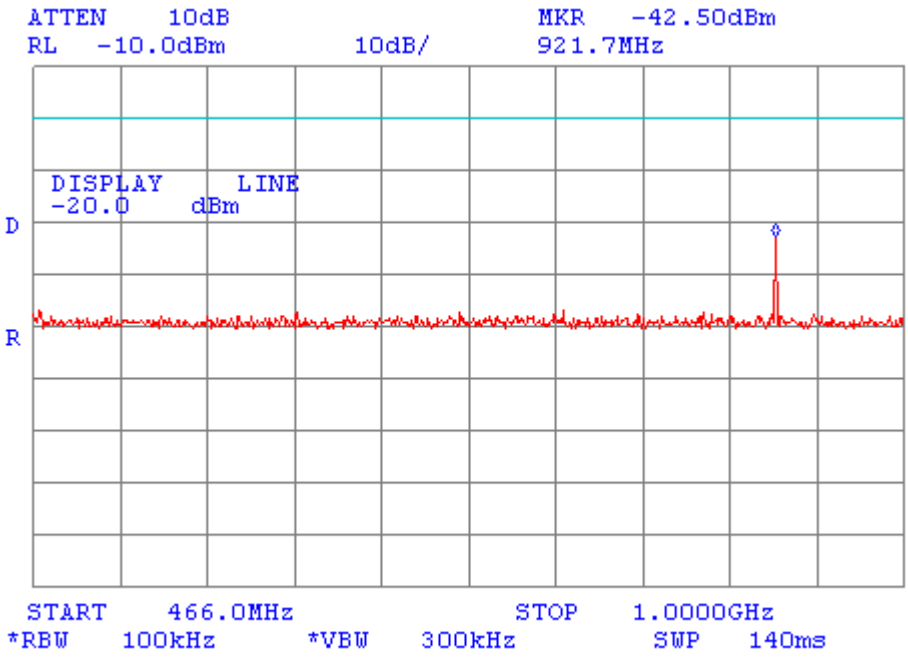
Plot A 40

Conducted spurious emission measurements from 466.000 MHz to 1 GHz @ 460 MHz carrier, all "0" modulation



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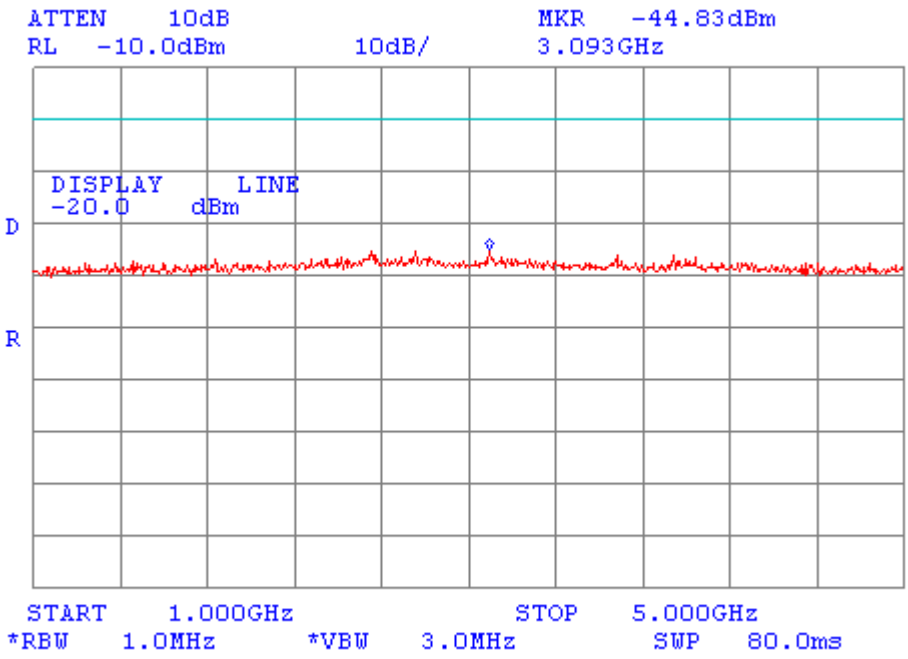
Plot A 41

Conducted spurious emission measurements from 1 GHz to 5 GHz
@ 460 MHz carrier, all "0" modulation



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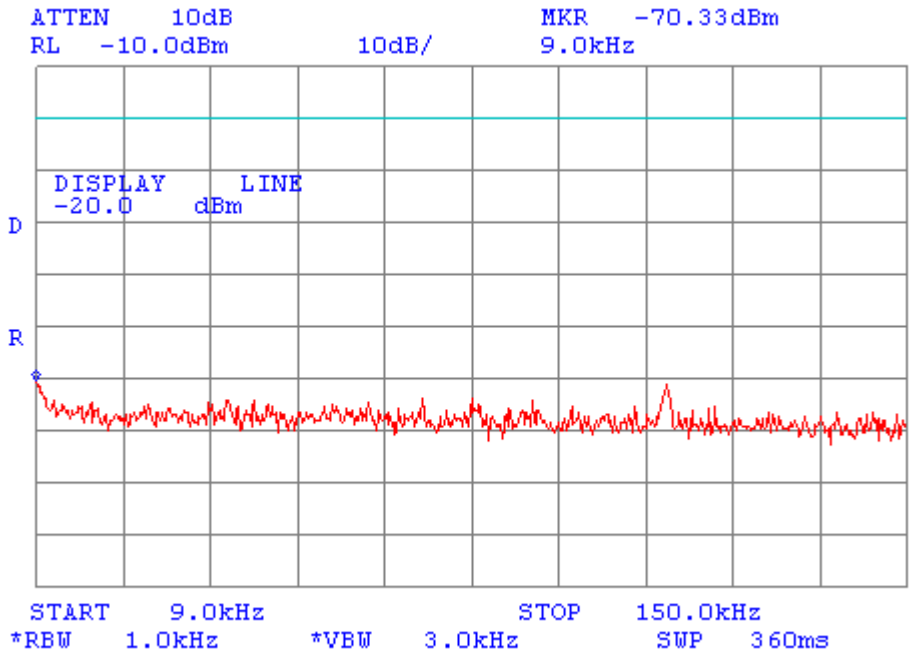
Plot A 42

Conducted spurious emission measurements from 9 kHz to 150 kHz
@ 470 MHz carrier, all "0" modulation



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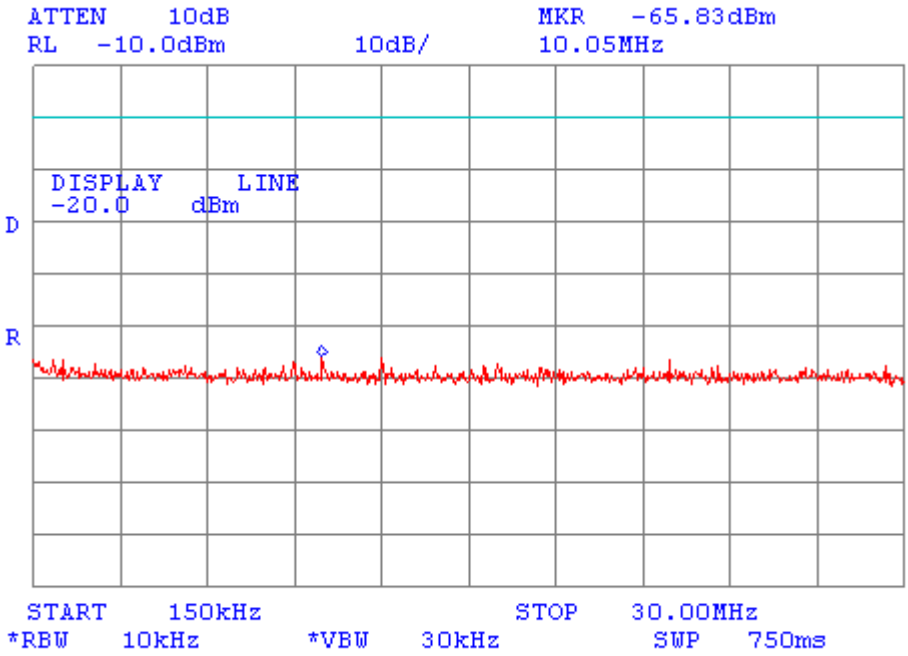
Plot A 43

Conducted spurious emission measurements from 150 kHz to 30 MHz
@ 470 MHz carrier, all "0" modulation



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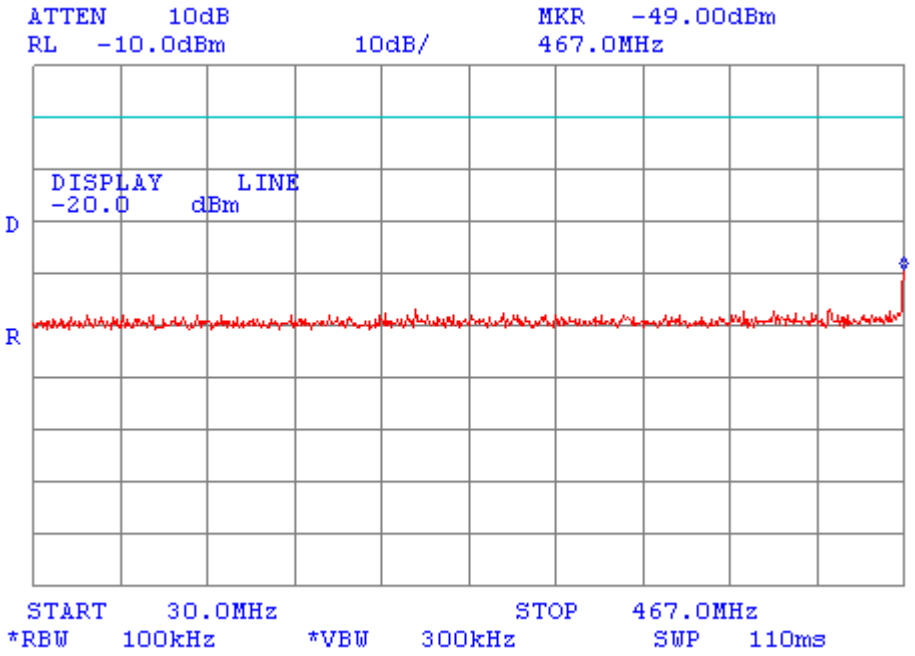
Plot A 44

Conducted spurious emission measurements from 30 MHz to 467 MHz
@ 470 MHz carrier, all "0" modulation



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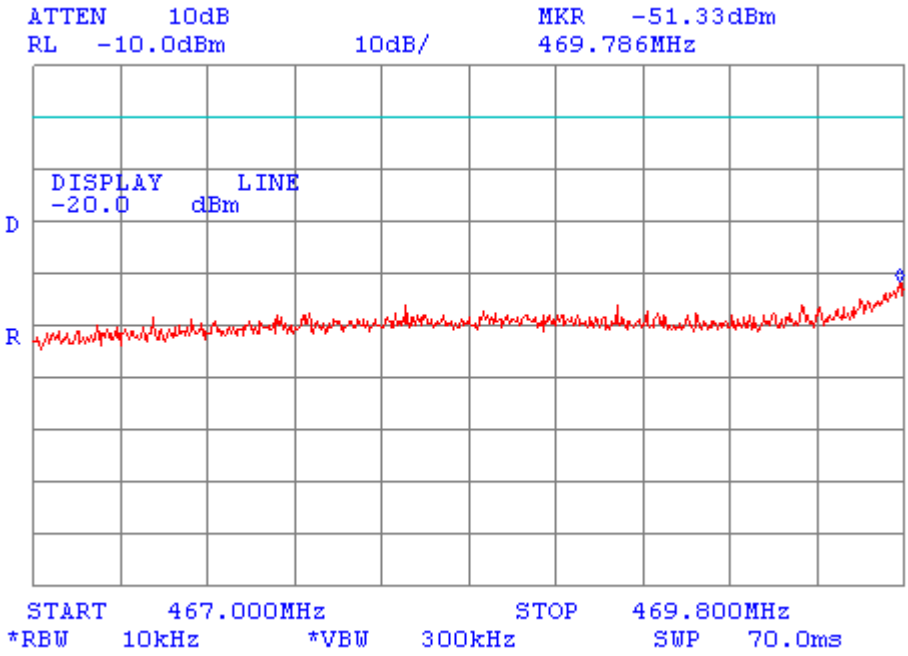
Plot A 45

Conducted spurious emission measurements from 467 MHz to 469.800 MHz @ 470 MHz carrier, all "0" modulation



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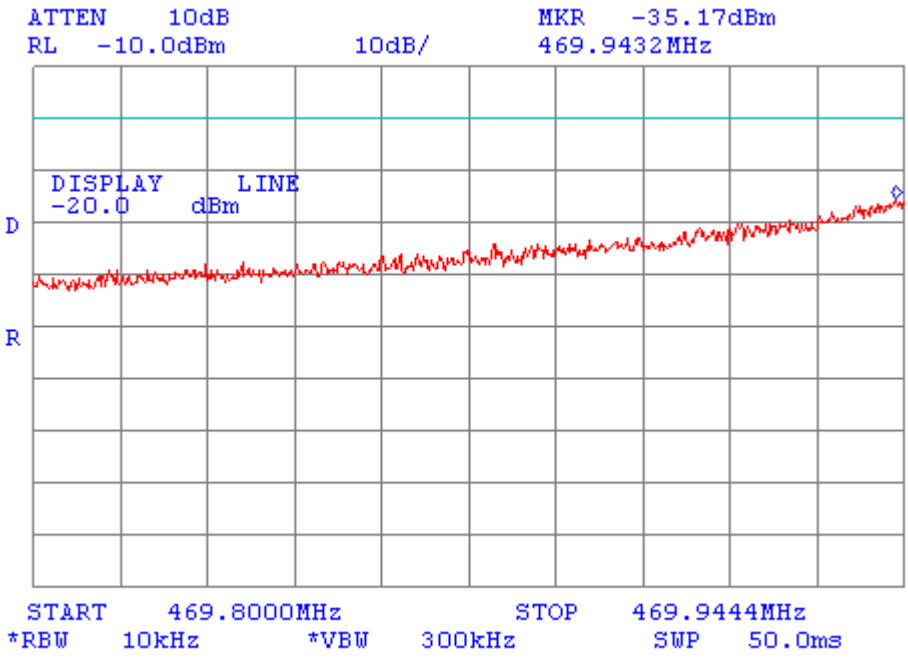
Plot A 46

Conducted spurious emission measurements from 469.800 MHz to 469.9444 MHz @ 470 MHz carrier, all "0" modulation



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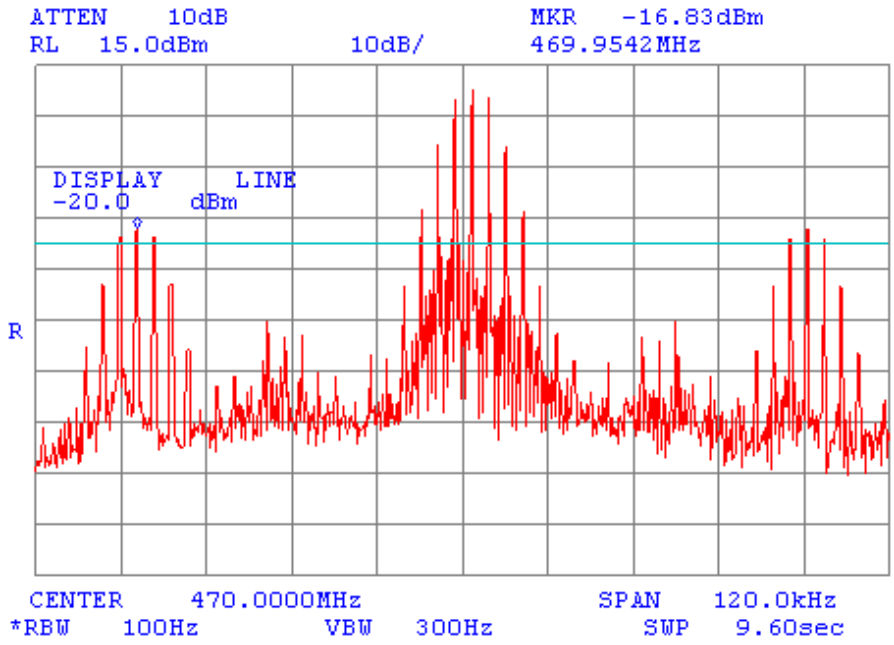
Plot A 47

Conducted spurious emission measurements in assigned band
@ 470 MHz carrier, all "0" modulation



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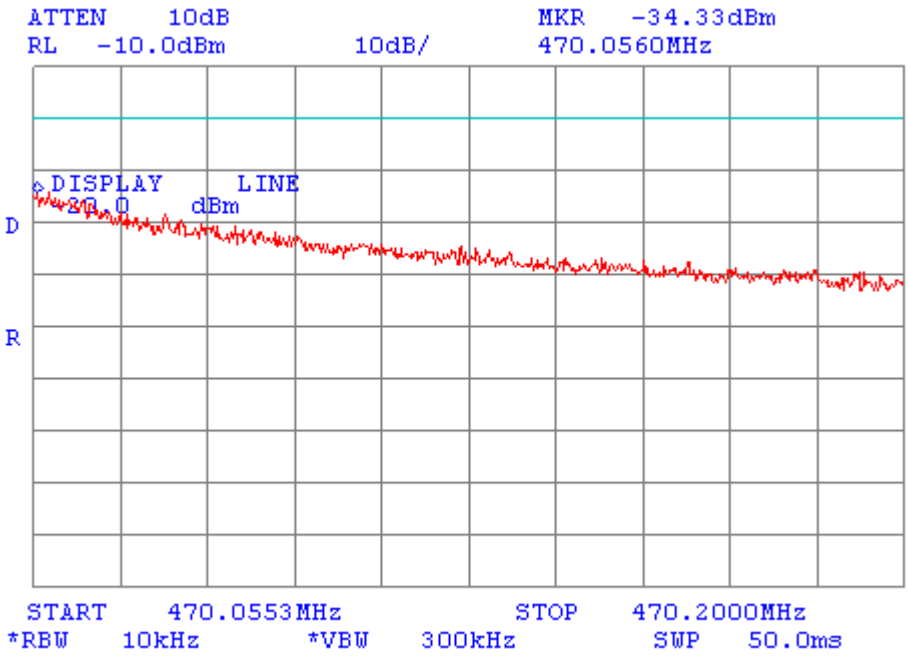
Plot A 48

Conducted spurious emission measurements from 470.0553 MHz to 470.200 MHz @ 470 MHz carrier, all "0" modulation



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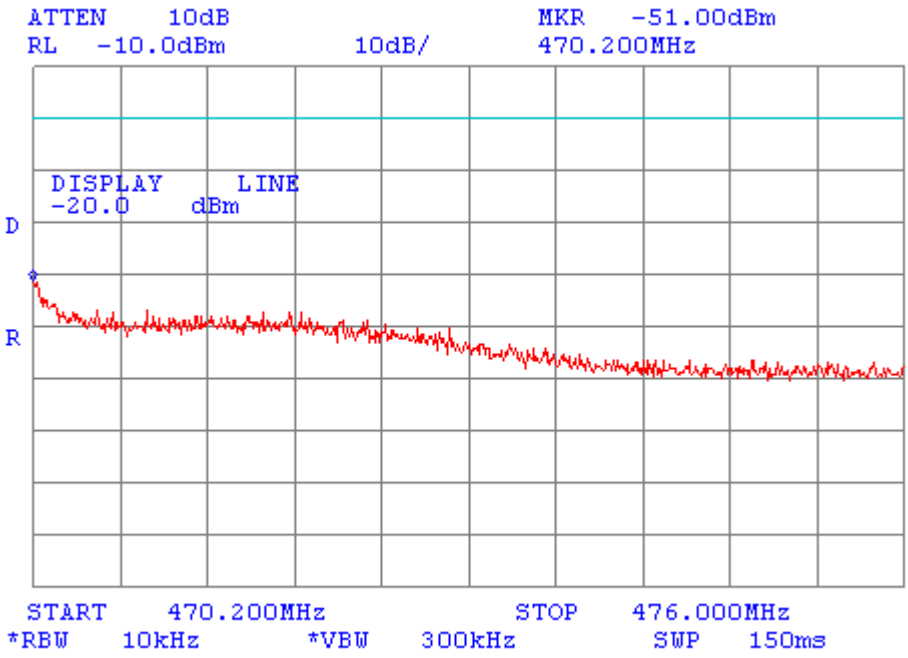
Plot A 49

Conducted spurious emission measurements from 470.200 MHz to 476.000 MHz @ 470 MHz carrier, all "0" modulation



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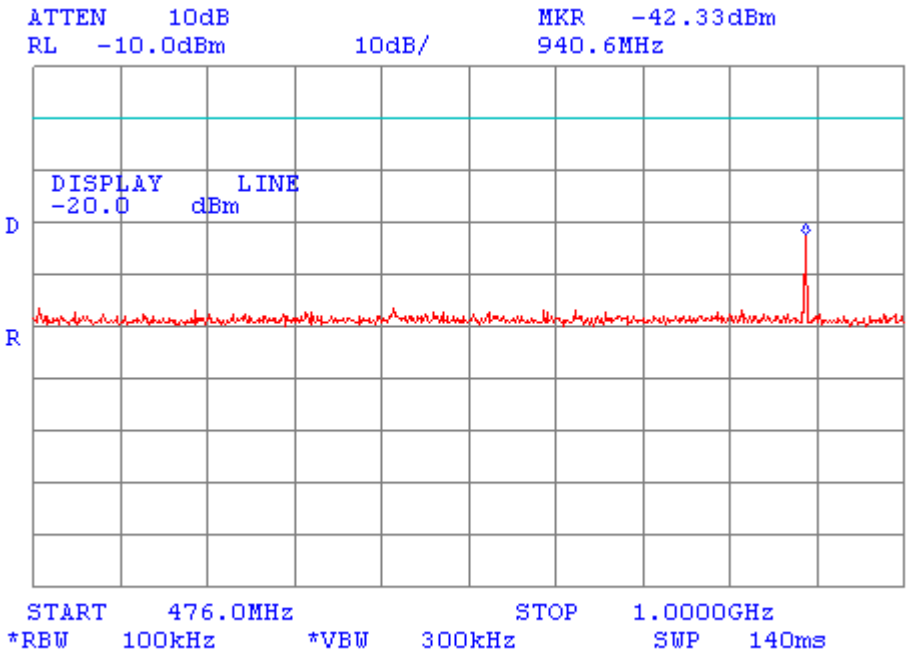
Plot A 50

Conducted spurious emission measurements from 476.000 MHz to 1 GHz @ 470 MHz carrier, all "0" modulation



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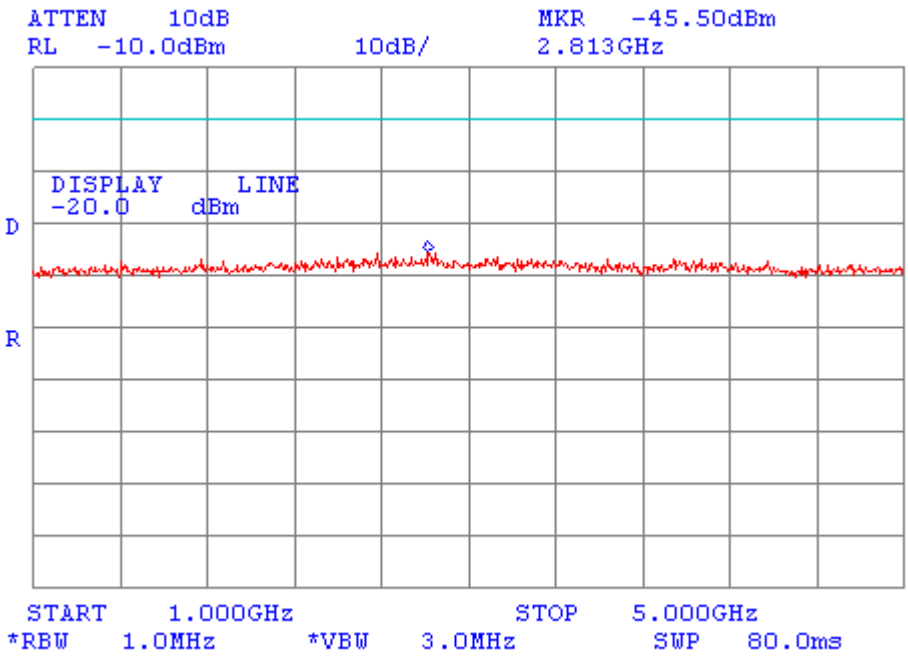
Plot A 51

Conducted spurious emission measurements from 1 GHz to 5 GHz
@ 470 MHz carrier, all "0" modulation



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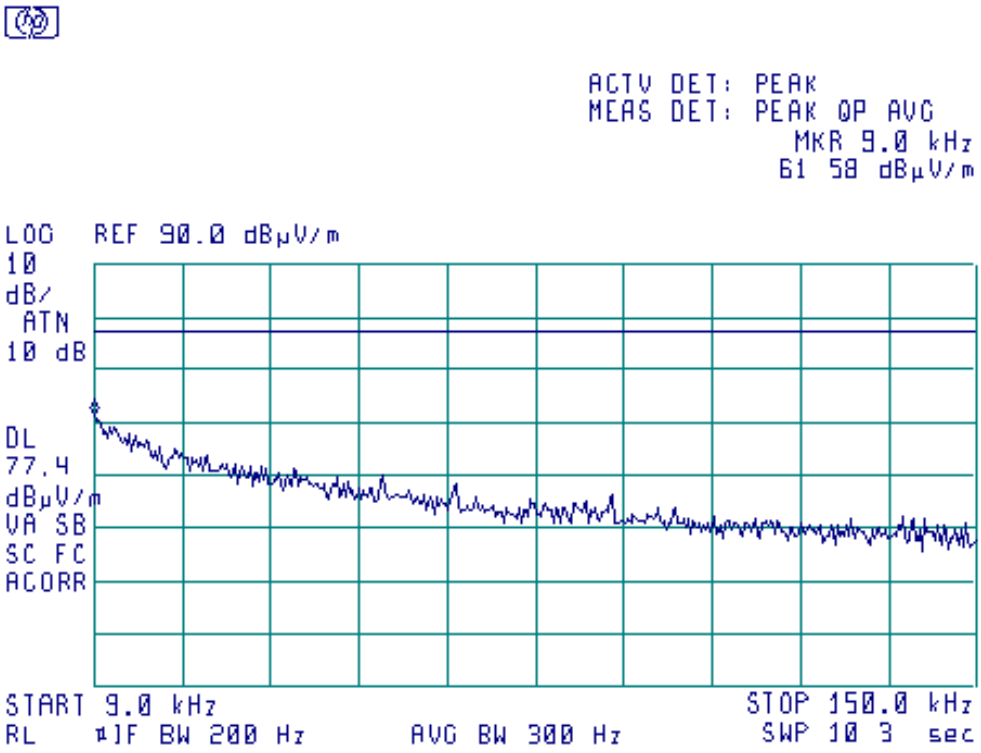
Plot A 52

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model Galaxy Remote @ 450 MHz carrier



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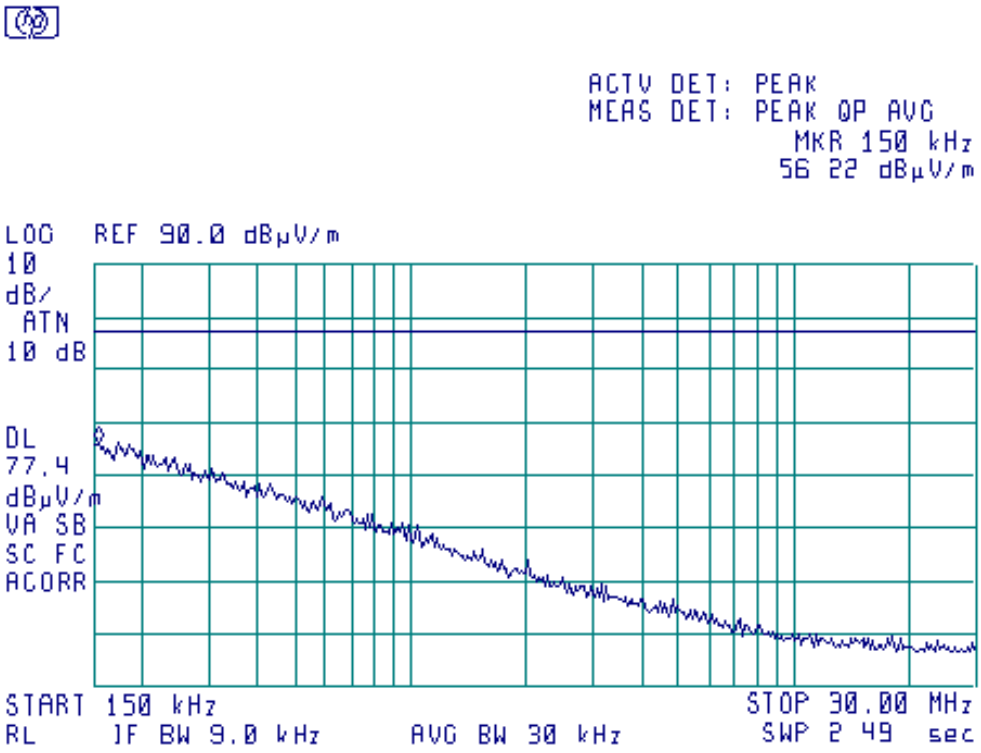
Plot A 53

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model Galaxy Remote @ 450 MHz carrier



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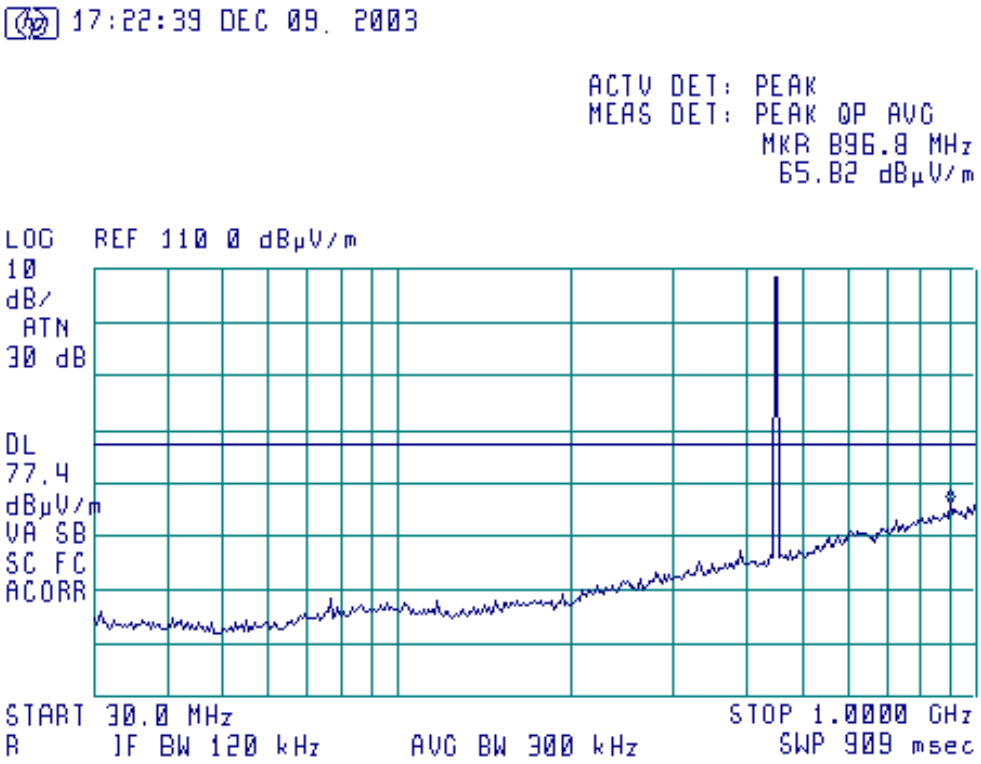
Plot A 54

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 1000 MHz model Galaxy Remote @ 450 MHz carrier



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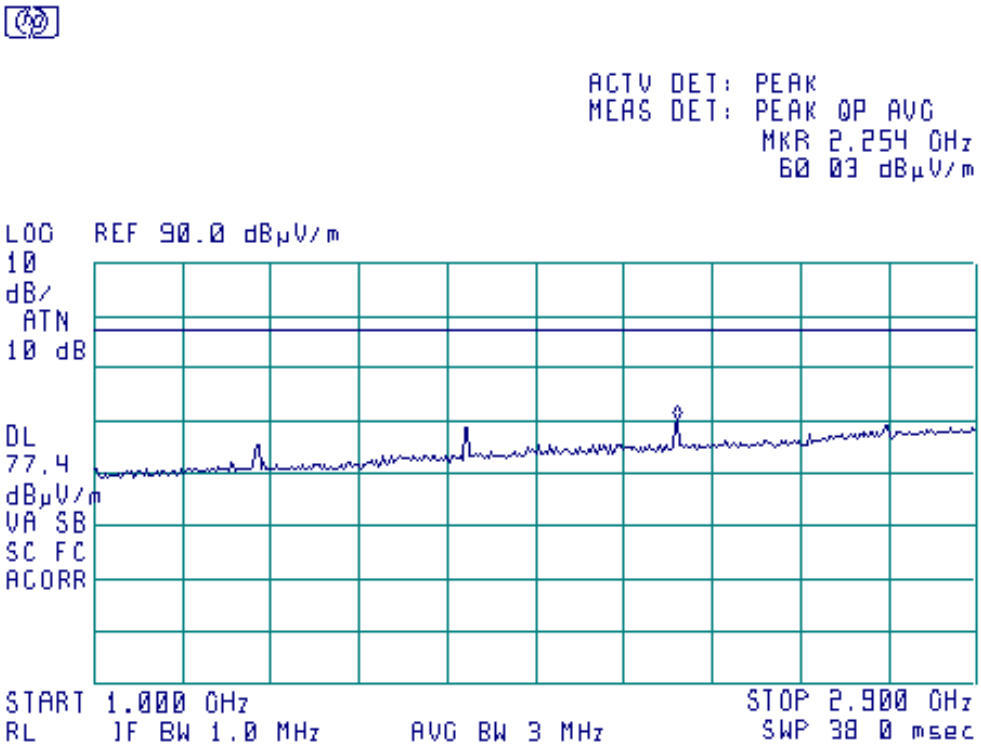
Plot A 55

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model Galaxy Remote @ 450 MHz carrier



No spurious emissions were found except harmonics

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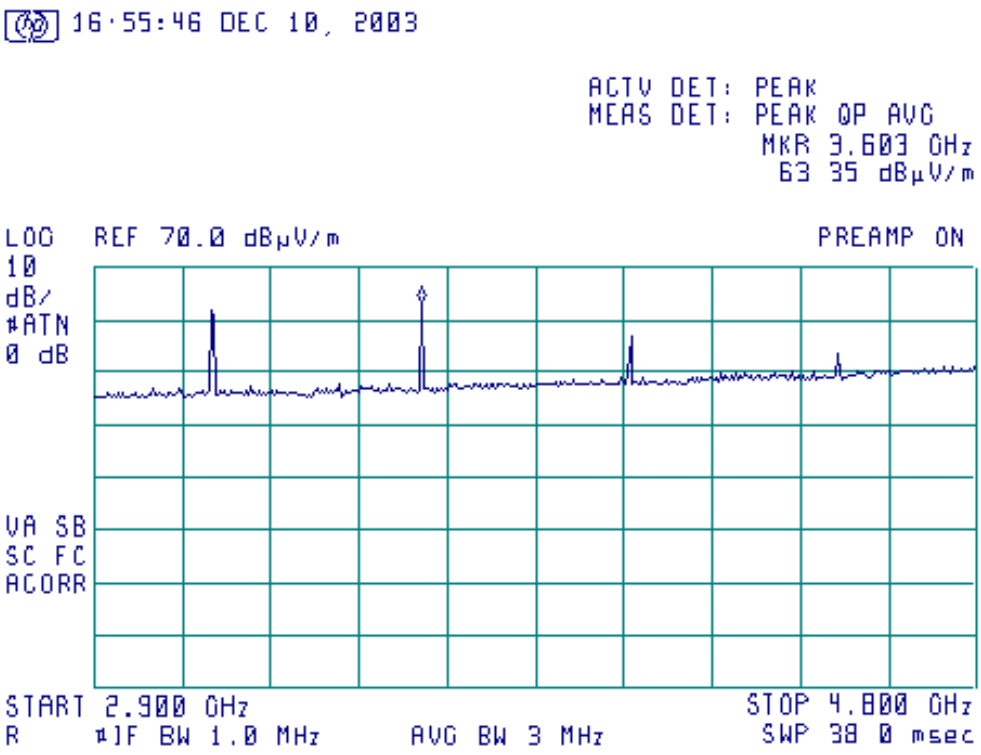
Plot A 56

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model Galaxy Remote @ 450 MHz carrier



No spurious emissions were found except harmonics.

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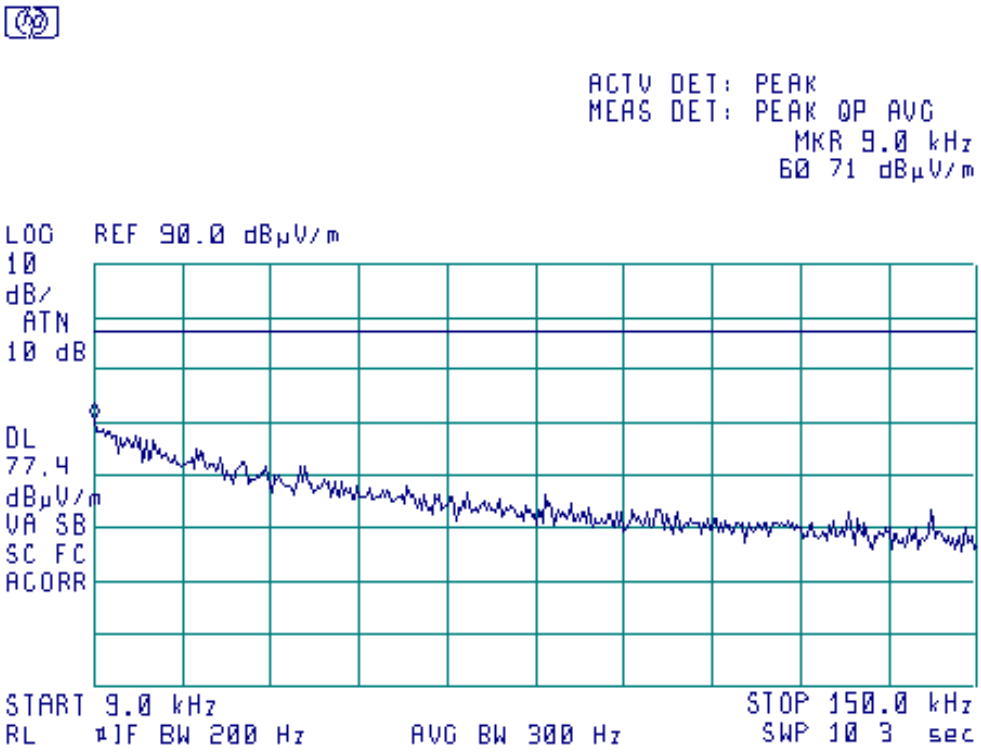
Plot A 57

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model Galaxy Remote @ 460 MHz carrier



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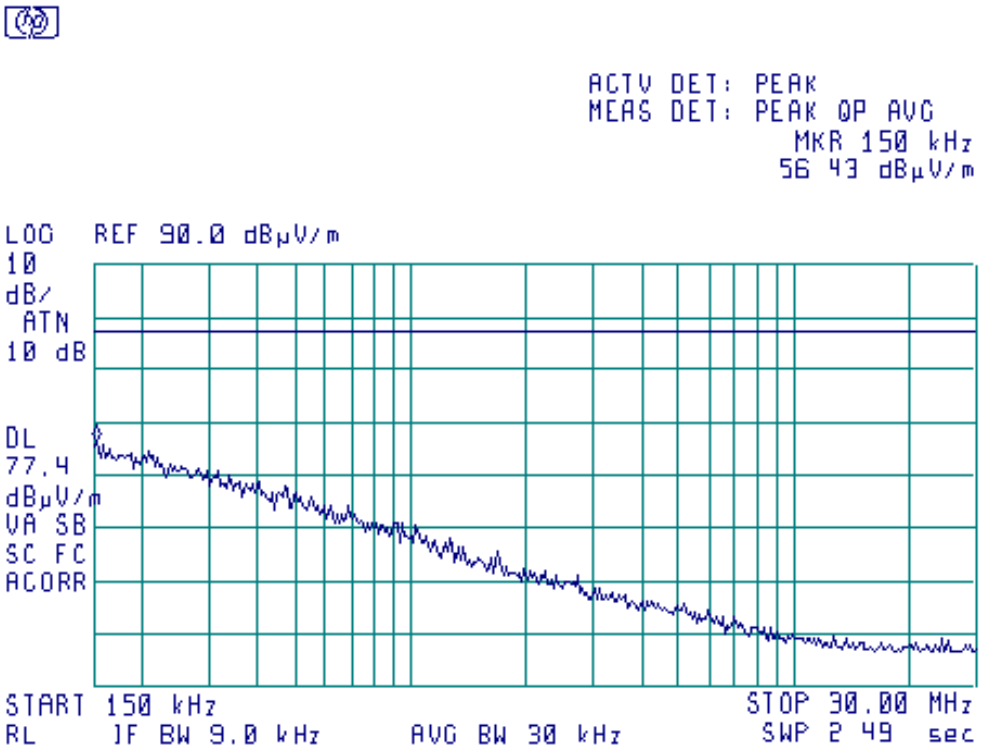
Plot A 58

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model Galaxy Remote @ 460 MHz carrier



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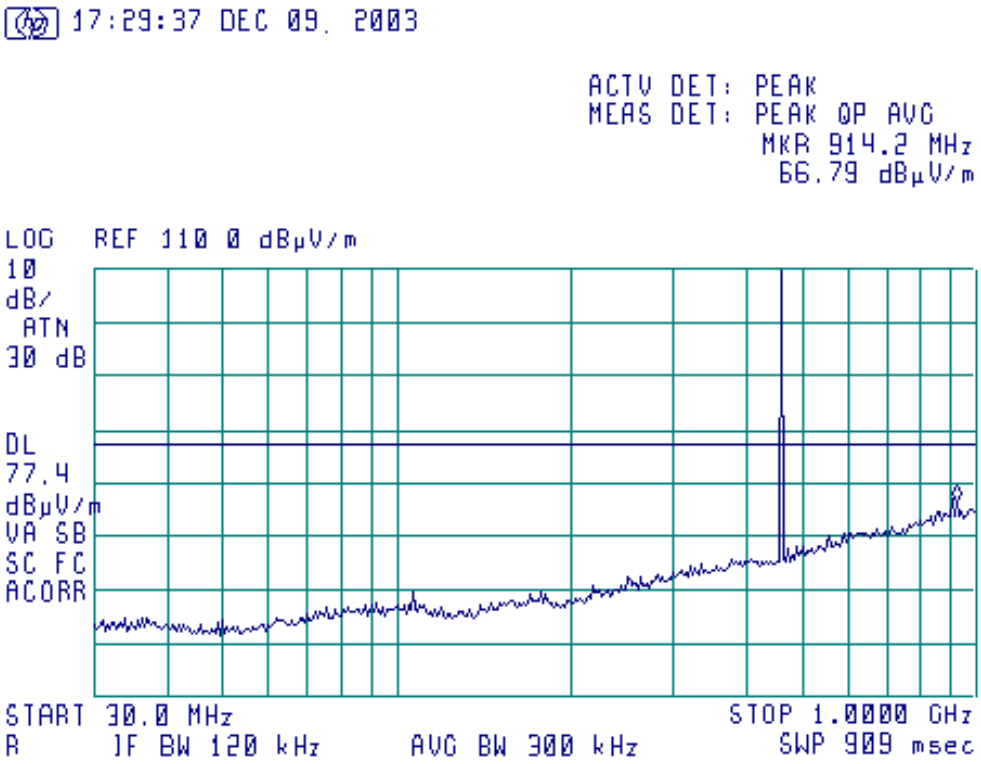
Plot A 59

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 1000 MHz model Galaxy Remote @ 460 MHz carrier



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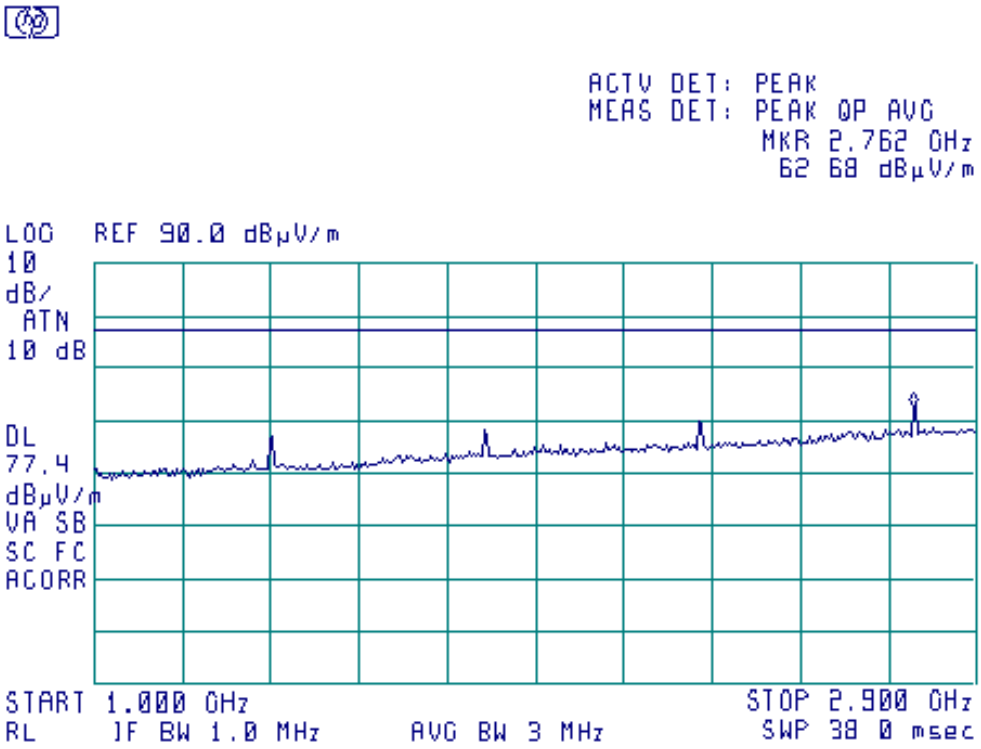
Plot A 60

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model Galaxy Remote @ 460 MHz carrier



No spurious emissions were found except harmonics

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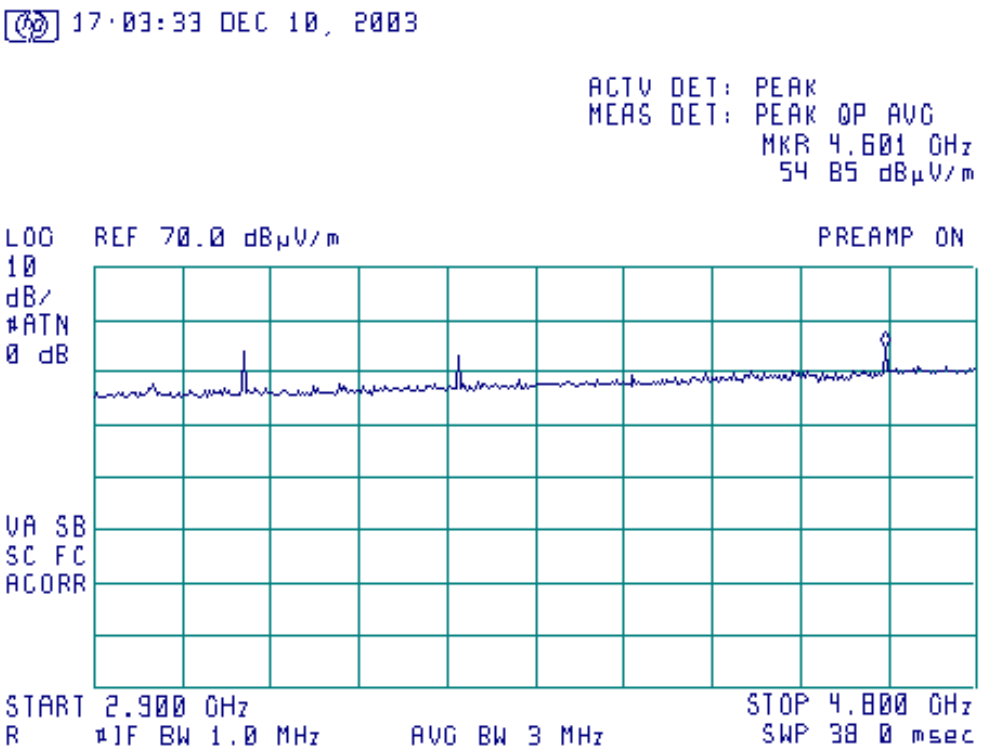
Plot A 61

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model Galaxy Remote @ 460 MHz carrier



No spurious emissions were found except harmonics.

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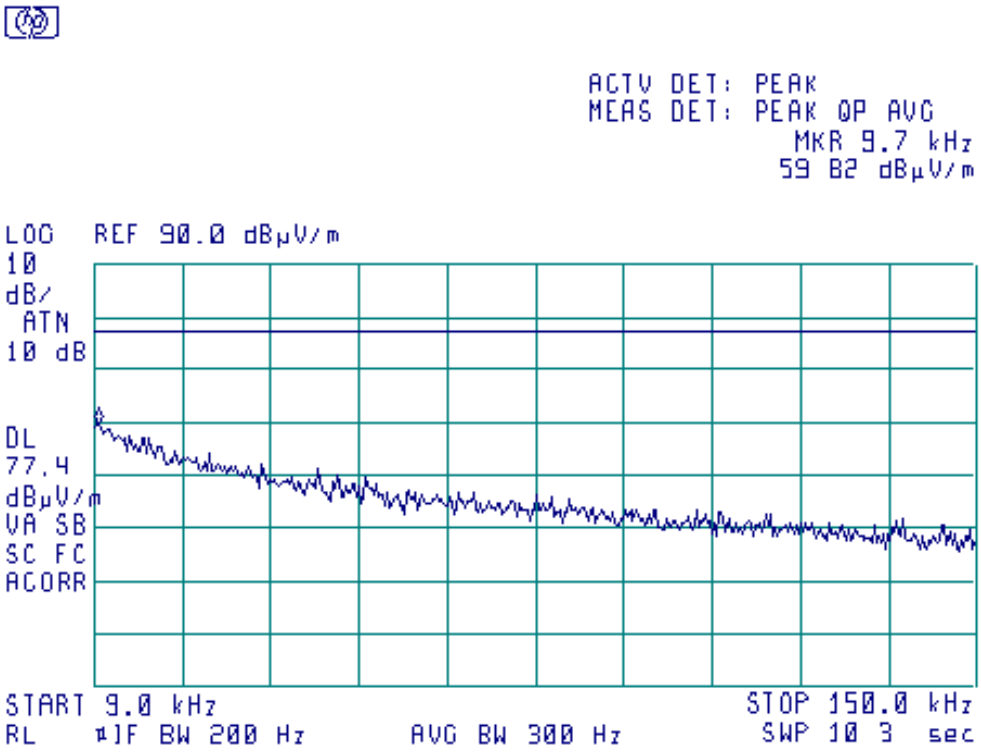
Plot A 62

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model Galaxy Remote @ 470 MHz carrier



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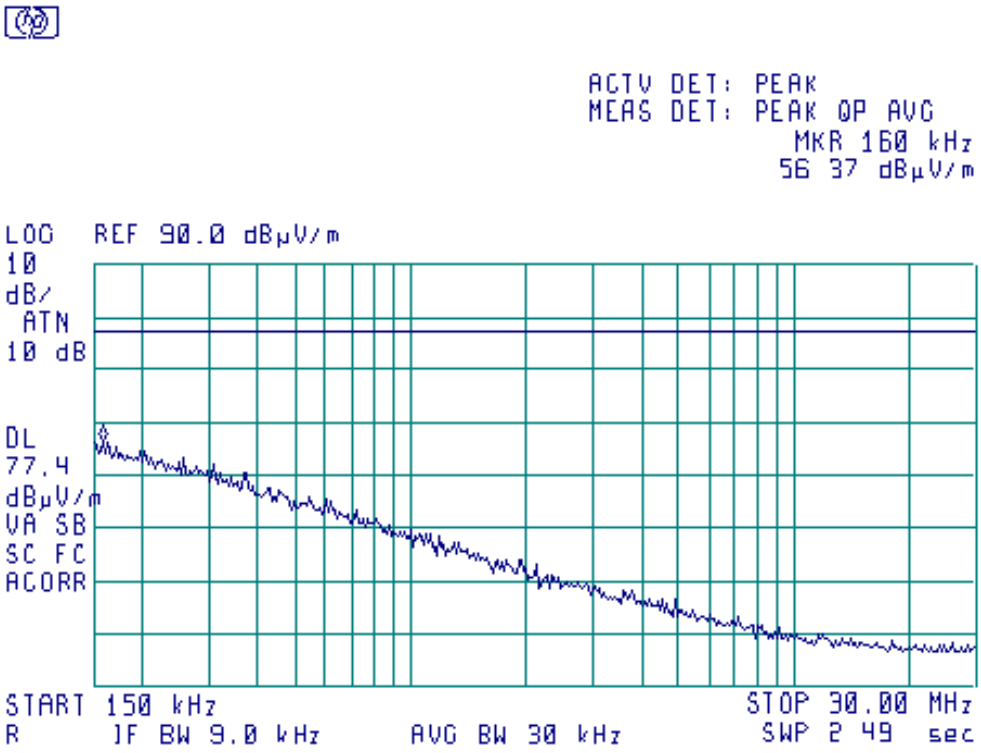
Plot A 63

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model Galaxy Remote @ 470 MHz carrier



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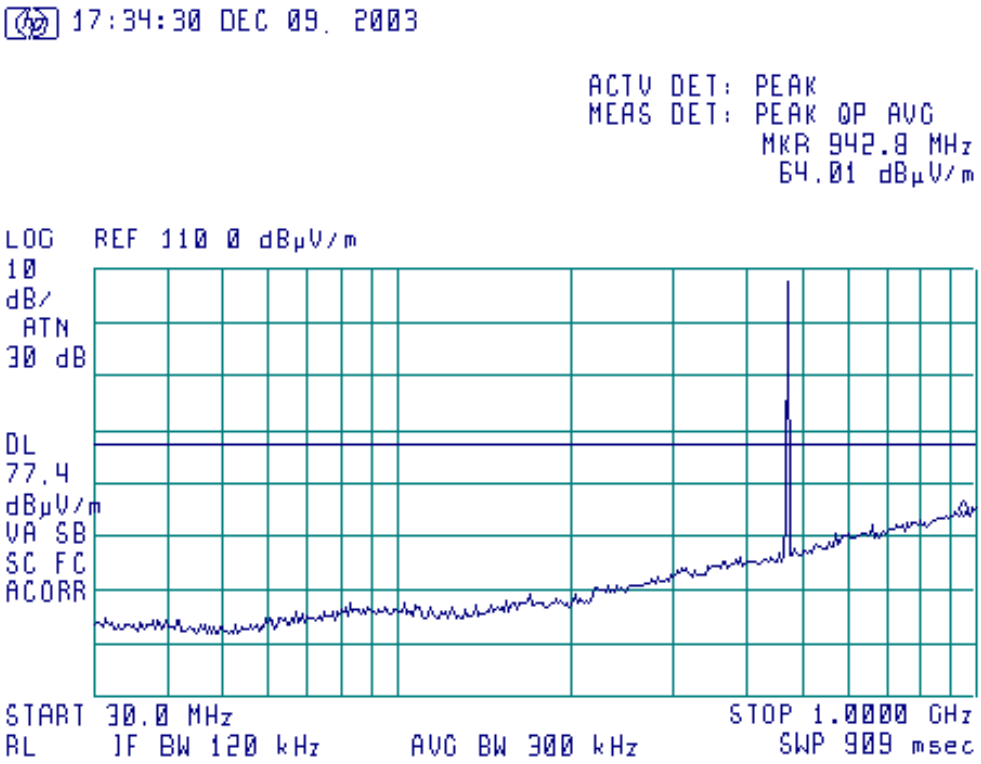
Plot A 64

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 1000 MHz model Galaxy Remote @ 470 MHz carrier



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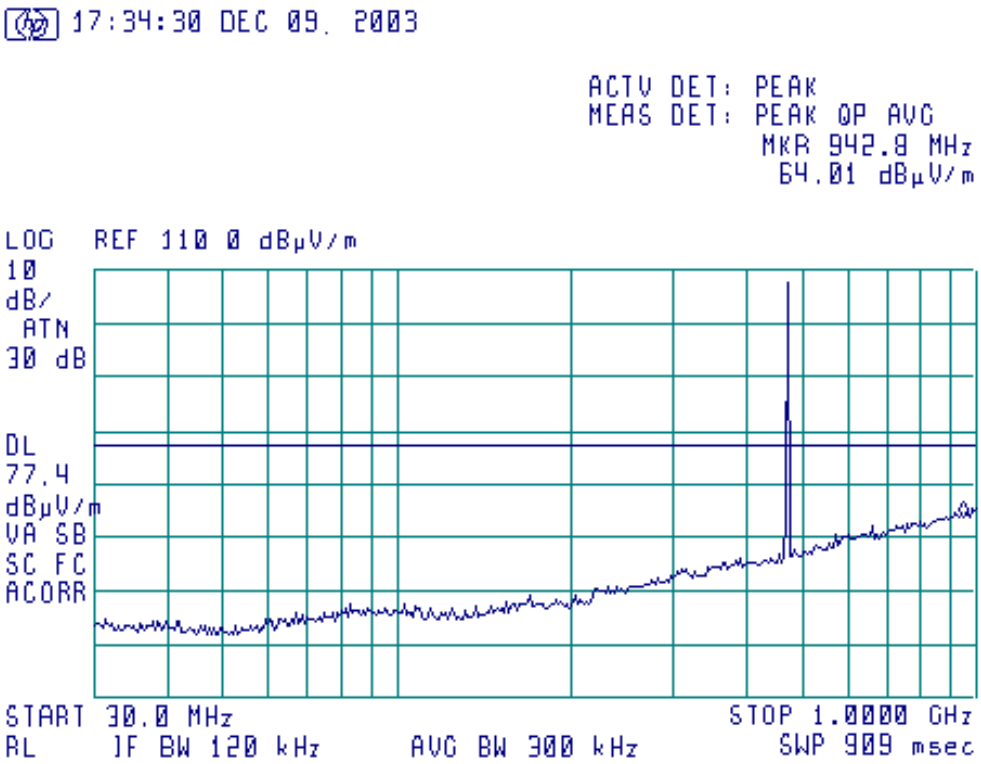
Plot A 65

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model Galaxy Remote @ 470 MHz carrier



No spurious emissions were found except harmonics

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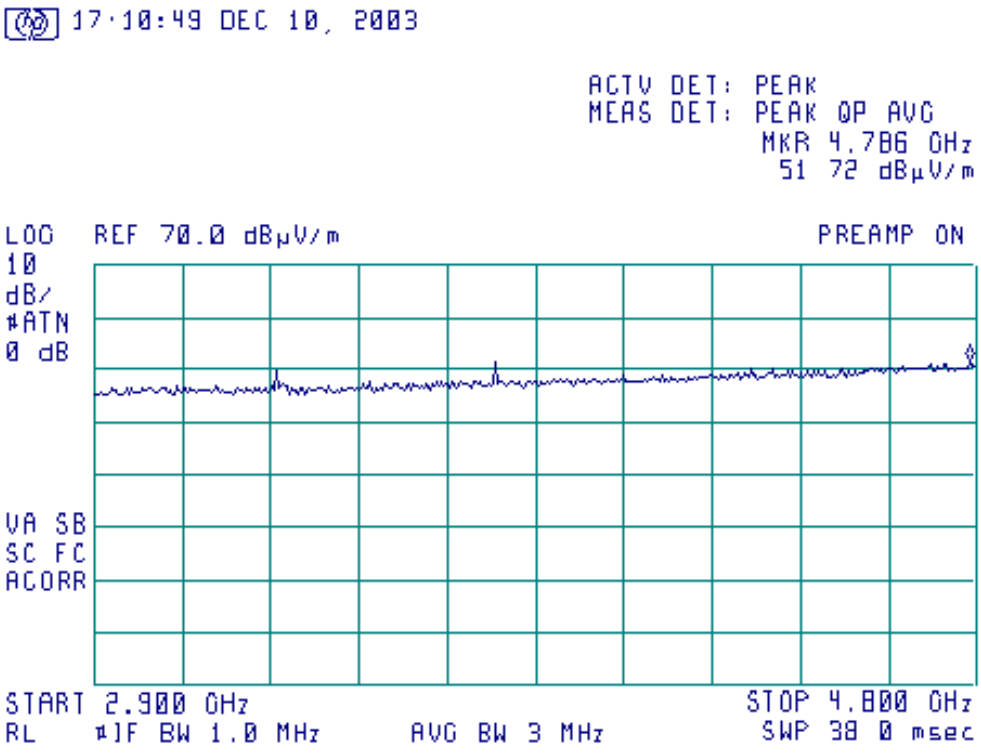
Plot A 66

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model Galaxy Remote @ 470 MHz carrier



No spurious emissions were found except harmonics.

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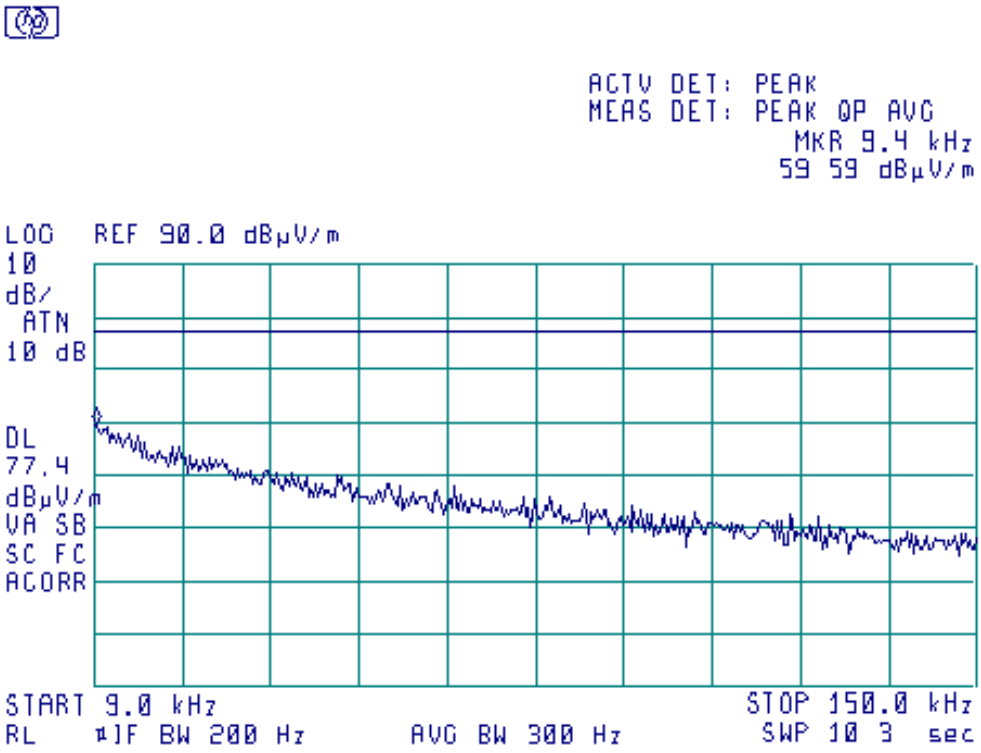
Plot A 67

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model SpeedRead @ 450 MHz carrier



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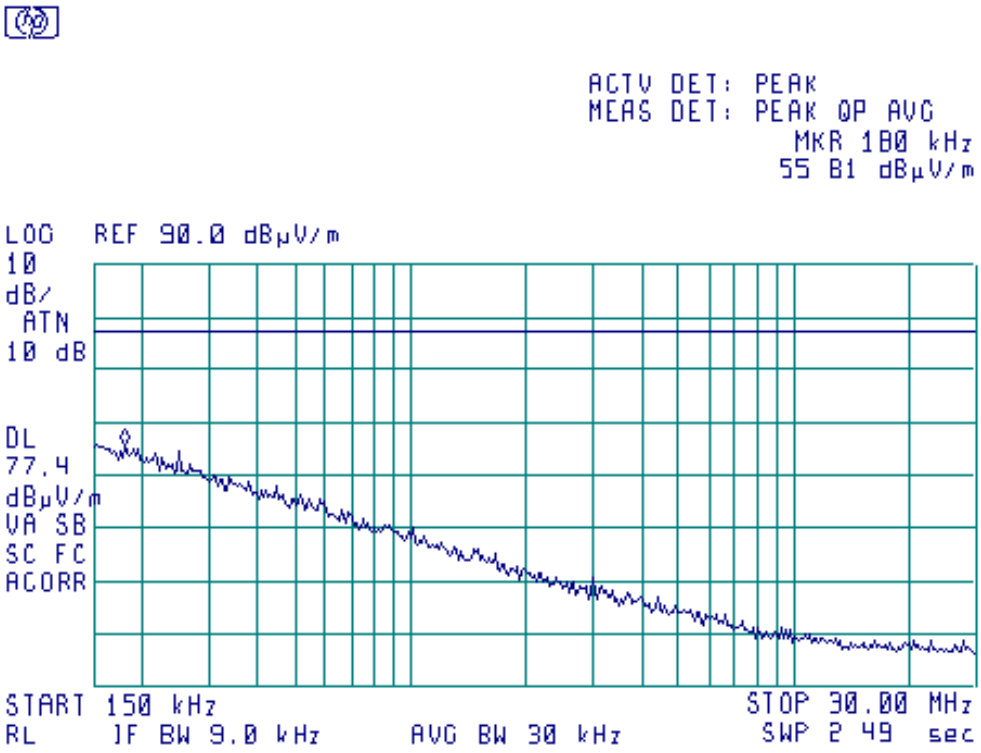
Plot A 68

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model SpeedRead @ 450 MHz carrier



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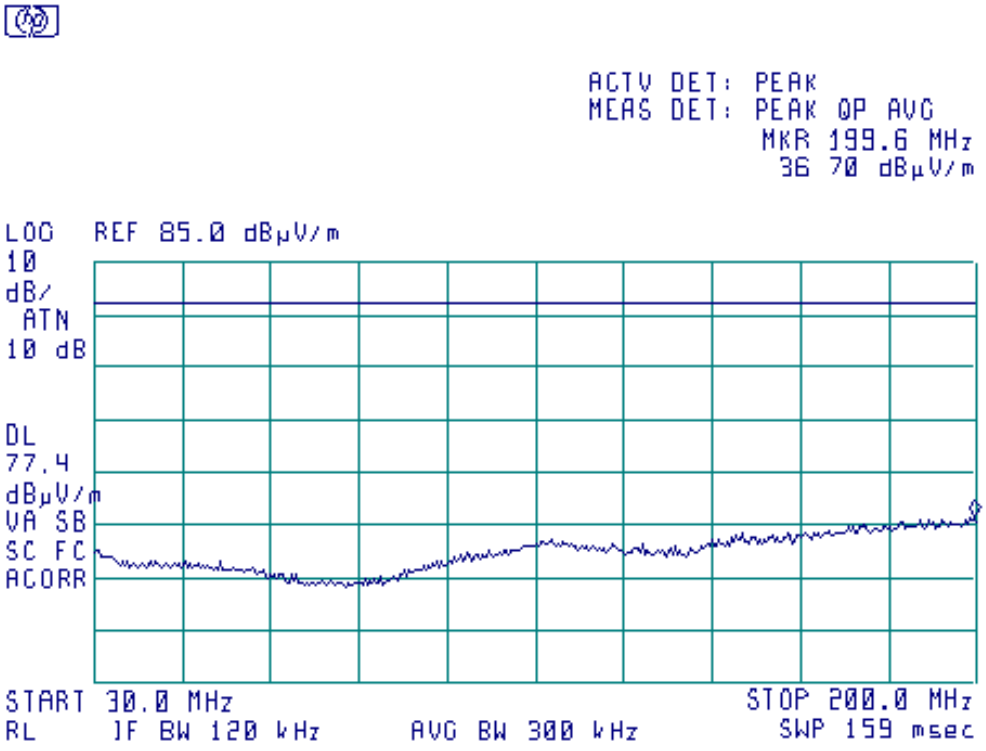
Plot A 69

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 200 MHz model SpeedRead @ 450 MHz carrier



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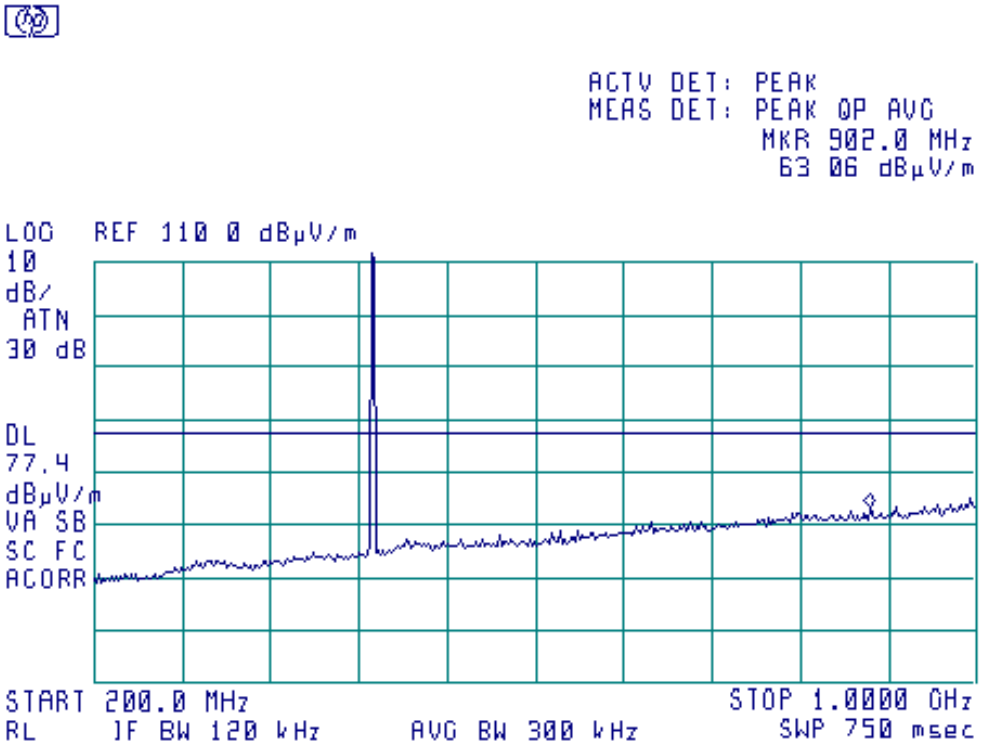
Plot A 70

Radiated spurious emission measurements in the anechoic chamber from 200 MHz to 1000 MHz model SpeedRead @ 450 MHz carrier



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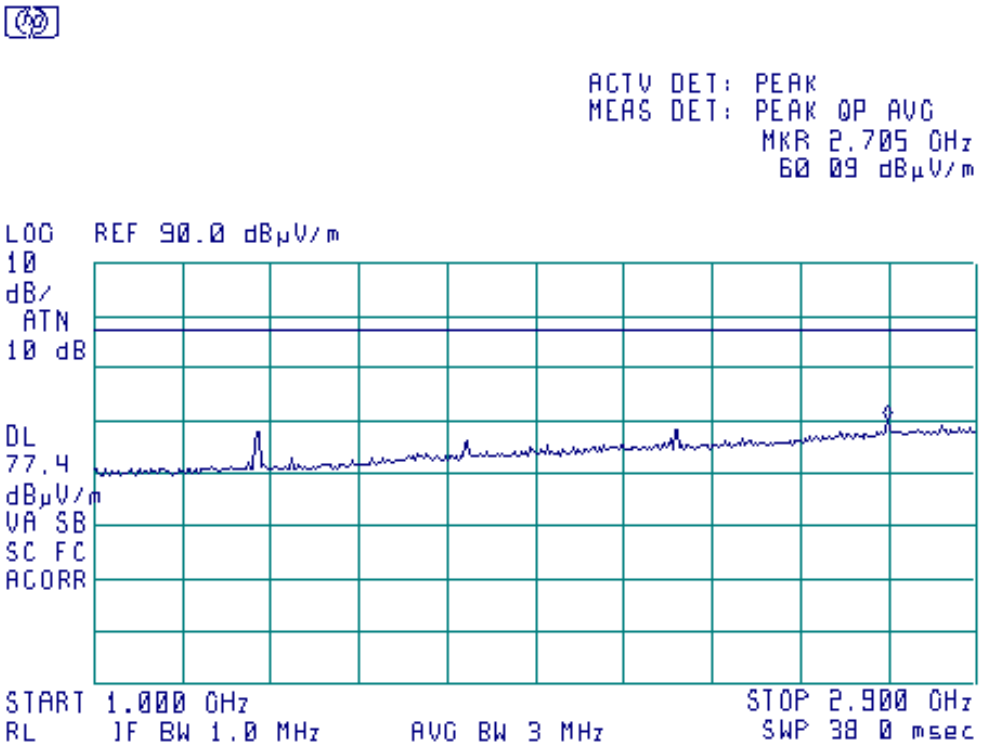
Plot A 71

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model SpeedRead @ 450 MHz carrier



No spurious emissions were found except harmonics

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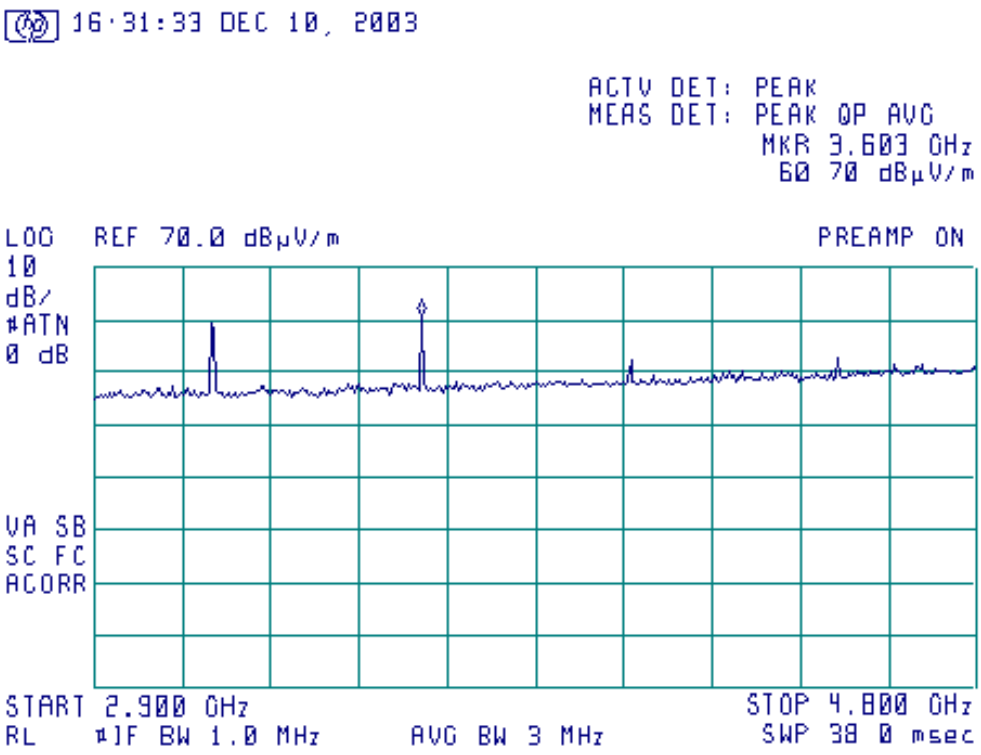
Plot A 72

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model SpeedRead @ 450 MHz carrier



No spurious emissions were found except harmonics.

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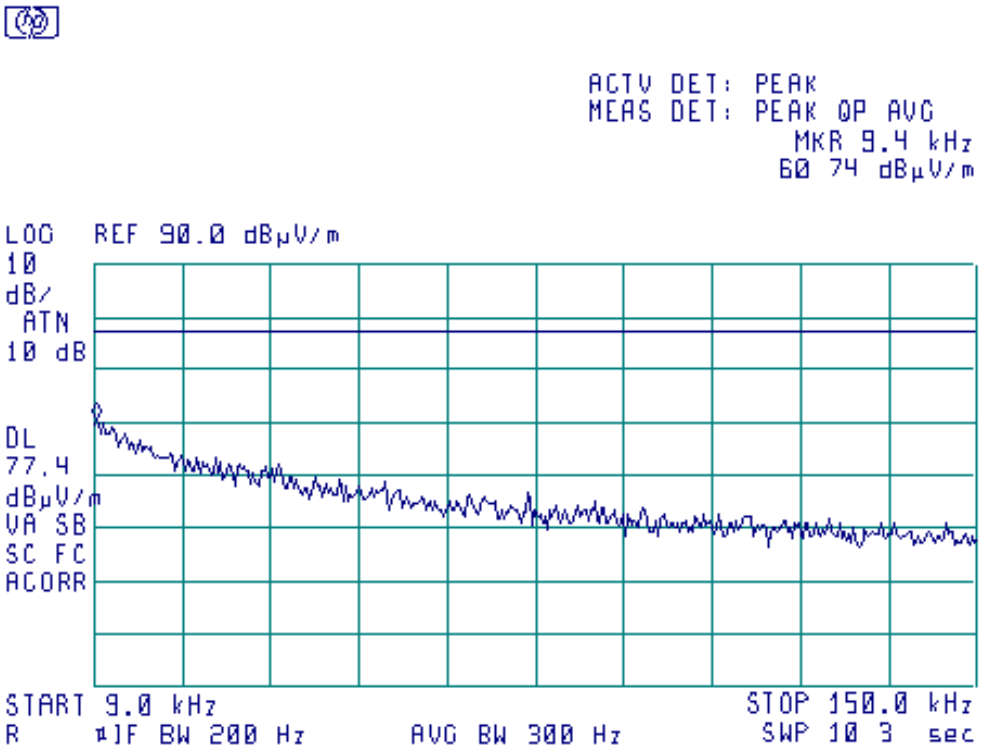
Plot A 73

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model SpeedRead @ 460 MHz carrier



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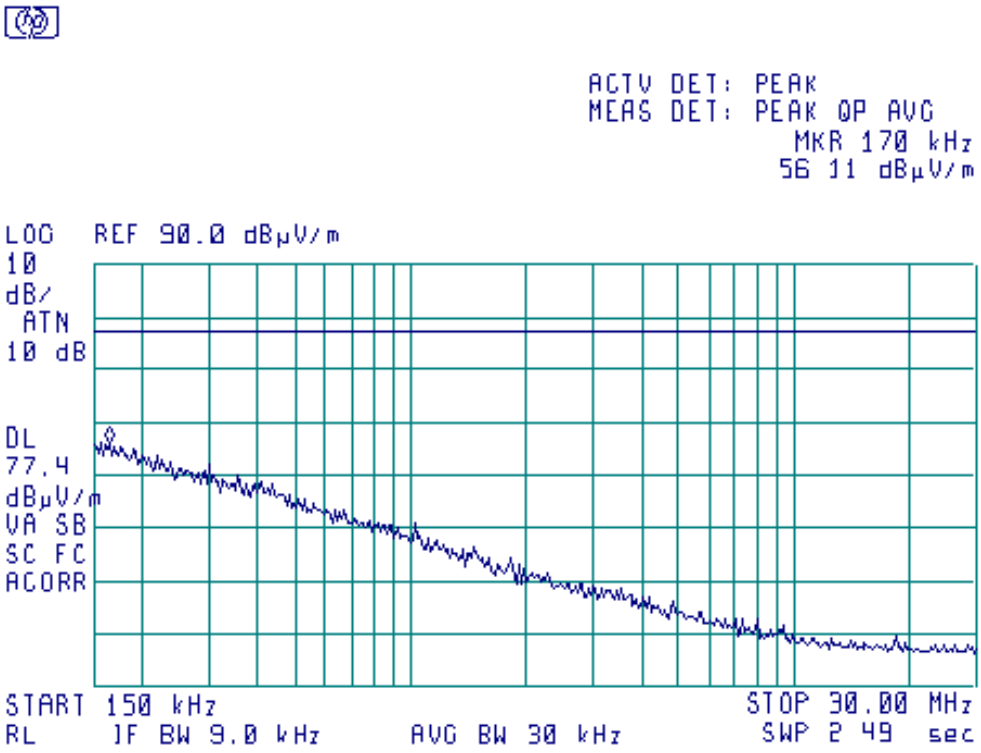
Plot A 74

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model SpeedRead @ 460 MHz carrier



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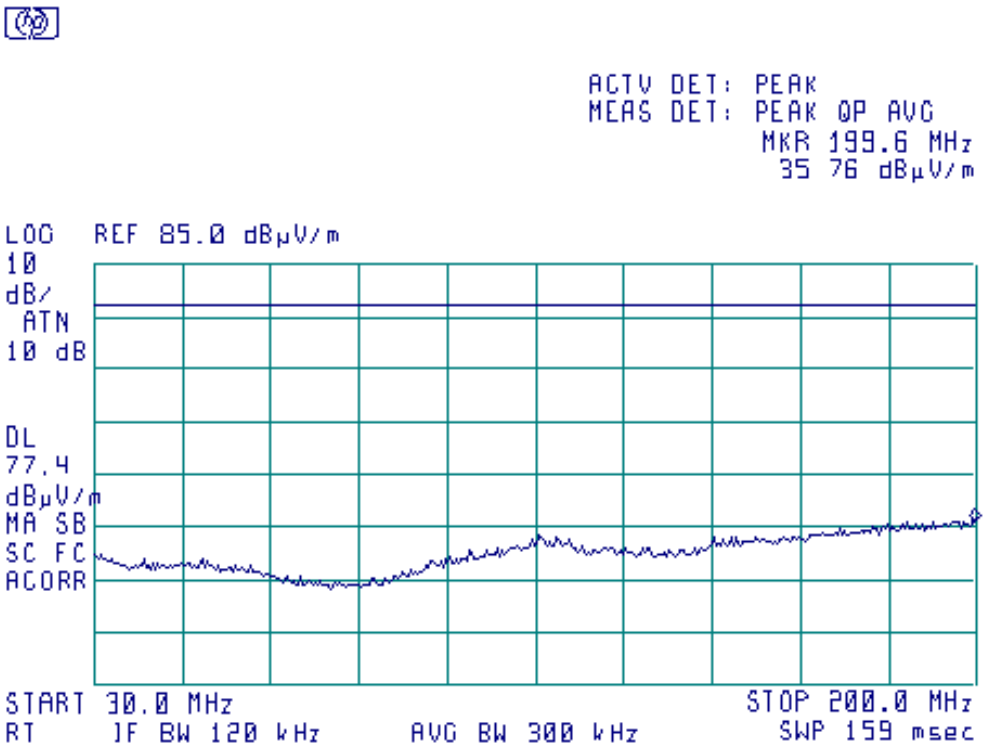
Plot A 75

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 200 MHz model SpeedRead @ 460 MHz carrier



No spurious were found

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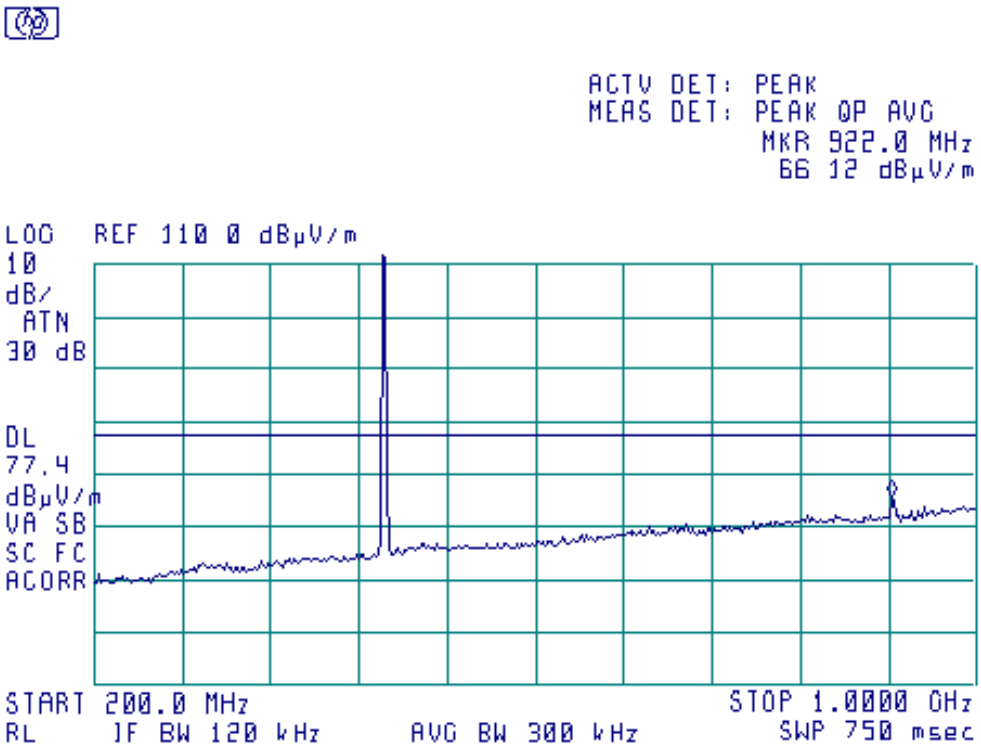
Plot A 76

Radiated spurious emission measurements in the anechoic chamber from 200 MHz to 1000 MHz model SpeedRead @ 460 MHz carrier



No spurious emissions were found except fundamental and 2nd harmonic

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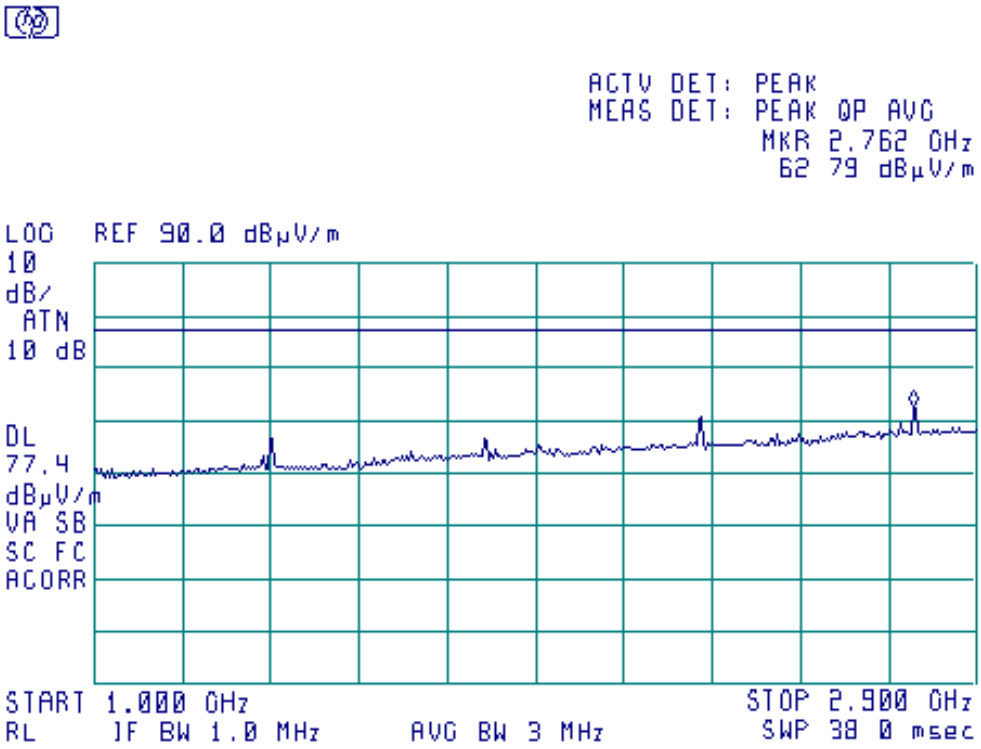
Plot A 77

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model SpeedRead @ 460 MHz carrier



No spurious emissions were found except harmonics

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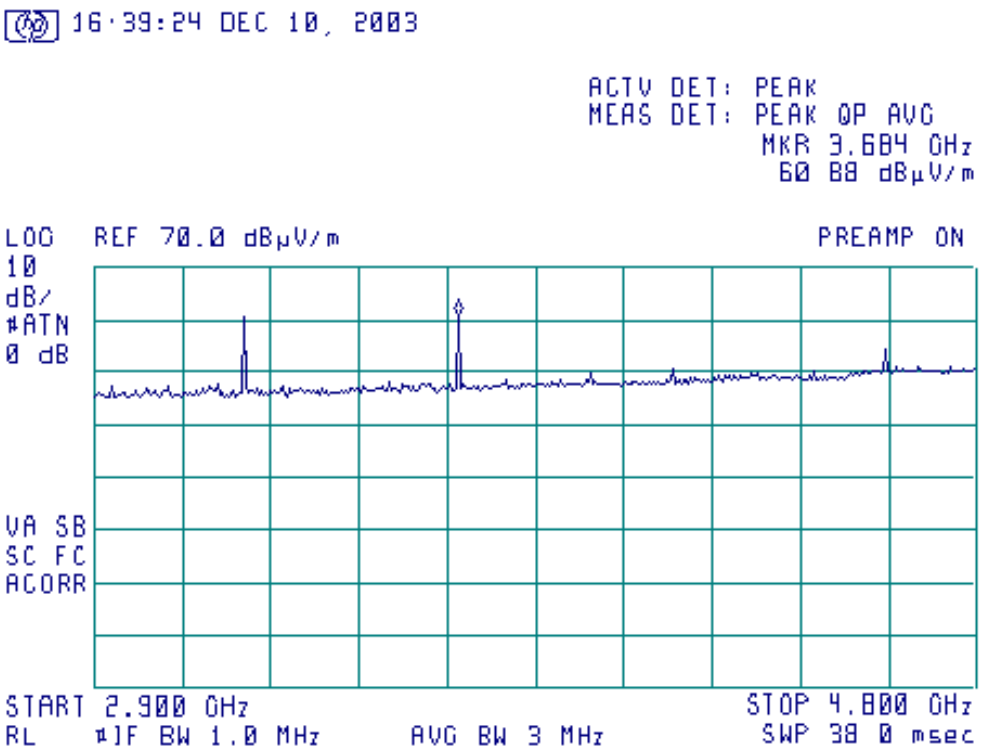
Plot A 78

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model SpeedRead @ 460 MHz carrier



No spurious emissions were found except harmonics.

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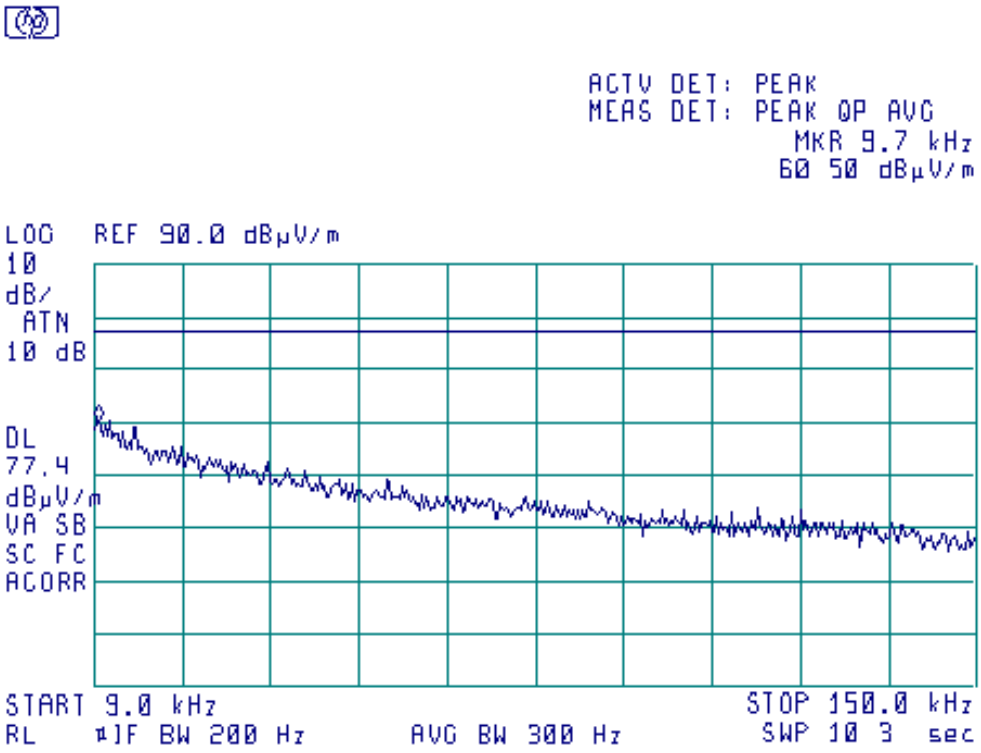
Plot A 79

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model SpeedRead @ 470 MHz carrier



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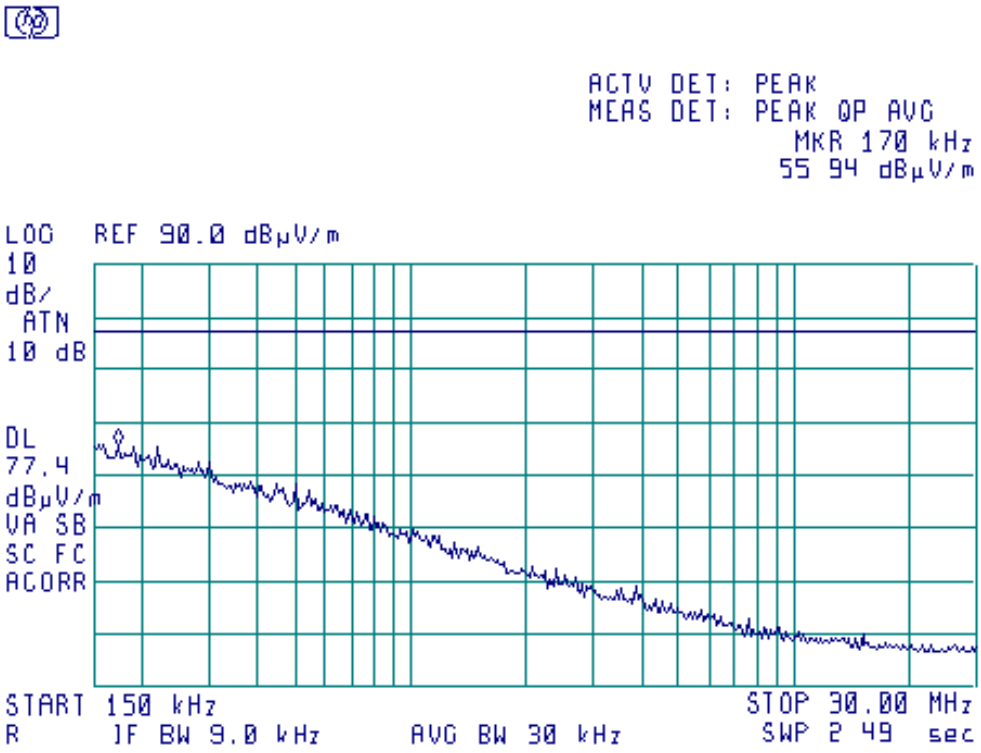
Plot A 80

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model SpeedRead @ 470 MHz carrier



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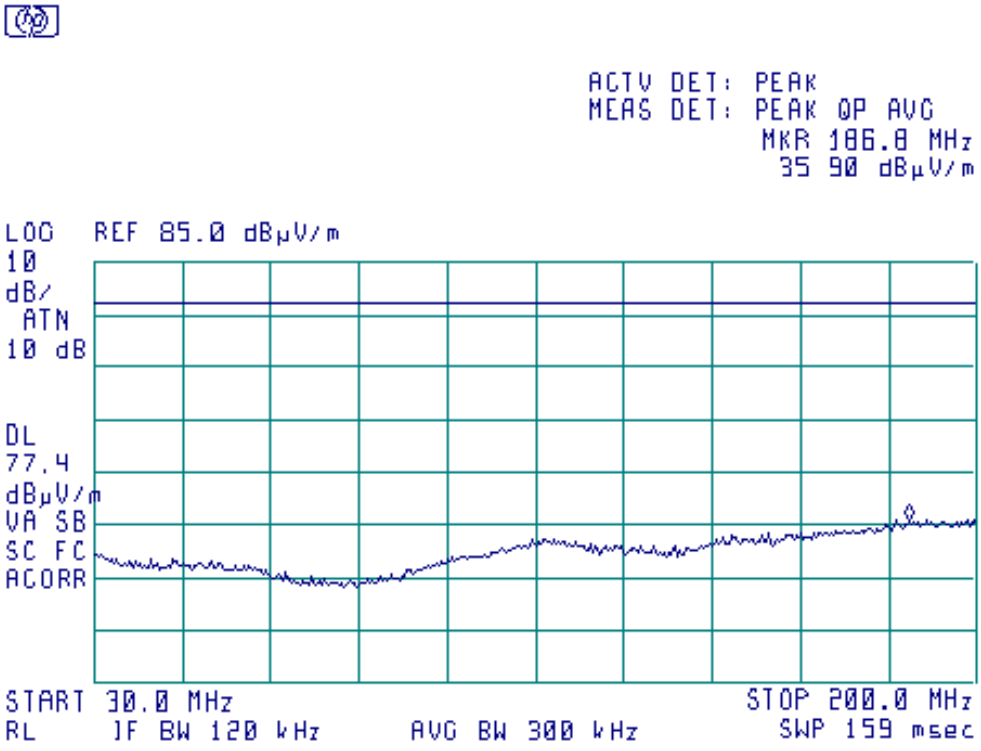
Plot A 81

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 200 MHz model SpeedRead @ 470 MHz carrier



No spurious emissions were found

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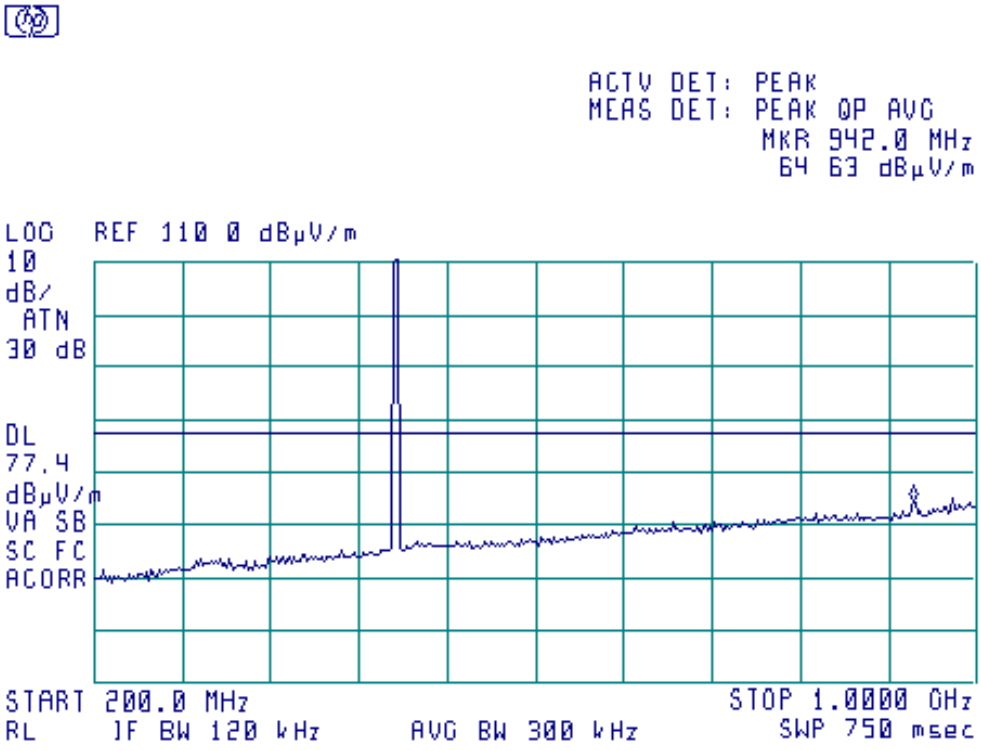
Plot A 82

Radiated spurious emission measurements in the anechoic chamber from 200 MHz to 1000 MHz model SpeedRead @ 470 MHz carrier



No spurious emissions were found except fundamental and 2nd harmonic

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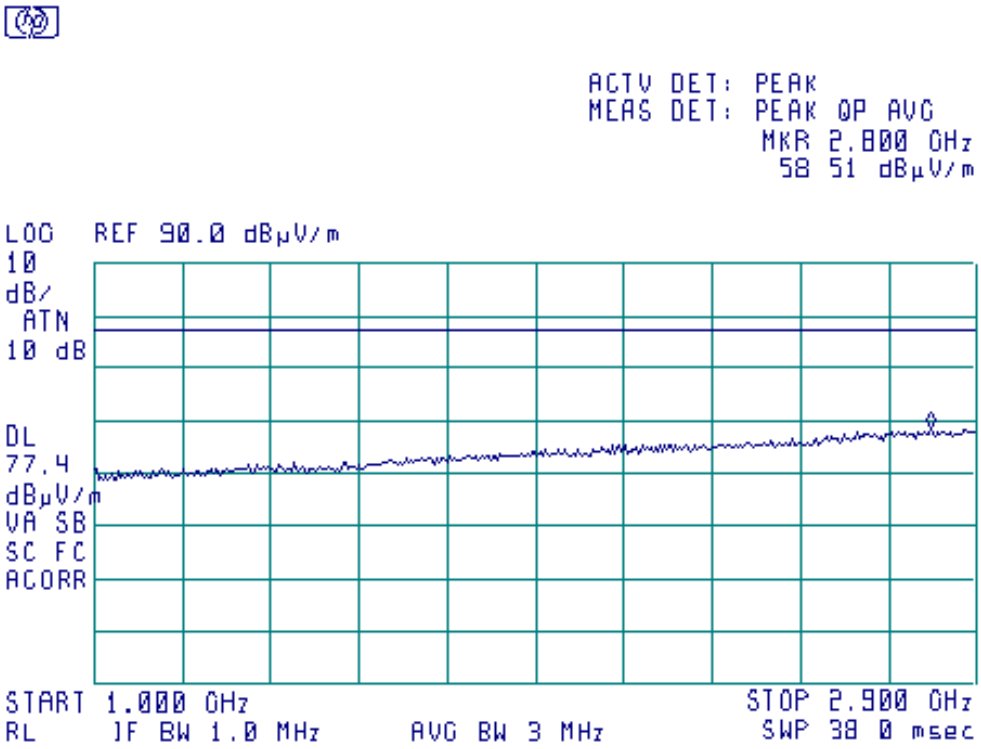
Plot A 83

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model SpeedRead @ 470 MHz carrier



No spurious emissions were found

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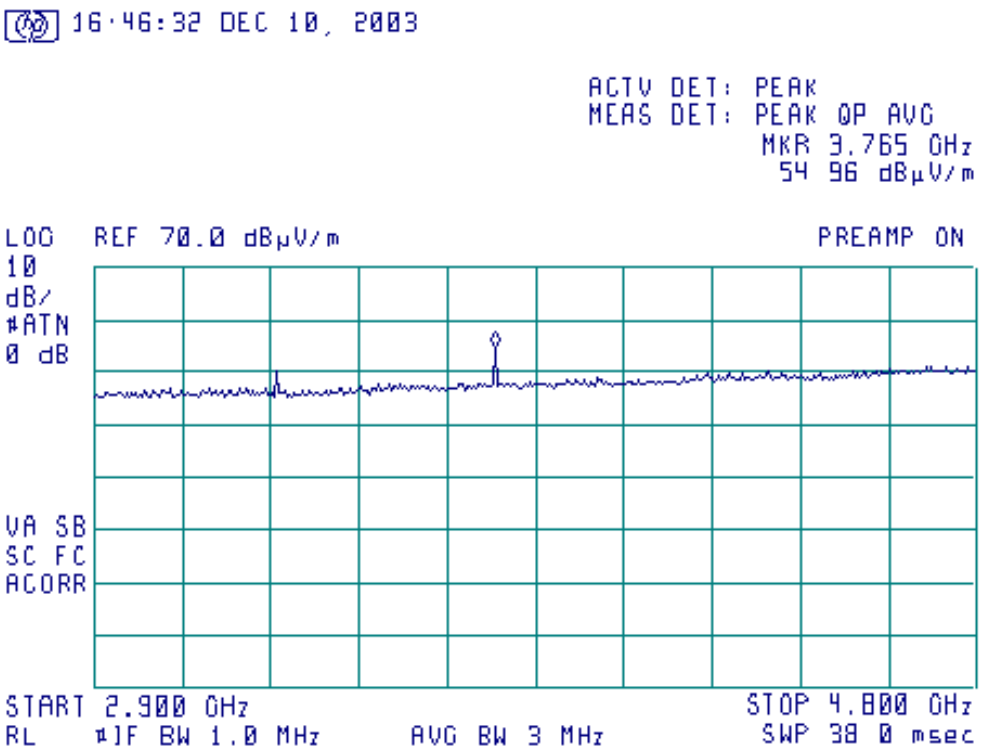
Plot A 84

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model SpeedRead @ 470 MHz carrier



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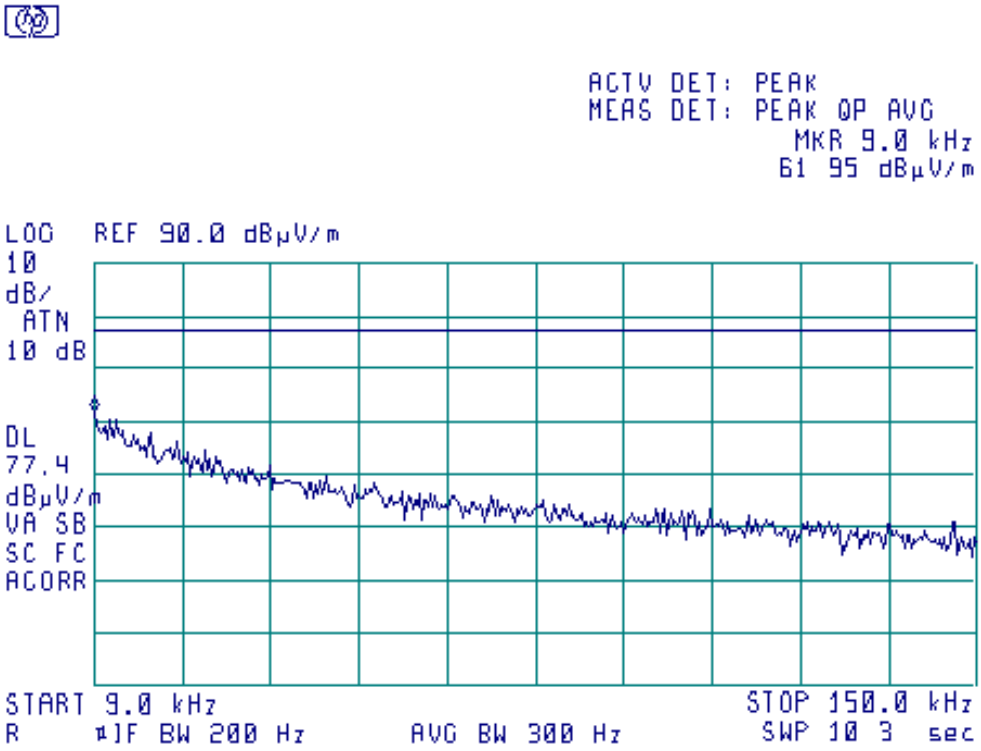
Plot A 85

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model Irriwise @ 450 MHz carrier



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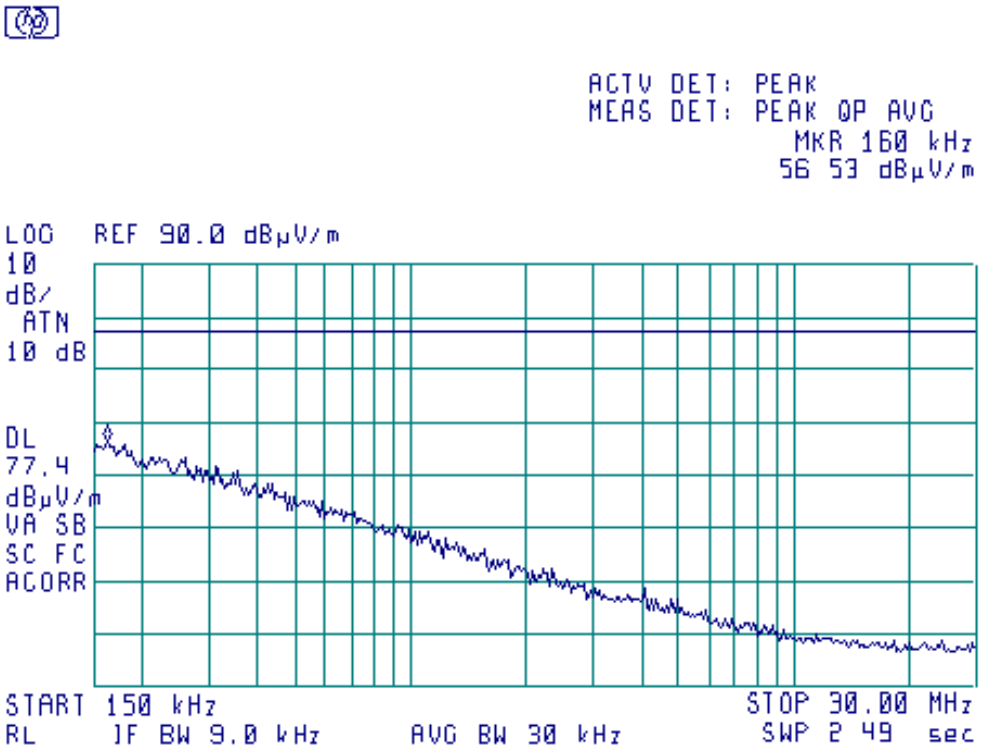
Plot A 86

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model Irriwise @ 450 MHz carrier



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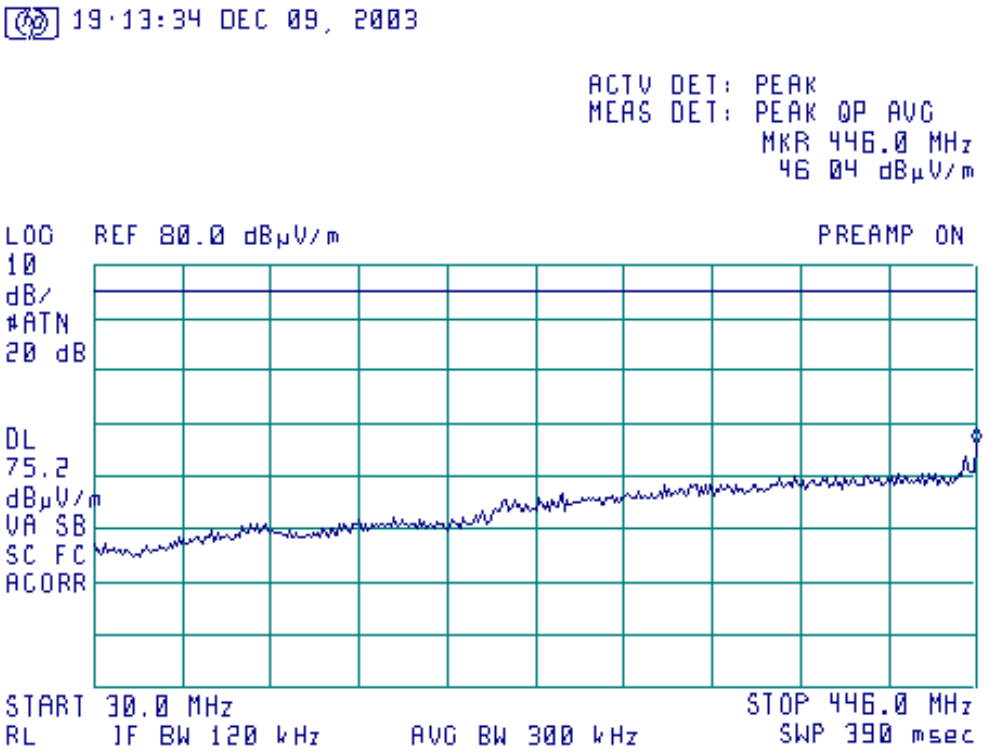
Plot A 87

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 446 MHz model Irriwise @ 450 MHz carrier



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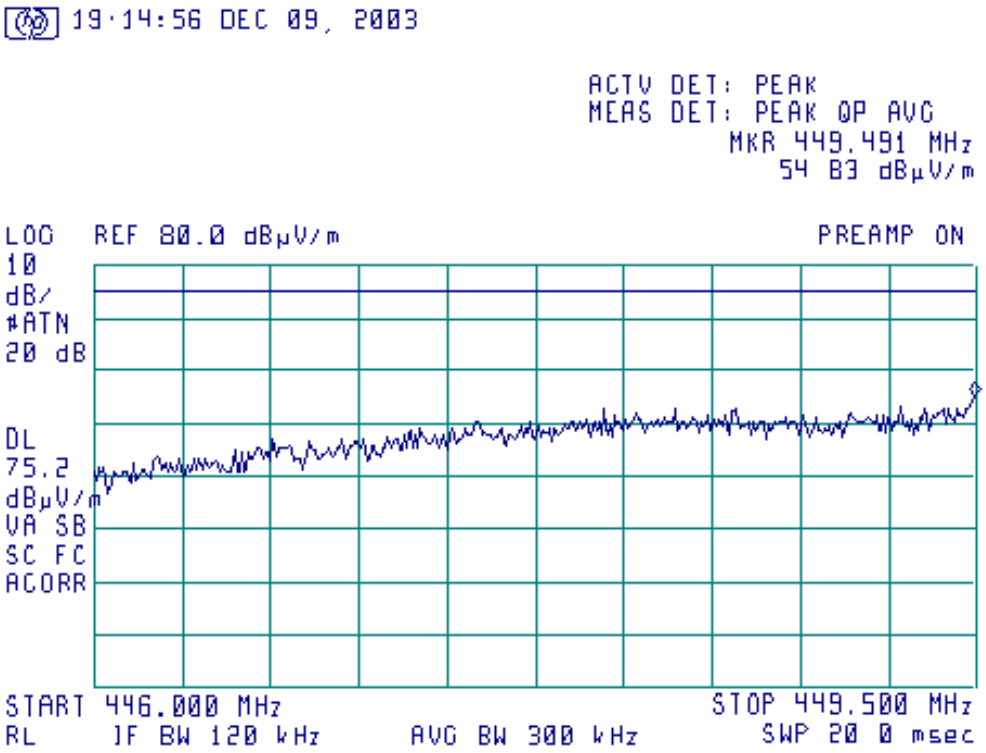
Plot A 88

Radiated spurious emission measurements in the anechoic chamber from 446 MHz to 449.500 MHz model Irriwise @ 450 MHz carrier



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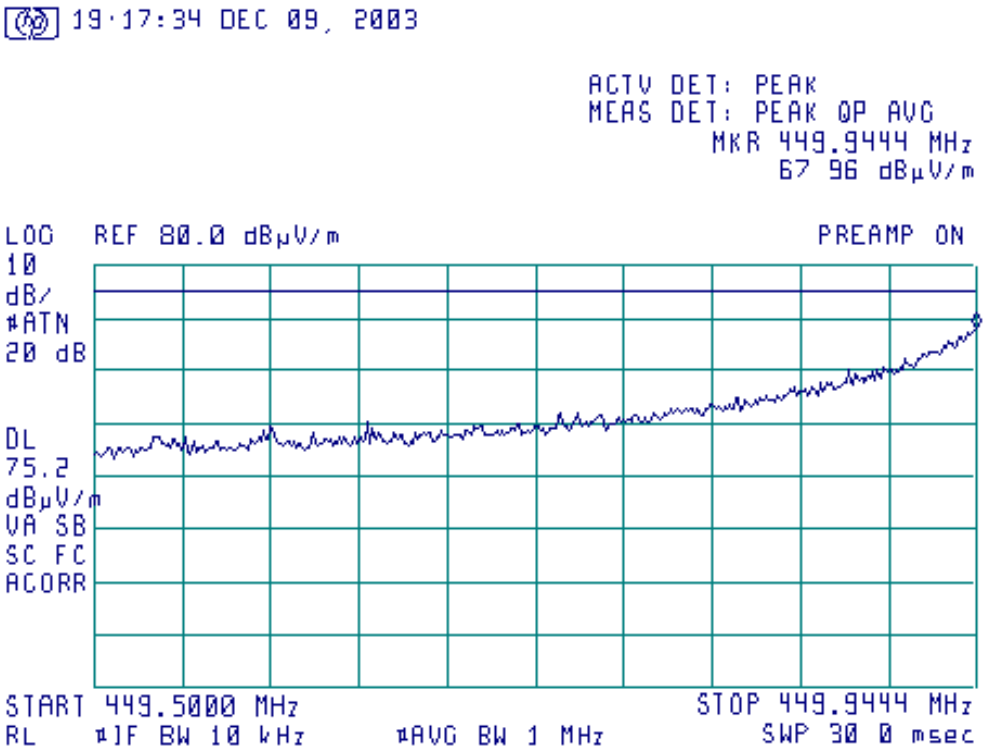
Plot A 89

Radiated spurious emission measurements in the anechoic chamber from 449.500 MHz to 449.9444 MHz model Irriwise @ 450 MHz carrier



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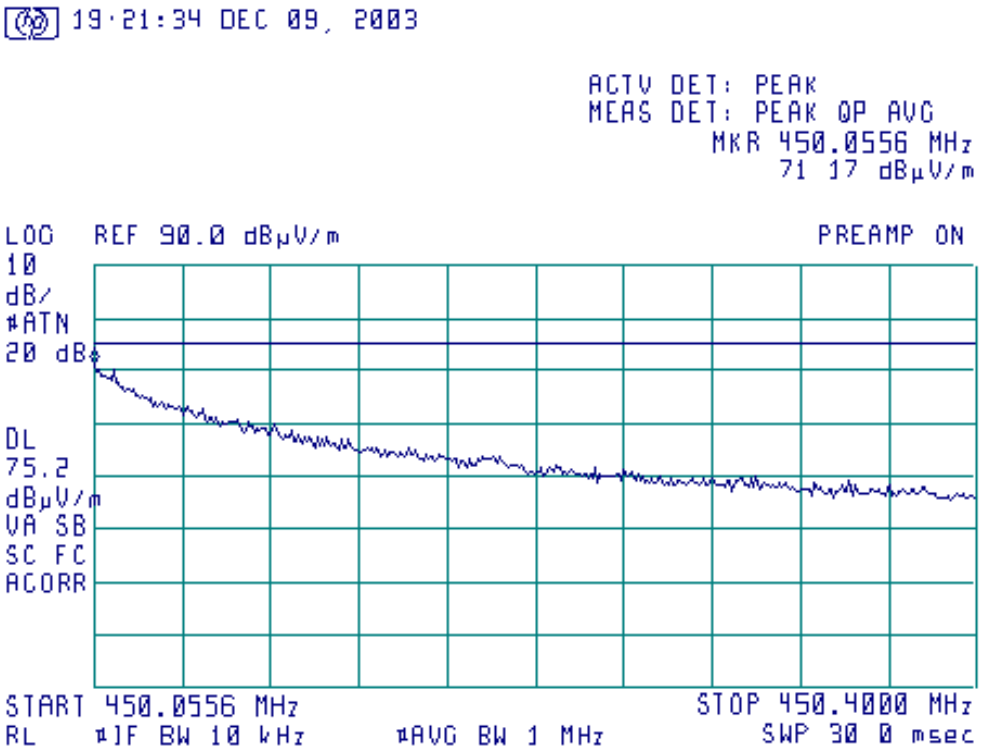
Plot A 90

Radiated spurious emission measurements in the anechoic chamber from 450.0556 MHz to 450.400 MHz model Irriwise @ 450 MHz carrier



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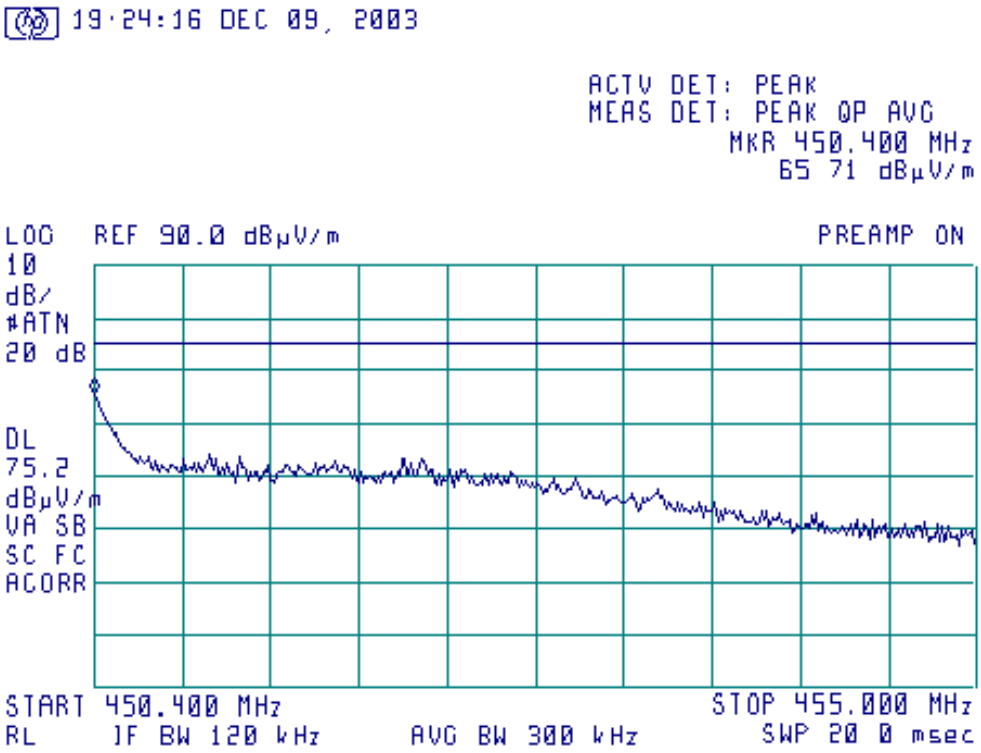
Plot A 91

Radiated spurious emission measurements in the anechoic chamber from 450.400 MHz to 455.000 MHz model Irriwise @ 450 MHz carrier



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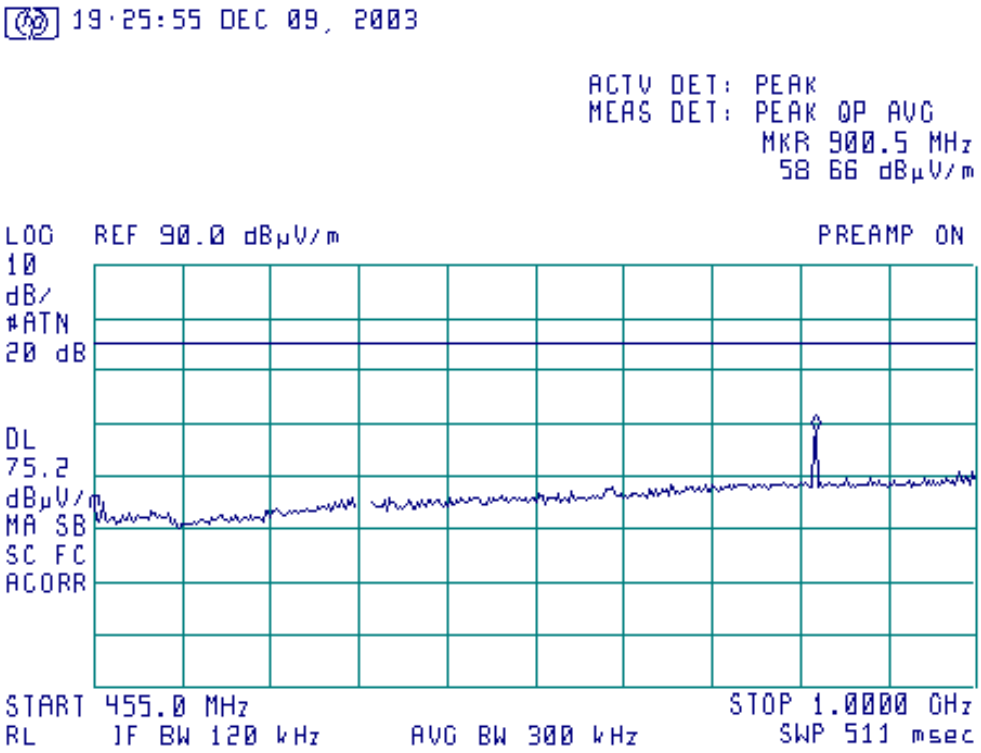
Plot A 92

Radiated spurious emission measurements in the anechoic chamber from 455.000 MHz to 1000 MHz model Irriwise @ 450 MHz carrier



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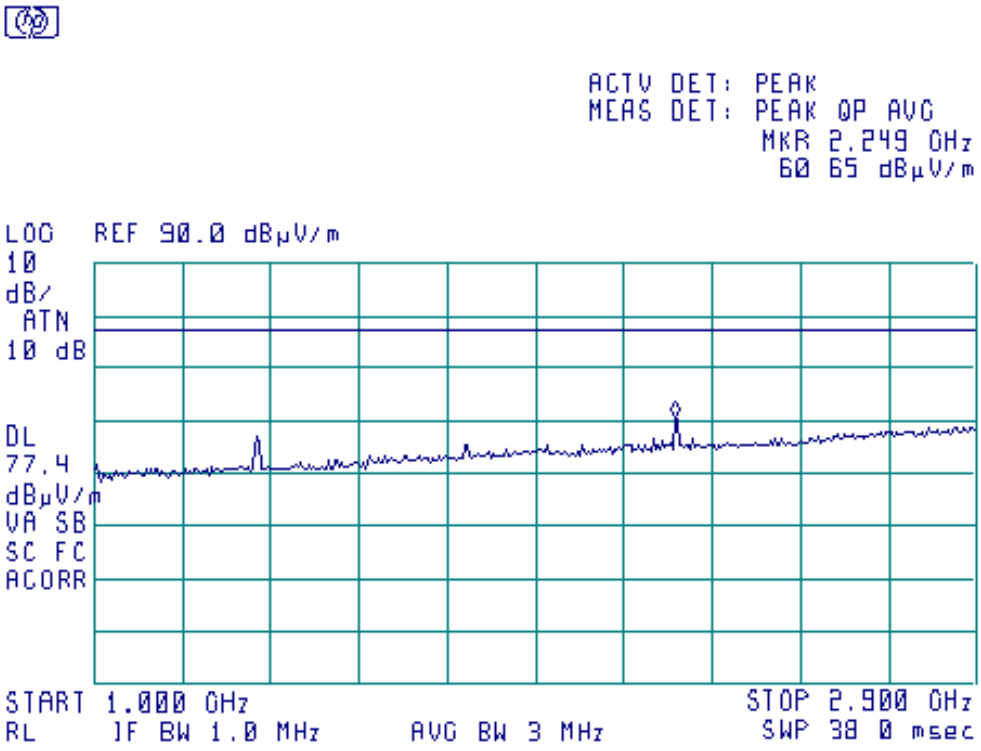
Plot A 93

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model Irriwise @ 450 MHz carrier



No spurious emissions were found except harmonics

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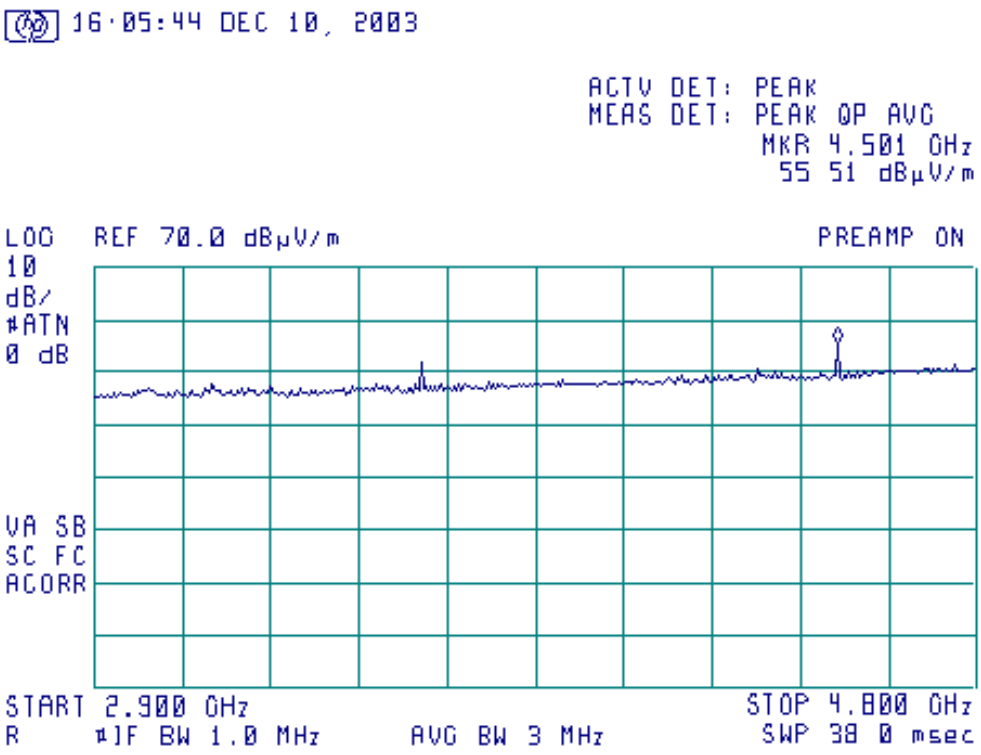
Plot A 94

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model Irriwise @ 450 MHz carrier



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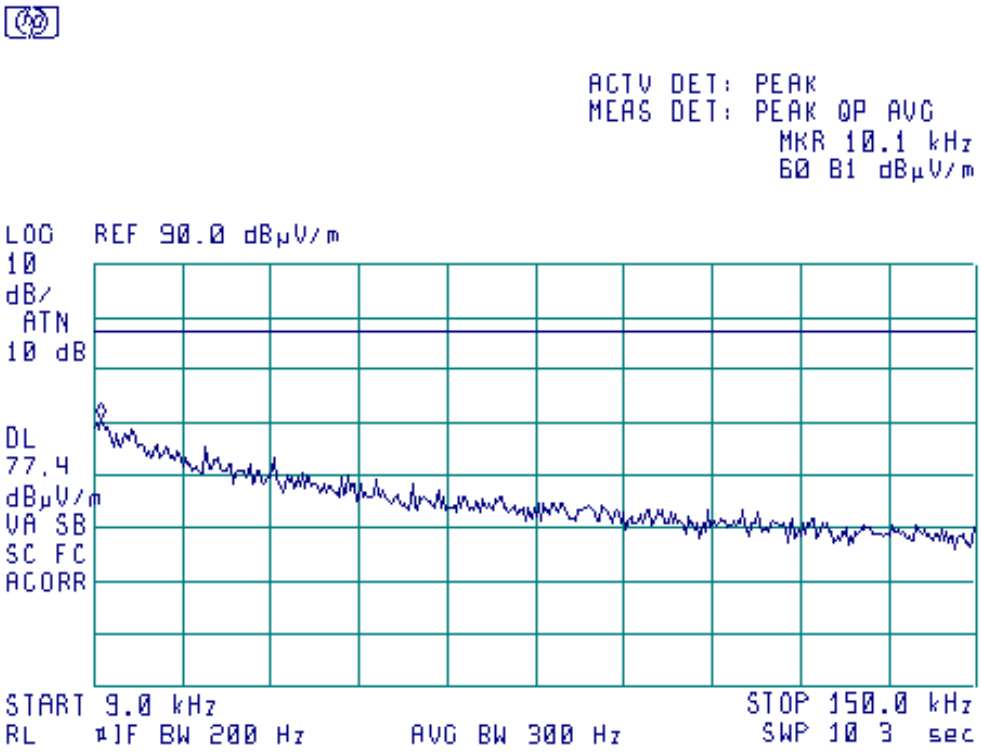
Plot A 95

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model Irriwise @ 460 MHz carrier



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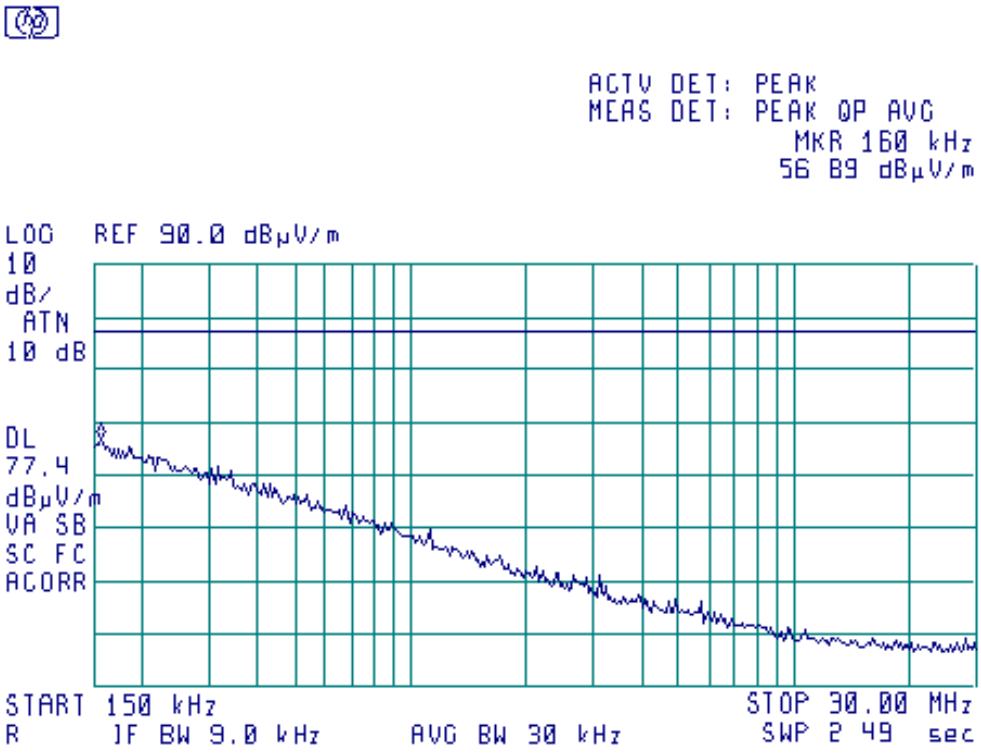
Plot A 96

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model Irriwise @ 460 MHz carrier



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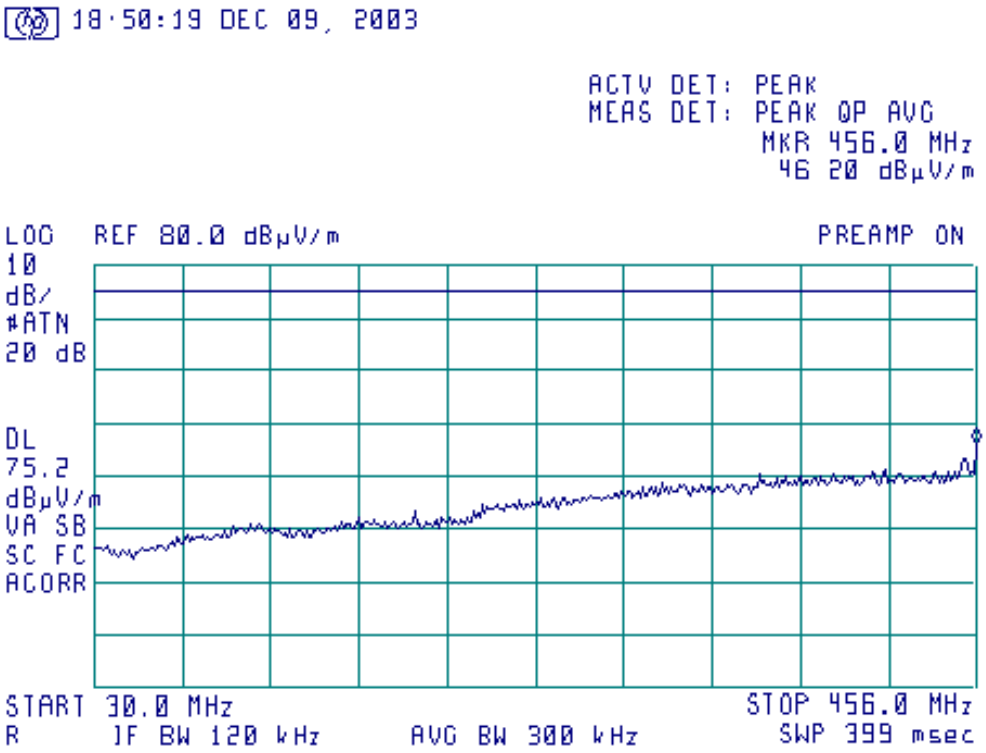
Plot A 97

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 456.0 MHz model Irriwise @ 460 MHz carrier



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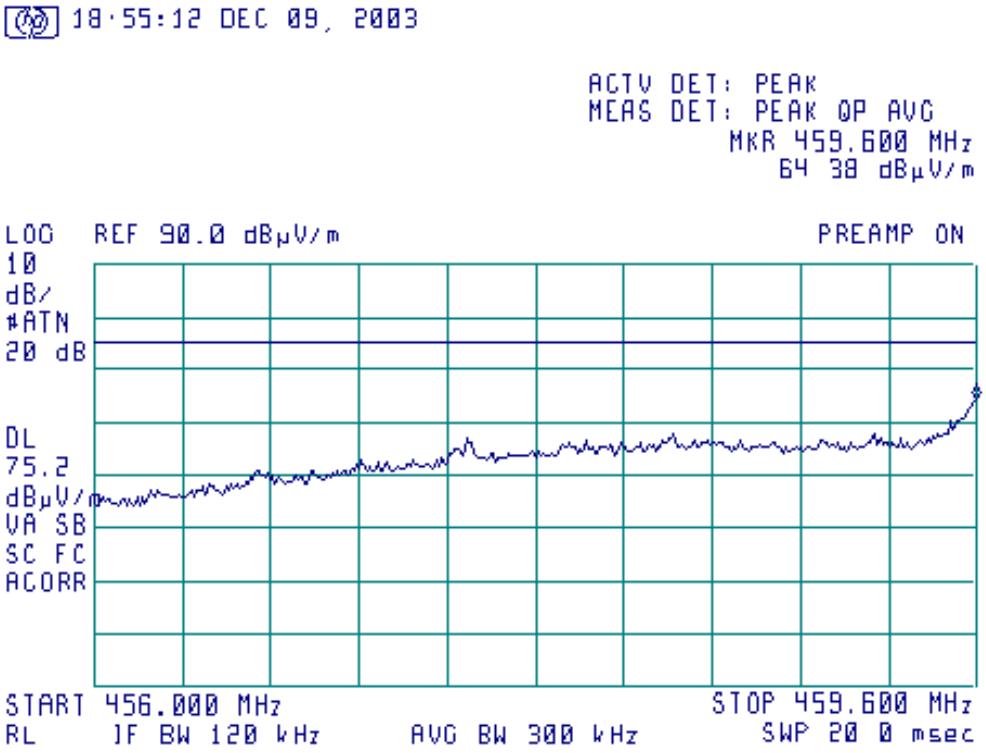
Plot A 98

Radiated spurious emission measurements in the anechoic chamber from 456 MHz to 459.600 MHz model Irriwise @ 460 MHz carrier



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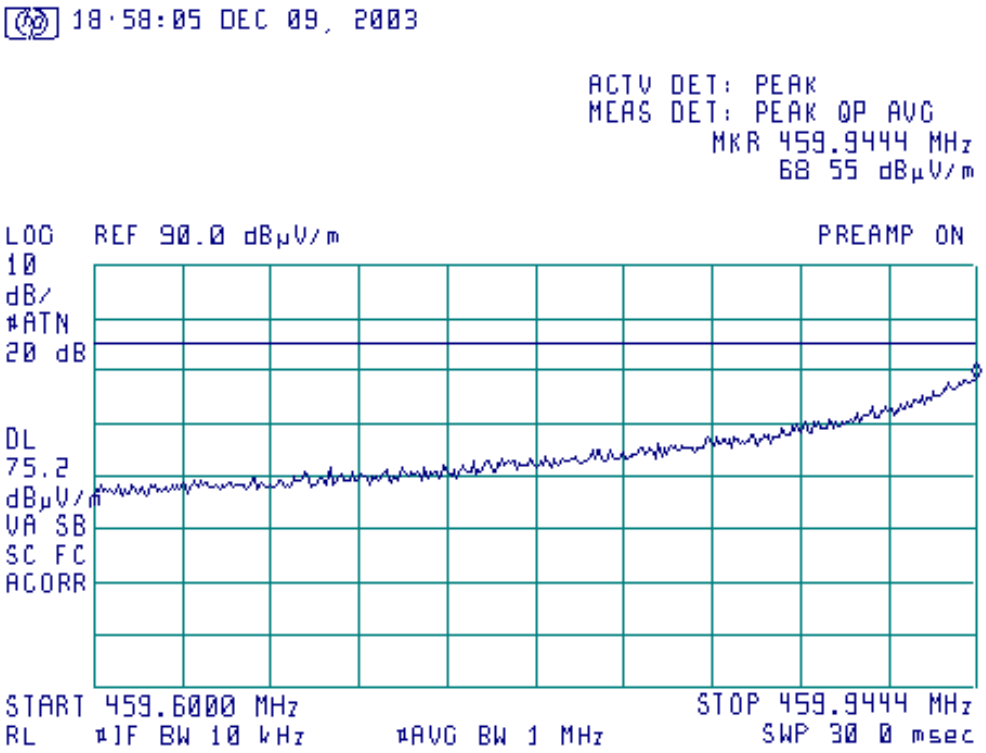
Plot A 99

Radiated spurious emission measurements in the anechoic chamber from 459.600 MHz to 459.9444 MHz model Irriwise @ 460 MHz carrier



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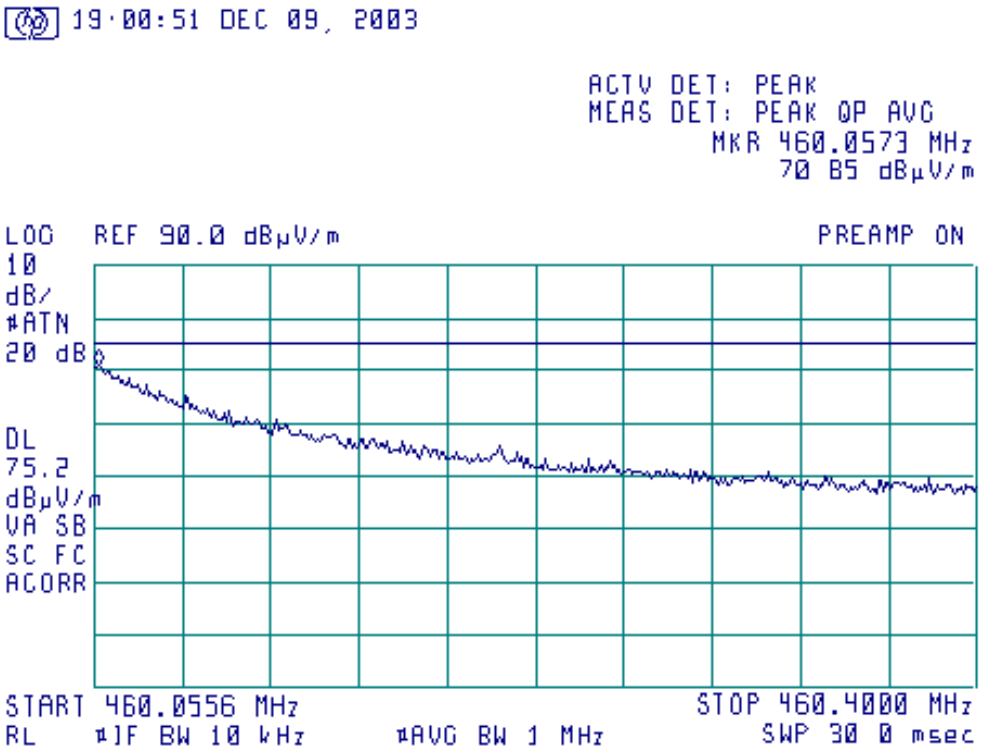
Plot A 100

Radiated spurious emission measurements in the anechoic chamber from 460.0556 MHz to 460.400 MHz model Irriwise @ 460 MHz carrier



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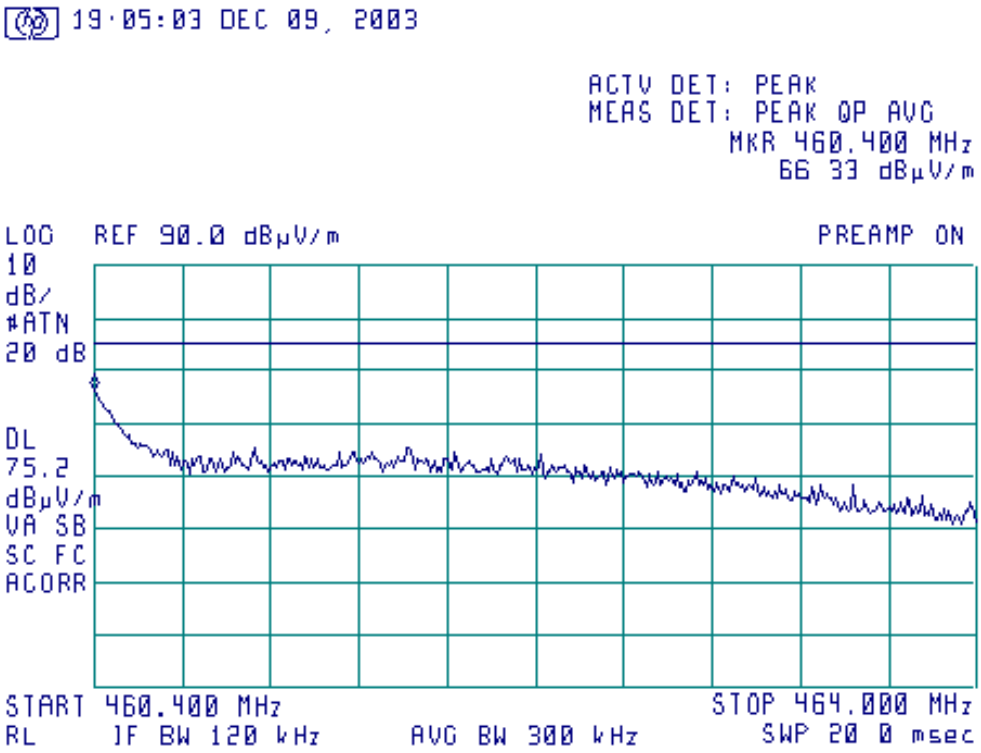
Plot A 101

Radiated spurious emission measurements in the anechoic chamber from 460.400 MHz to 464.000 MHz model Irriwise @ 460 MHz carrier



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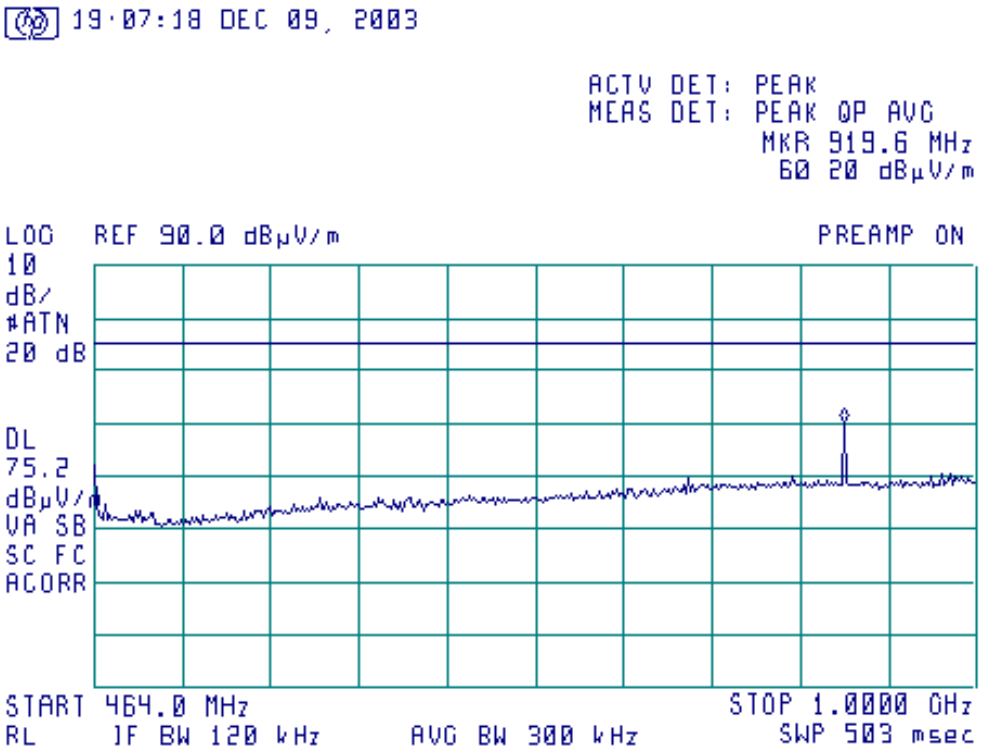
Plot A 102

Radiated spurious emission measurements in the anechoic chamber from 455.000 MHz to 1000 MHz model Irriwise @ 460 MHz carrier



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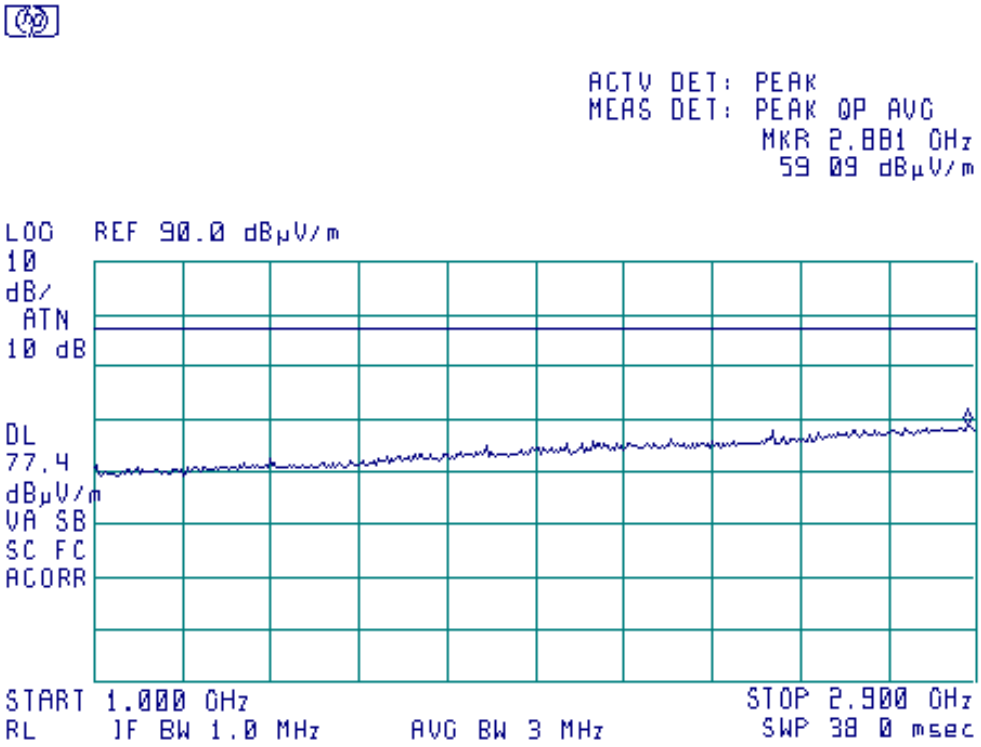
Plot A 103

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model Irriwise @ 460 MHz carrier



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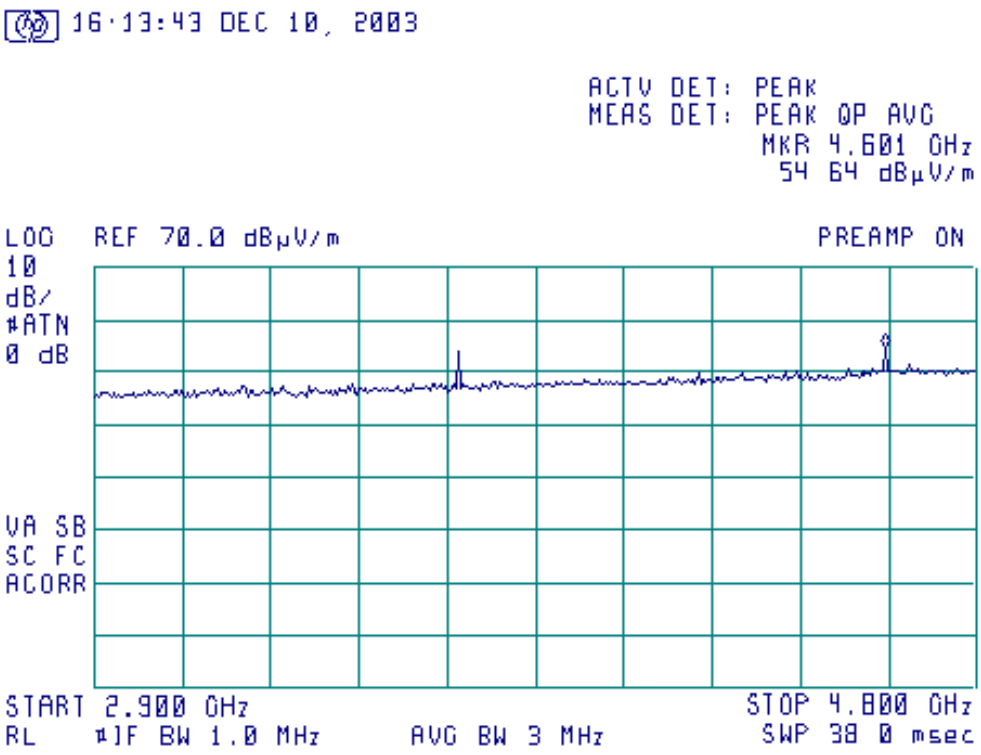
Plot A 104

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model Irriwise @ 460 MHz carrier



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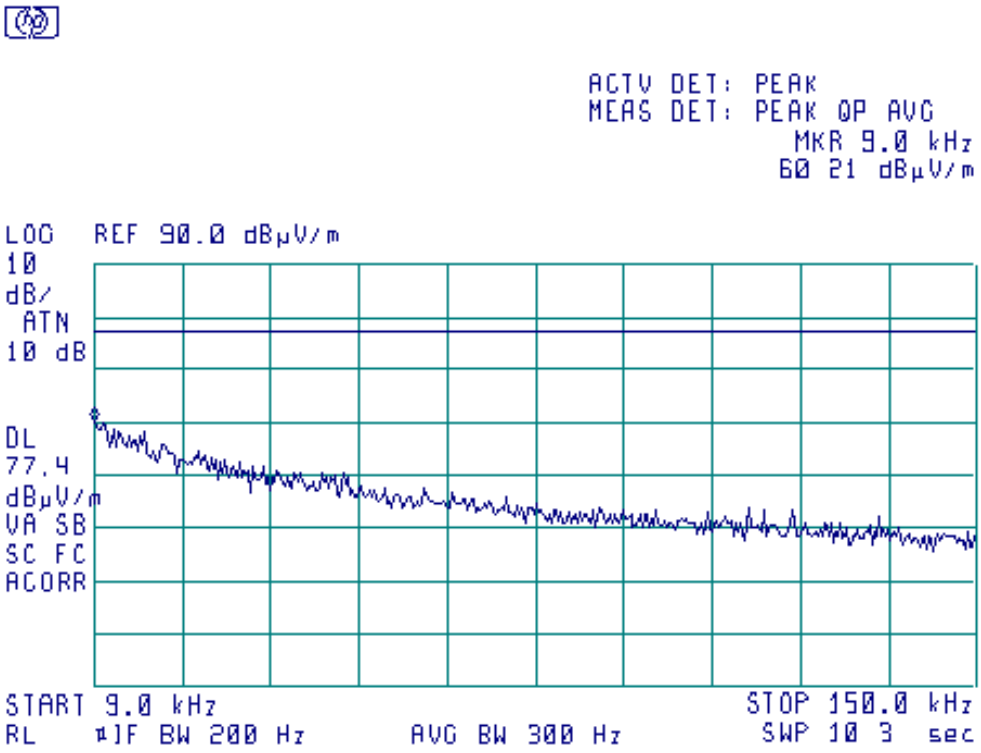
Plot A 105

Radiated spurious emission measurements in the anechoic chamber from 9 kHz to 150 kHz, model Irriwise @ 470 MHz carrier



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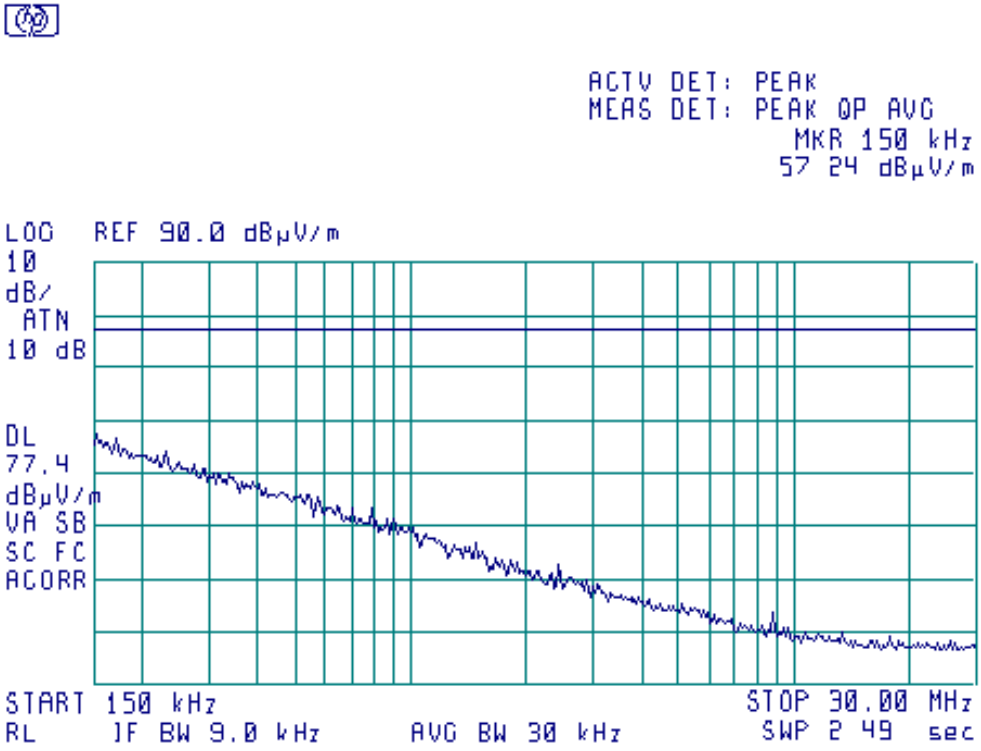
Plot A 106

Radiated spurious emission measurements in the anechoic chamber from 150 kHz to 30 MHz, model Irriwise @ 470 MHz carrier



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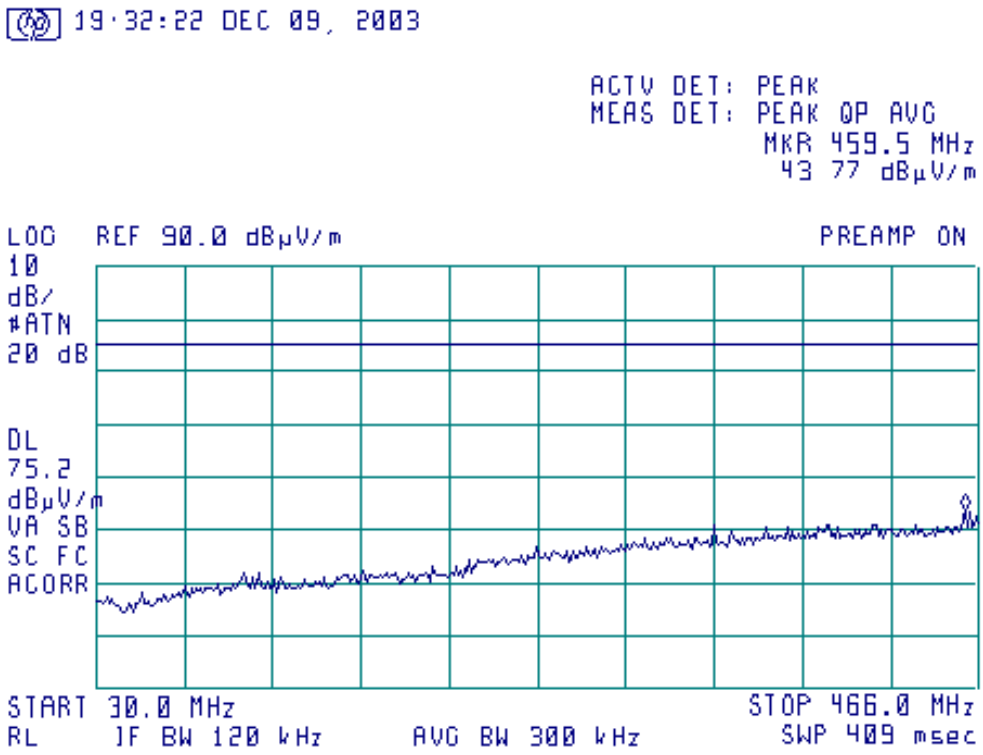
Plot A 107

Radiated spurious emission measurements in the anechoic chamber from 30 MHz to 466 MHz model Irriwise @ 470 MHz carrier



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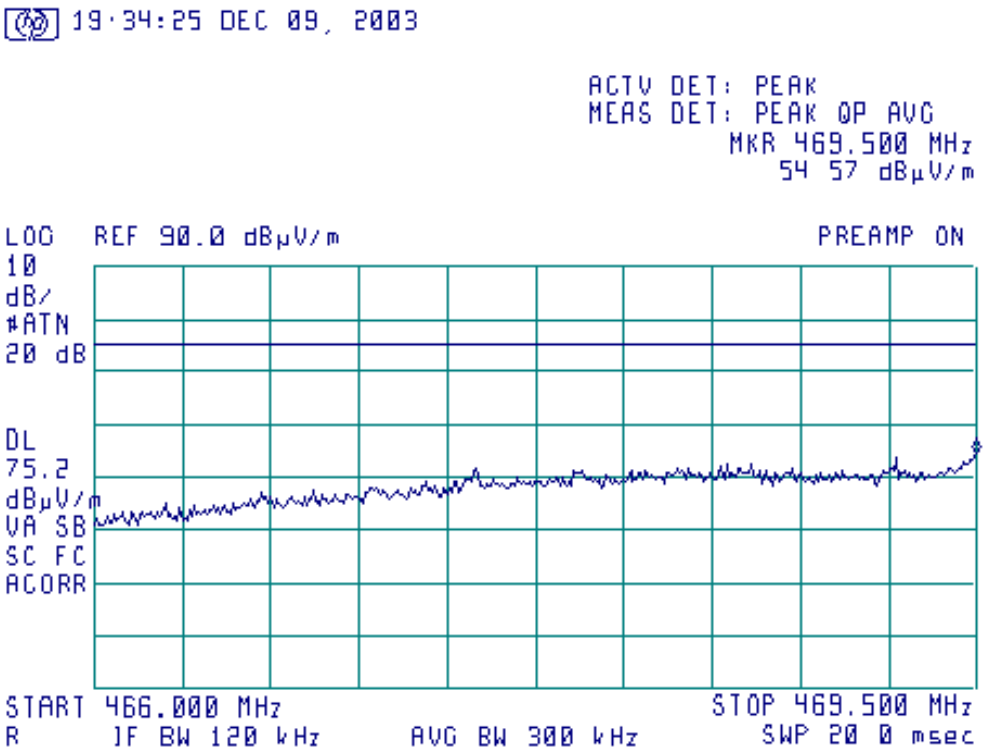
Plot A 108

Radiated spurious emission measurements in the anechoic chamber from 466 MHz to 469.500 MHz model Irriwise @ 470 MHz carrier



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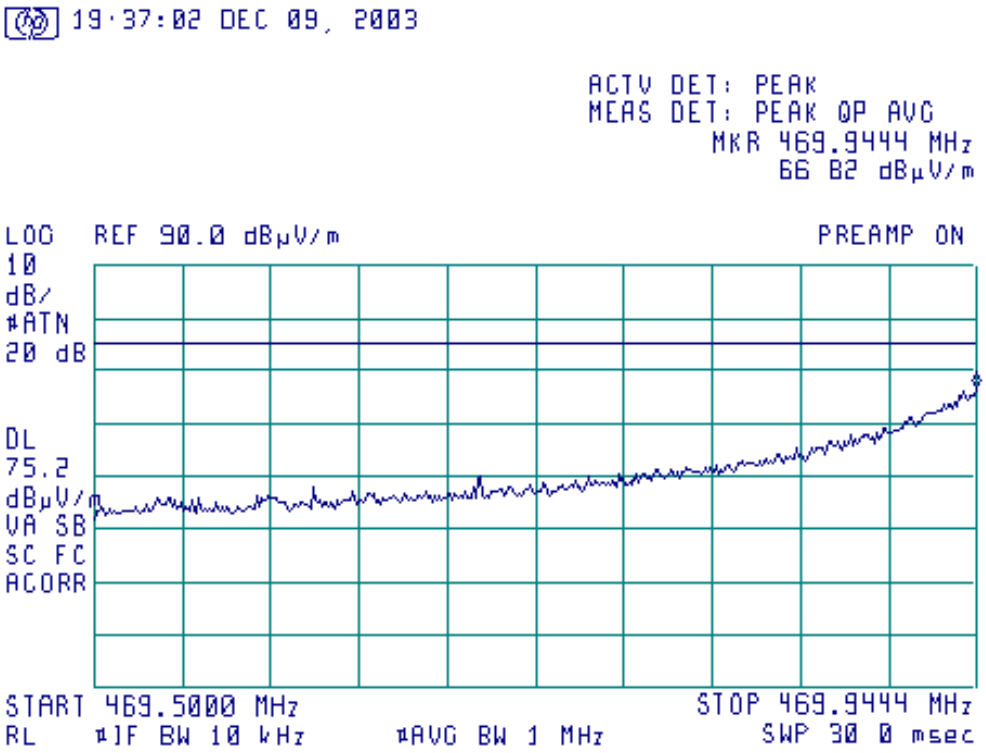
Plot A 109

Radiated spurious emission measurements in the anechoic chamber from 469.500 MHz to 469.9444 MHz model Irriwise @ 470 MHz carrier



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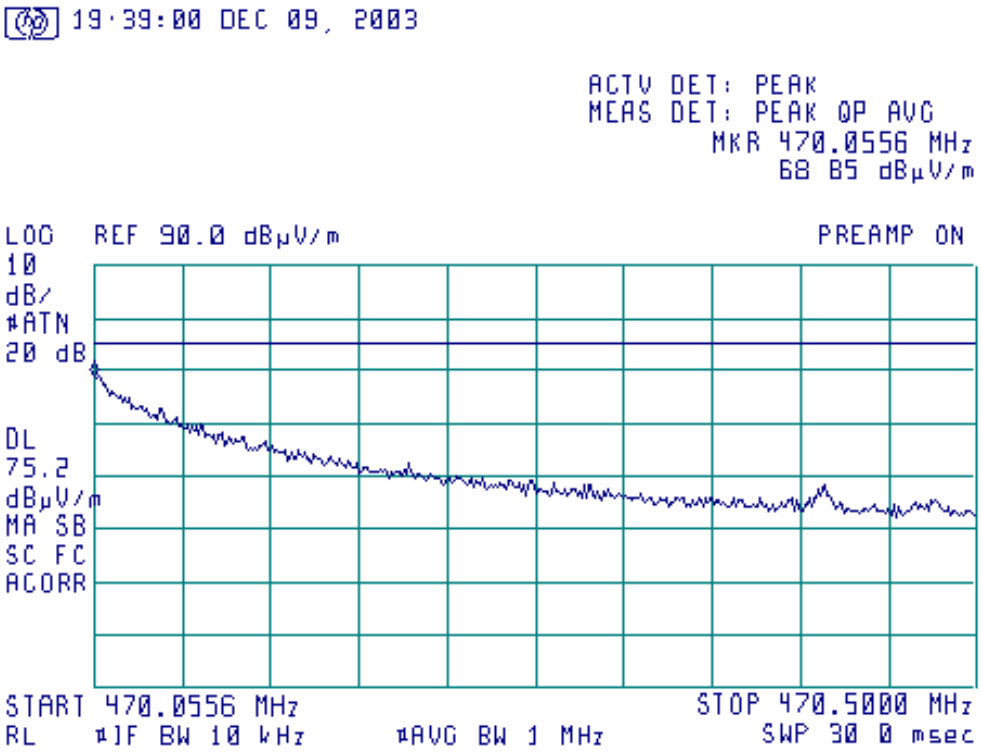
Plot A 110

Radiated spurious emission measurements in the anechoic chamber from 470.0556 MHz to 470.500 MHz model Irriwise @ 470 MHz carrier



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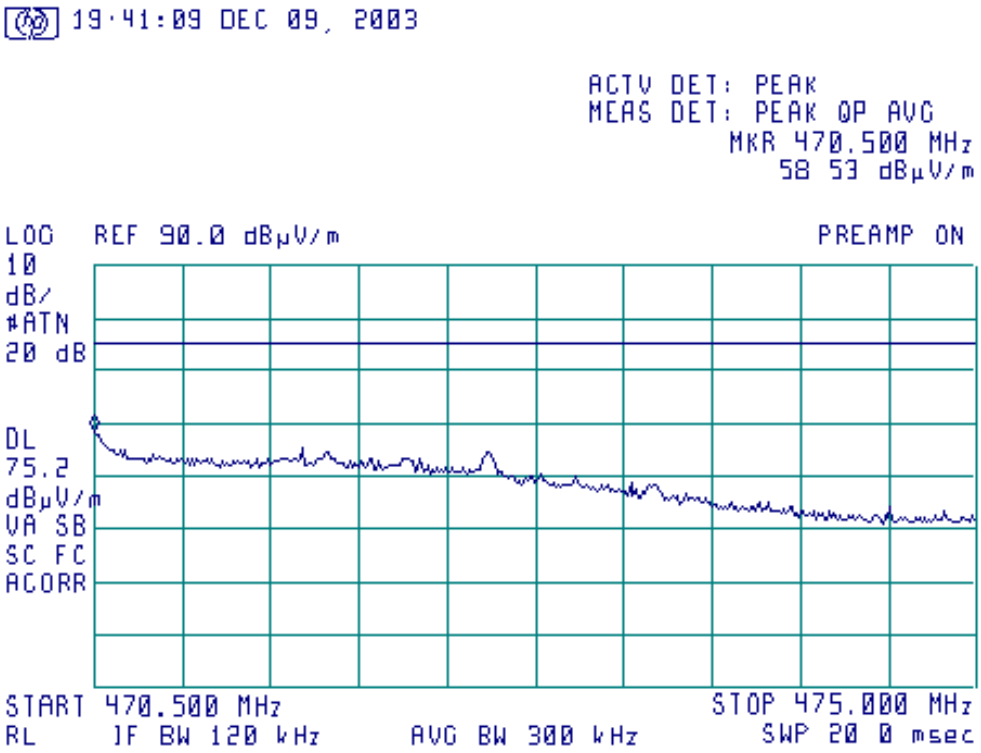
Plot A 111

Radiated spurious emission measurements in the anechoic chamber from 470.500 MHz to 475.000 MHz model Irriwise @ 470 MHz carrier



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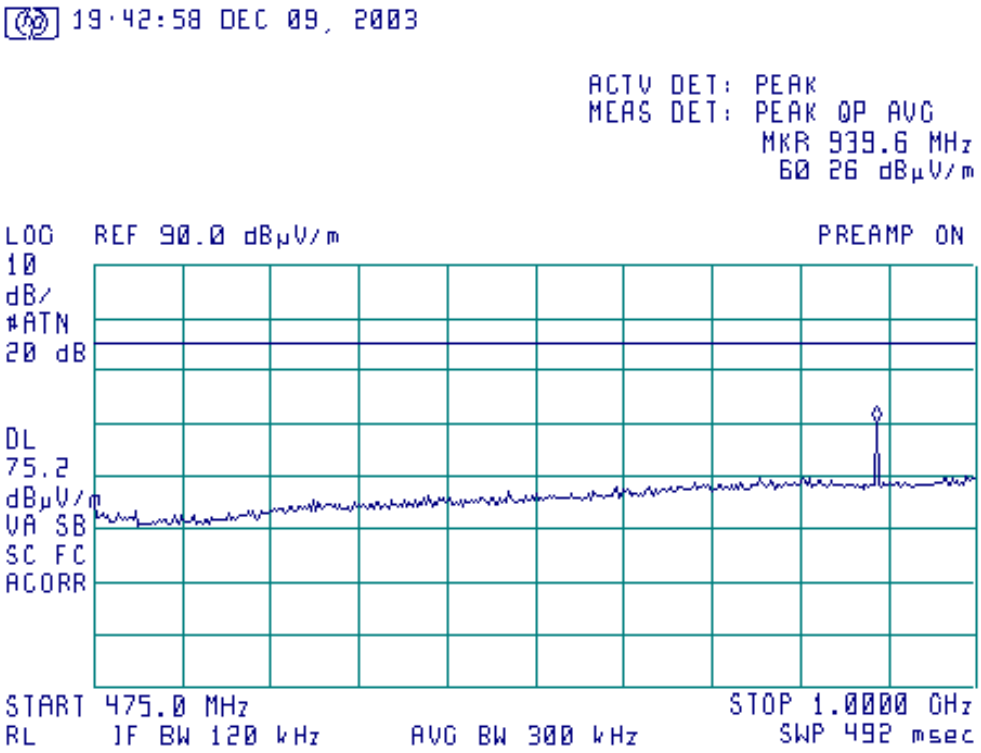
Plot A 112

Radiated spurious emission measurements in the anechoic chamber from 475 MHz to 1000 MHz model Irriwise @ 470 MHz carrier



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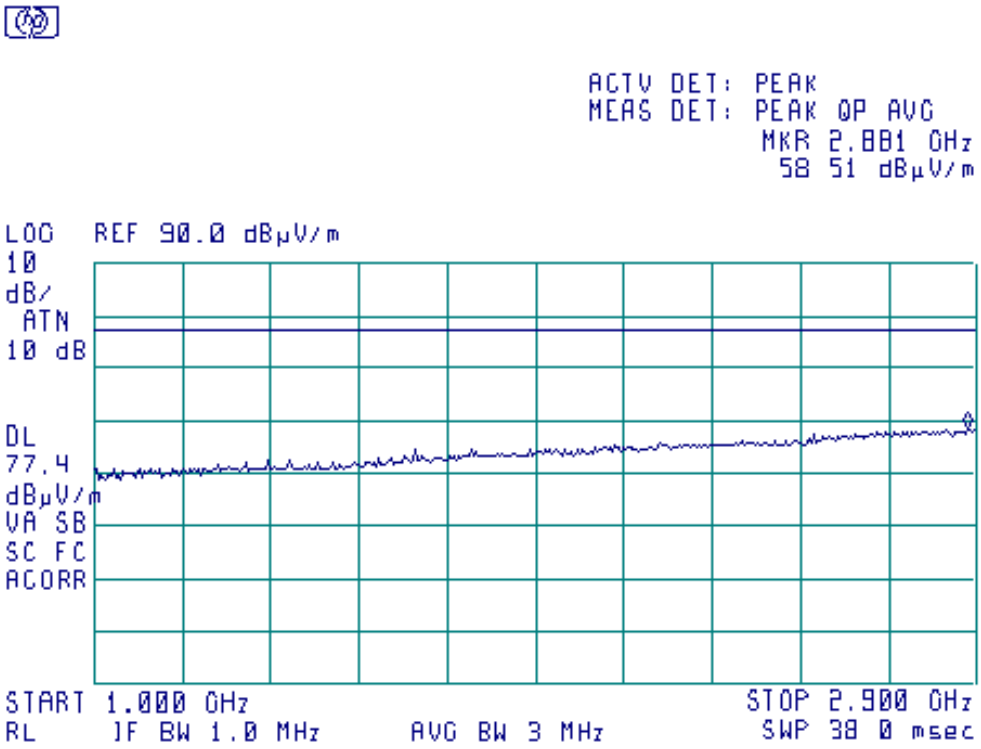
Plot A 113

Radiated spurious emission measurements in the anechoic chamber from 1.000 GHz to 2.900 GHz, model Irriwise @ 470 MHz carrier



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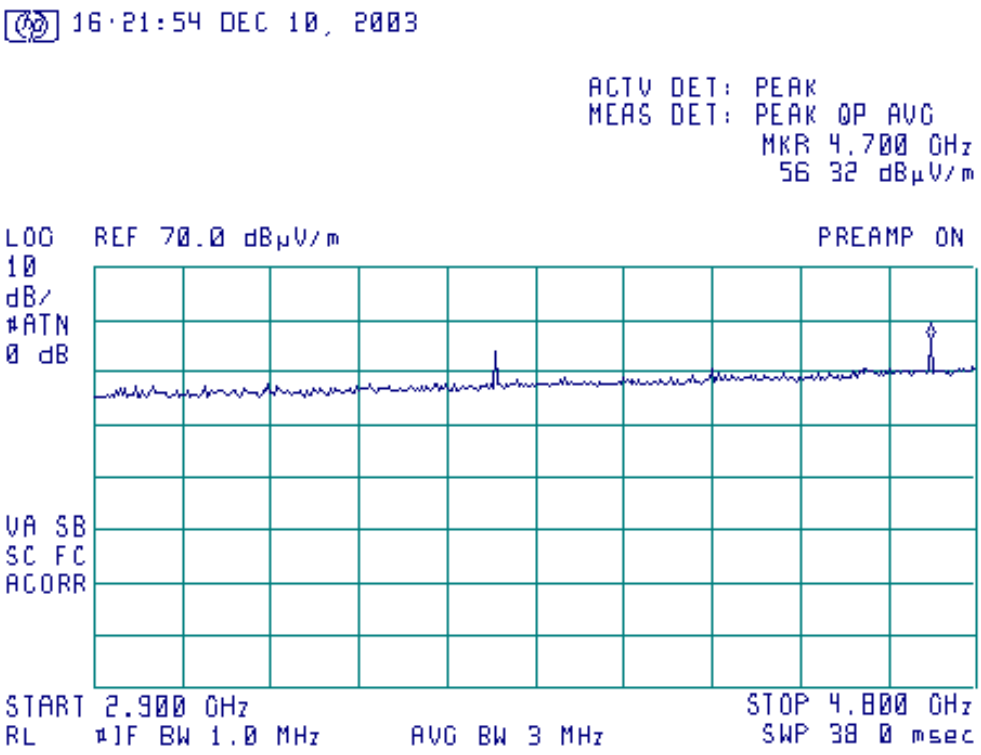
Plot A 114

Radiated spurious emission measurements in the anechoic chamber from 2.900 GHz to 4.800 GHz, model Irriwise @ 470 MHz carrier



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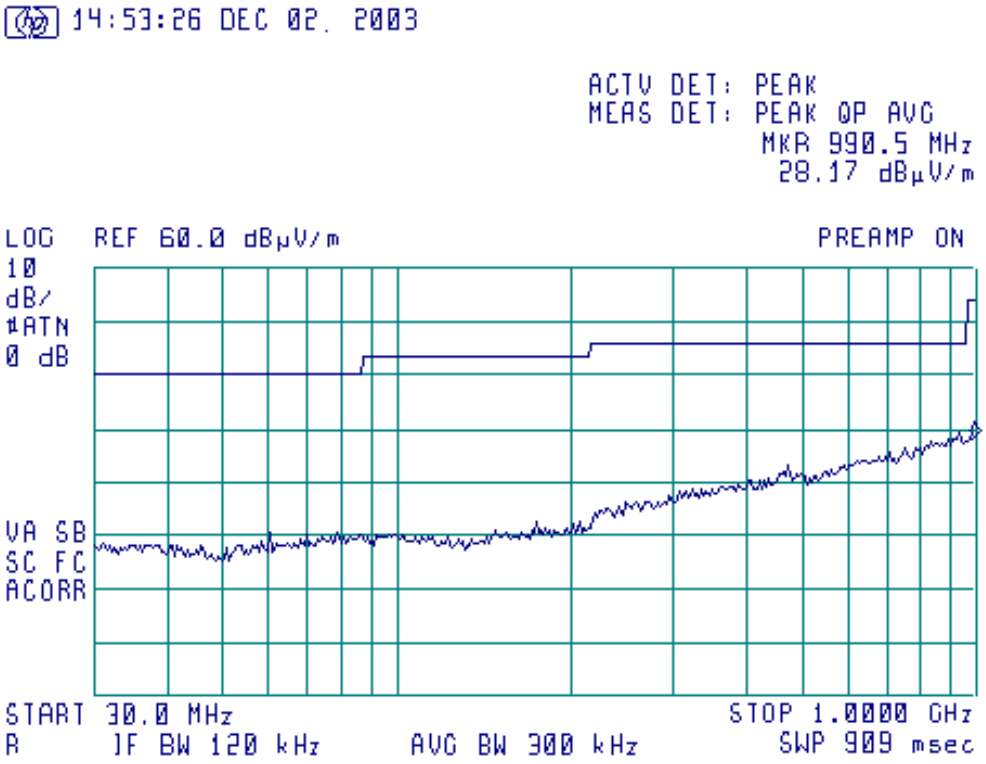
Plot A 115

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



No emissions were found.

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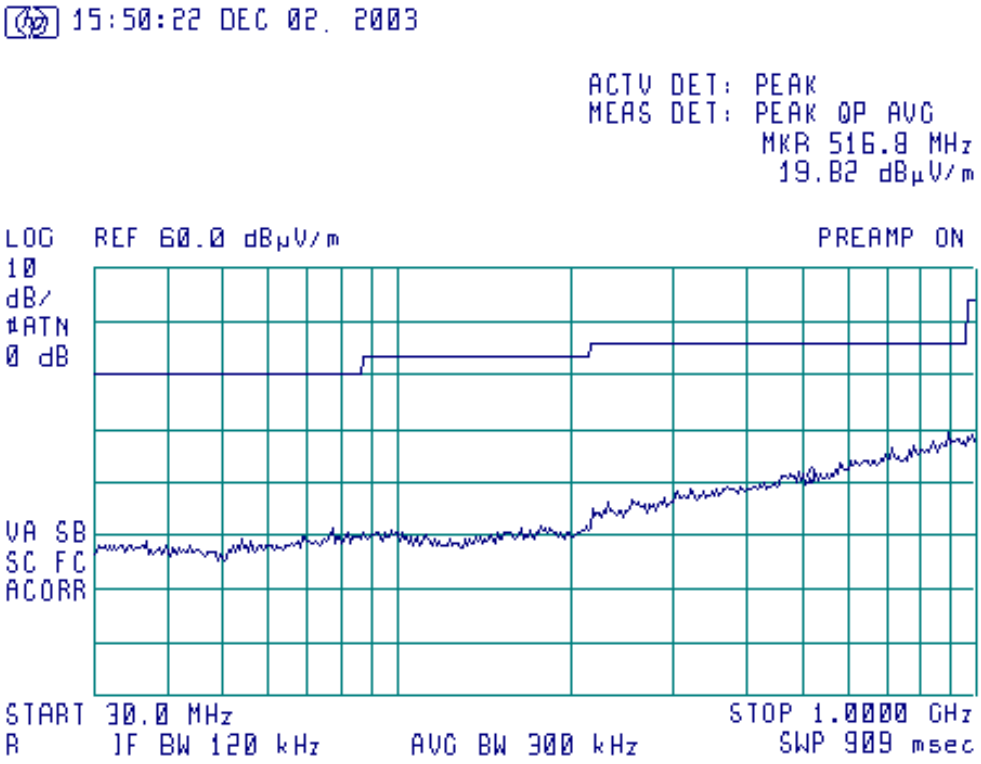
Plot A 116

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



No emissions were found.

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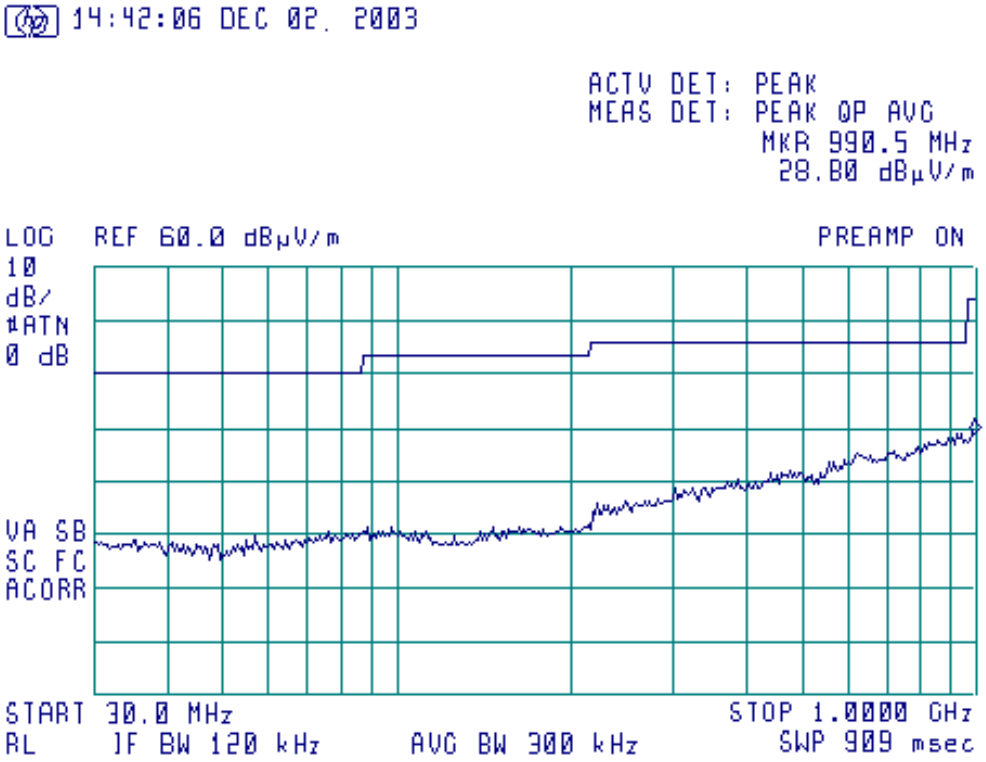
Plot A 117

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



No emissions were found.

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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.	
0025	Spectrum analyzer, 10 kHz-23 GHz	Anritsu	MS-710C	5837	10/04
0034	Log periodic antenna, 200 – 1000 MHz	Electro-Metrics	LPA 25/30	1988	1/05
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
0287	Turntable, motorized diameter, 2 m	Hermon Labs	TMD-2	042	11/04 check
0415	Cable coax RF, RG-58	Hermon Labs	CC-3	056	5/04
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
0539	Generator signal	Marconi Instruments	52023-001H	1041	12/04
0566	Antenna, biconical, 20-200 MHz	Electro-Metrics	BIA 25/30	3566	4/04
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	1/05 check
0604	Antenna biconilog log-periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	1/05
0614	Antenna dipole tunable, 200 –500 MHz	Electro-Metrics	TDS 30-1	334	1/05
0661	Generator swept signal, 10 MHz to 40 GHz+ 10 dBm	Hewlett Packard	83640B	0266	9/04
0788	Power splitter/combiner	Mini-Circuits	ZFSC-2-1	923705	9/04
0793	Radio communication test set	Marconi Instruments	2955	9507/179	2/04
0810	Power supply DC, programmable, dual, 0-10 V DC, with GPIB	American Reliance, Inc.	AMREL	20140028	1/05
0812	Cable, coax, RG-214, 11.5 m, N-type connectors	Hermon Labs	C214-11	148	5/04
1004	Cable, coaxial ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/04
1097	Attenuator, 50 Ohm, 2 W, DC to 8 GHz, 20 dB	Midwest Microwave	0793-20-NN-07	1097	1/05
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/04

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HL Serial No.	Description	Manufacturer information			Due Calibr. Month/ year
		Name	Model No.	Serial No.	
1425	EMI Receiver System, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3710A00222	9/04
1430	EMI receiver system, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3807A00262	9/04
1451	Cable, 1.5 m	Harbour Industries	MIL 17/60-RG142	1451	12/04
1457	Cable, 1 m	Harbour Industries	MIL 17/60-RG142	1457	12/04
1518	Cable RF, 0.5 m	Telequis	MIL-C-17F- RG 058	1518	12/04
1553	Cable RF, 3.5 m	Alpha wire	RG-214	1553	5/04
1556	Cable RF, 0.5 m	Telequis	MIL-C-17F-RG 058 CU	1556	12/04
1562	Oscilloscope 100 MHz, DMM	Tektronix	THS720A	B039444	9/04
1565	Antenna, dipole, tunable, 500 - 1000 MHz	Electro-Metrics	TDS-30-2	334	1/05
1566	Cable RF, 2 m	Huber-Suhner	Sucoflex 104PE	13094/4PE	12/04
1651	Attenuators set (2, 3, 5, 20 dB), DC – 18 GHz	M/A –COM	2082	1651	3/04
1826	Antenna mast and turntable position controller	Sh. I. Machines	CRL-4	1	5/04 check
1849	Antenna mast with polarity control	Sh. I. Mashines	AM-F4	NA	1/05 check
1850	Turntable	Sh. I. Mashines	TT-M-3	NA	1/05 check
1870	Oven temperature, 220 V AC	Tenney Engineering	OT	1870	4/04
1947	Cable 18 GHz, 6.5 m, blue	Rhophase Microwave Ltd	NPS-1803A-6500-NPS	T4974	10/04
1956	Cable 0.5 m, BNC/BNC	Telequis	RG-58	1956	12/04
1991	Attenuator, DC – 18 GHz, 30 dB, 2 W	Midwest Microwave	ATT 0290-30-SMA-02	NA	11/04
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	12/04
2109	Anechoic chamber 6 (L) x 5.5 (W) x 2.95 (H) m	Hermon Labs	AC-2	2109	12/04 check
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
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
2429	Attenuator, variable DC-1 GHz, 0-60dB, Ao=10 dB, Z=50 Ohm	Wandel& Goltermann	RT-1	2429	8/04
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

Antenna factor
Active Loop Antenna
Model 6502
S/N 2857

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
Biconical antenna
Electro-Metrics, model BIA-25/30
Ser.No.3566, HL 0566

Frequency MHz	Antenna Factor dB(1/m)	Frequency MHz	Antenna Factor dB(1/m)
30	14.7	120	16.8
35	12.9	125	15.5
40	12.6	130	15.5
45	12.8	135	15.1
50	12.6	140	14.8
55	11.8	145	15.1
60	11.7	150	16.9
65	10.4	155	17.2
70	9.2	160	17.3
75	9.1	165	17.8
80	9.1	170	18.3
85	9.5	175	19.0
90	11.2	180	19.5
95	12.6	185	20.0
100	13.7	190	20.4
105	14.2	195	20.5
110	15.3	200	20.6
115	17.1		

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).

Antenna factor
Log periodic antenna
Electro-Metrics, model LPA-25/30
Ser.No.1988, HL 0034

Frequency MHz	Antenna Factor dB(1/m)	Frequency MHz	Antenna Factor dB(1/m)
200	12.6	625	20.4
225	12.2	650	20.9
250	13.4	675	22.0
275	14.3	700	22.2
300	15.2	725	22.7
325	15.7	750	22.5
350	15.9	775	22.7
375	16.4	800	22.8
400	17.0	825	23.2
425	17.4	850	23.5
450	17.9	875	23.9
475	18.6	900	24.0
500	19.1	925	24.0
525	19.3	950	24.2
550	19.6	975	24.7
575	19.8	1000	25.1
600	20.0		

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 is to be added to receiver meter reading in dB(μV) to convert to field intensity in dB(μV/meter).

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Antenna factor
Double-ridged guide horn antenna
Model 3115, serial number: 00027177, HL 2432

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, RG-58/RG-214, s/n 056, HL 0415
+ Cable Coaxial, RG-214, 11.5m, s/n 148, HL 0812

No.	Frequency, MHz	Cable loss, dB	Measured uncertainty, dB
1	20	0.73	±0.12
2	30	0.91	
3	50	1.2	
4	80	1.56	
5	100	1.76	
6	200	2.59	
7	300	3.26	
8	400	3.93	
9	500	4.42	
10	600	4.92	
11	700	5.36	
12	800	5.88	
13	900	6.41	
14	1000	6.71	
15	1500	8.63	
16	2000	10.39	

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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
RF cable 3.5 m, Alpha Wire, model RG-214, S/N 149, HL 1553

No.	Frequency, MHz	Cable loss, dB	Measurement uncertainty, dB
1	1	0.01	±0.05
2	10	0.07	
3	30	0.12	
4	50	0.22	
5	100	0.26	
6	200	0.40	
7	300	0.52	
8	400	0.60	
9	500	0.70	
10	600	0.77	
11	700	0.84	
12	800	1.00	
13	900	1.00	
14	1000	1.05	
15	2000	1.70	

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Cable loss
Cable RF, 2m, model: Sucoflex 104PE, S/N 13094/4PE, HL 1566

No.	Frequency, MHz	Cable loss, dB	Tolerance, dB	Measurement uncertainty, dB
1	30	0.10	5.0	±0.12
2	50	0.13		
3	100	0.20		
4	300	0.33		
5	500	0.45		
6	800	0.60		
7	1000	0.65		
8	1500	0.91		
9	2000	1.08		
10	2500	1.19		
11	3000	1.28		
12	3500	1.49		
13	4000	1.63		
14	4500	1.63	5.0	±0.17
15	5000	1.66		
16	5500	1.88		
17	6000	1.96		
18	6500	1.93		
19	7000	2.07		
20	7500	2.37		
21	8000	2.34		
22	8500	2.64		
23	9000	2.68		
24	9500	2.64		
25	10000	2.70		
26	10500	2.84		
27	11000	2.88		
28	11500	3.19		
29	12000	3.15		
30	12500	3.20	5.0	±0.26
31	13000	3.22		
32	13500	3.47		
33	14000	3.41		
34	14500	3.59		
35	15000	3.79		
36	15500	4.24		
37	16000	4.12		
38	16500	4.46		
39	17000	4.50		
40	17500	4.49		
41	18000	4.45		

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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

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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:

ASK	amplitude shift keying
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
LMS	location and monitoring service
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
RF	radio frequency
rms	root mean square
s	second
V	volt
W	width

Specification references

47CFR part 90: 2002	Private land mobile radio services
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.