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Electrical

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ELECTROMAGNETIC EMISSION TEST REPORT

according to 47CFR Part 15, §15.249 and subpart B
for

Tadiran Telematics Ltd.

EQUIPMENT UNDER TEST:

TransMeter Water

model: TMW-40D

Document ID: TADRAD_FCC.15046_2.doc
Date of Issue: October 2002

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1 Project information

Description of equipment under test

Test items	: TransMeter Water
Manufacturer	: Tadiran-Telematics Ltd
Equipment serial number	: 001188
Types (Models)	: TMW-40D
Hardware revision	: A1
Software revision	: A1
Equipment FCC code[1]	: DXX

Applicant information

Applicant's responsible person	: Mr. Uzi Erman
Company	: Tadiran-Telematics Ltd
Address	: 26, Hamelaha street
Postal code	: 58117
City	: Holon
Country	: Israel
Telephone number	: +972 (0) 3 5575755
Telefax number	: +972 (0) 3 5575753

Test performance

Project Number:	: 15046-2
Location	: Hermon Laboratories
Receipt date	: July 9, 2002
Test performed	: September 9, 2002
Purpose of test	Apparatus compliance verification in accordance with emission requirements
Test specification(s)	47CFR Part 15, §15.249 and subpart B

[1] FCC Equipment codes – see Appendix D

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2 Summary of tests

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

Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
Transmitter characteristics								
Field strength of fundamental	(a)	**C**				Mr. Y. Neuman, test engineer	September 9, 2002	
Field strength of harmonics	(a)	**C**				Mr. Y. Neuman, test engineer	August 19, 2002	
Out of band spurious emissions (radiated)	(c)	**C**				Mr. Y. Neuman, test engineer	August 19, 2002	
Unintentional radiation, §15.107, §15.109								
Conducted emissions	15.107				**NA**			
Radiated emissions	15.109	**C**						
Receiver characteristics, §15.109								
Spurious radiated emissions	15.109	**C**				Mrs. Pitt, test engineer	July 9, 2002	
General conditions under Part 15								
The Intentional radiator operates at 916.3 MHz	15.249	**C**						
The intentional radiator has permanently attached antenna or antenna that uses a unique coupling to the intentional radiator.	15.203	**C**						
The intentional radiator has a standard connector and must be professionally installed. To demonstrate that professional installation is required, the following three points must be addressed: (a) the application (or intended use) of the EUT; (b) the installation requirements of the EUT, and (c) the method by which the EUT will be marketed.	15.203				**NA**			

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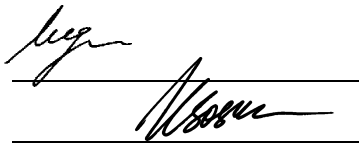
Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
No antenna other than that furnished by the responsible party can be used with the device.	15.203	C						
Antenna technical characteristics, as referred to in "Transmitter description" table in the test report	15.204	C						

NOTE: C: The parameter is compliant with the requirements.
NC: The parameter is not compliant with the requirements.
NT: The parameter is not tested.
NA: The test of this parameter is not applicable.

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

Test report approved by: Mr. A. Usoskin, QA manager



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3 EUT description

3.1 General description

The EUT, TMW-40D, is a water meter with a built-in 2-way RF communicator. The RF capabilities enable transmission of meter readings and some extra information to a collecting unit.
The TMW-40D consists of two parts: RF transceiver with integral antenna and a microcontroller.
The device is intended for installation with internal antenna in horizontal position and powered by two internal 3.6 V lithium batteries.

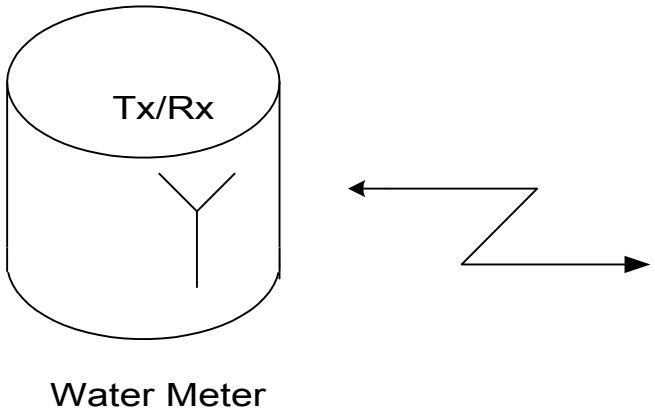
3.2 EUT test configuration

The EUT test configuration is shown in Figure 3.2.1, clock and oscillator frequencies are provided in Table 3.2.1.

Table 3.2.1 EUT operating frequencies

Frequency	Card Id
852.3 MHz	LO1
53.3 MHz	LO2
26.6353 MHz	clock1
32.768 kHz	clock2

Figure 3.2.1



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3.3 Transmitter description

Type of equipment						
X	Stand-alone (Equipment with or without its own control provisions)					
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)					
	Plug-in card (Equipment intended for a variety of host systems)					
	Other:					
Operating frequency	916.3 MHz					
Transmitter aggregate data rate (bits per second)	60 kBps					
Normal test signal	FSK modulated signal					
Maximum rated output power						
At transmitter permanent external 50 Ω rf output connector (dBm)						
Effective radiated power (for equipment with integral antenna) (dBm)	18					
Is transmitter output power variable?	**X**	No				
		Yes		continuous variable		
				stepped variable		
				stepsize (dB):.....		
				minimum RF power (dBm):.....		
				maximum RF power (dBm):.....		
Transmitter power source						
	Battery	**Nominal rated voltage (VDC)**				
	Nickel Cadmium					
X	Lithium					
	Other					
	DC	**Nominal rated voltage (VDC)**				
	AC mains	**Nominal rated voltage (VAC)**				
Is there common power source for transmitter and receiver			**X**	Yes		
Antenna technical characteristics						
			Type	**Manufacturer**	**Model number**	**Gain**
Integral		with temporary RF connector	**Planar inverted F**	**Arad Technologies**	**NA**	**2 dBi**
	X	without temporary RF connector				
External						
External antenna connection – NA						
	standard connector SMA			unique coupling		

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4 Test results

4.1 Field strength of fundamental according to § 15.249 (a), §15.35

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4
DATE:	September 9, 2002
RELATIVE HUMIDITY:	36%
AMBIENT TEMPERATURE:	25°C
TEST PERFORMED IN:	On site testing
TEST DISTANCE	3 m
OPERATING FREQUENCY RANGE	902-928 MHz
PULSE DURATION	3.5 ms
RBW	120 kHz

Quasi-peak detector (pulse repetition period 46 ms)

Pit	TMW configuration	Type of soil	Azimuth*, (°)	Antenna height, m	Field strength, dB(µV/m)	Specified limit, dB(µV/m)	Margin, dB	Pass / Fail
plastic	with adhesive sticker	black	220	1	90.6	94	3.4	Pass
plastic	with adhesive sticker	red	320	1	89.5	94	4.5	Pass
plastic	with adhesive sticker	sand	315	1	92.1	94	1.9	Pass
concrete	with adhesive sticker	black	300	1	90.3	94	3.7	Pass
concrete	with adhesive sticker	red	290	1.5	92.8	94	1.2	Pass
concrete	with adhesive sticker	sand	45	1.2	92.1	94	1.9	Pass
metal	without adhesive sticker	black	100	1	82.2	94	11.8	Pass
metal	without adhesive sticker	red	130	1.5	86.5	94	7.5	Pass
metal	without adhesive sticker	sand	110	1.3	84.7	94	9.3	Pass
Measurement uncertainty, dB					+5.71 dB/-5.56 dB			

The 0° axis corresponds to the direction of the pipe, to which the water meter is attached.

Test results recorded in the table were obtained throughout the testing with the measurement antenna in vertical polarization.

TEST EQUIPMENT USED:

HL 0026	HL 0034	HL 1538				

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LIMIT

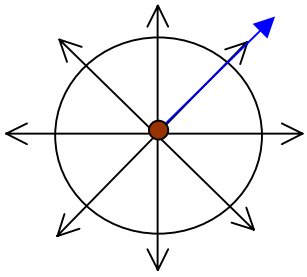
Operating frequency range, MHz	Field strength of fundamental, dB(µV/m)
902-928	94
2400-2483.5	94
5275-5850	94
24000-24250	107.95

TEST PROCEDURE

The EUT was tested at three different installations; in black soil, red soil and sand, and in three different pits (metallic, concrete, plastic) in turn.

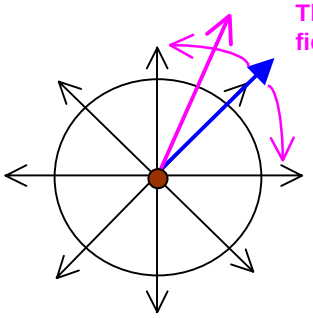
Each test was conducted as follows:

1) field strength measurements were performed at 8 different azimuths (with 45 degrees step, at 3 m test distance, with antenna in vertical polarization at 1 m height). The azimuth, at which the course maximum field strength was found, was recorded.



The azimuth, where the course maximum field strength was found

2) field strength measurements were continued at azimuths varying around the above recorded azimuth (at 3 m test distance). The azimuth, where the fine maximum field strength was found, was recorded in the test report.



The azimuth, where the fine maximum field strength was found

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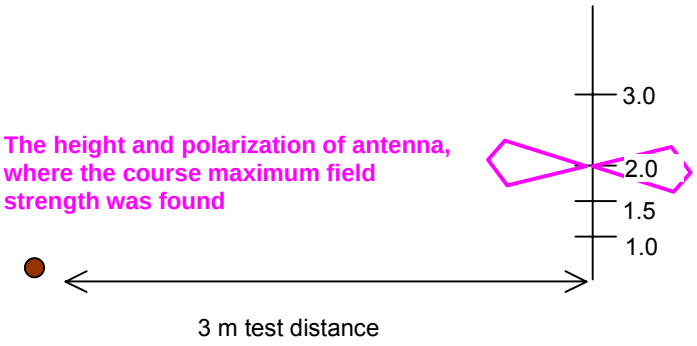
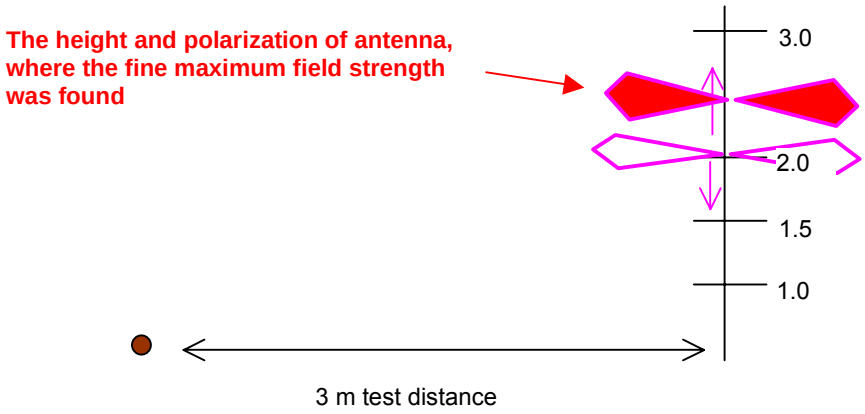
3) at the recorded azimuth, the measurements were continued at 1; 1.5; 2 and 3 m antenna heights, with antenna in horizontal and vertical polarizations in turn. The height and polarization of antenna, where the course maximum field strength is found, was recorded.



4) the measurements were continued with antenna height varying around the above recorded position in recorded polarization. The fine maximum field strength, which was found during these measurements, was recorded in the test report.



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

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4
DATE:	August 19, 2002
RELATIVE HUMIDITY:	47%
AMBIENT TEMPERATURE:	22°C
Rated carrier field strength	112.89 dB(μV/m)
TEST PERFORMED IN:	ANECHOIC CHAMBER (1-4 GHz); OATS (2-9.3 GHz)
TEST DISTANCE:	3 m
FREQUENCY RANGE	1000 – 9300 MHz
CARRIER FREQUENCY	916.3 MHz

Peak detector

Harmonic, MHz	Field strength, dB(μV/m)	Peak limit, dB (μV/m)	Margin, dB	Reference to Plots in Appendix A
1832.7	57.93	74	26.07	A7
2749.0	46.00	74	38.00	A9
3665.4	48.83	74	25.83	A10
Measurement uncertainty, dB		+5.73 dB / -5.57 dB		

Peak detector + Average factor

Carrier frequency, MHz	Field strength, dB(μV/m)	Average limit, dB(μV/m)	Margin, dB	Reference to Plots in Appendix A
1832.7	39.53	54	14.47	NA
2749.0	27.6	54	26.4	NA
3665.4	30.43	54	23.57	NA
Measurement uncertainty, dB		+5.73.dB / -5.57 dB		

4.2.1 Average factor calculation, §15.35

Tx ON, ms	Duty cycle	Average factor, dB	Reference to Plots in Appendix A
11.95*	0.1195	-18.4	NA
Measurement uncertainty (1% of sweep time)		**0.2 ms**	

- * The extended data transmission duration (as declared by customer) was used for calculating the average factor. The pulse repetition period was 46 ms, as stated by the customer and shown in Plot A16.

TEST EQUIPMENT USED:

HL 0038	HL 0041	HL 0465	HL 0521	HL 0589	HL 0604	HL 1004
HL 1424	HL 1942	HL 1947	HL 2009			

LIMIT

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

TEST PROCEDURE

The EUT was placed on a wooden 80 cm height turntable, as shown in Figures 4.2.1, 4.2.2. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antenna polarization was changed from vertical to horizontal.

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Figure 4.2.1 Setup for radiated emissions test, tabletop equipment, anechoic chamber method

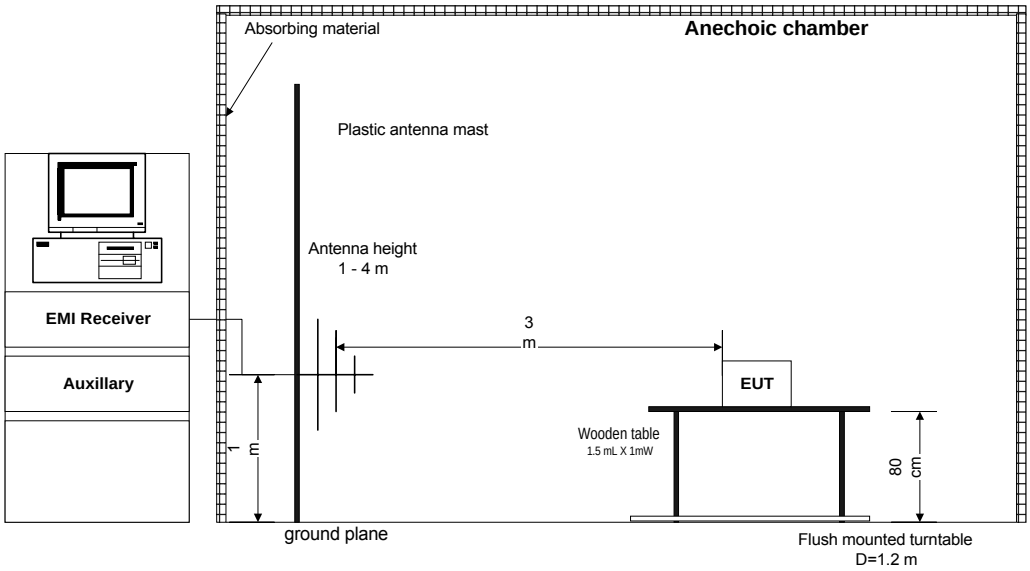

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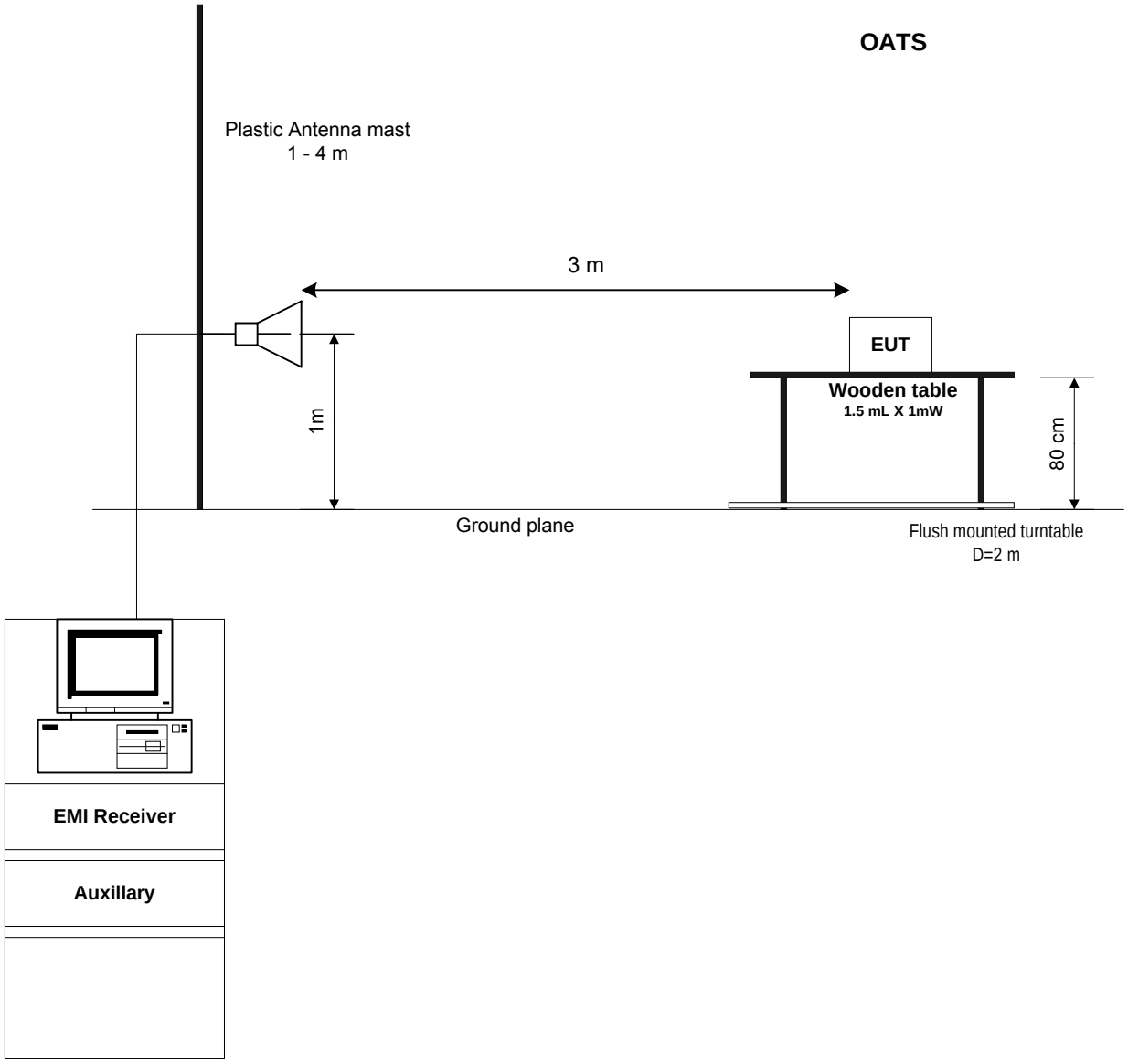
Figure 4.2.2 Setup for radiated emissions test, tabletop equipment, OATS method



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4.3 Out of band spurious emissions according to § 15.249 (c)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4/ §13.1.5
DATE:	August 19, 2002
RELATIVE HUMIDITY:	47%
AMBIENT TEMPERATURE:	22°C
RATED CARRIER FIELD STRENGTH	112.89 dB(μV/m)
TEST PERFORMED IN:	ANECHOIC CHAMBER (9 kHz – 4 GHz); OATS (2 GHz – 9.3 GHz)
TEST DISTANCE	3 m
OPERATING FREQUENCY RANGE	902-928
FREQUENCY RANGE	9 kHz – 9.3 GHz

Peak detector

Frequency, MHz	Antenna polarization	Radiated emission, dB (μV/m)	Limit, dB (μV/m)	Margin, dB	Reference to Plots in Appendix A
0.009 – 0.15	All emissions were found more than 30 dB below limit				A1
0.15 – 30	All emissions were found more than 25 dB below limit				A2
30 – 850	All emissions were found more than 15 dB below limit				A3
850 – 902	All emissions were found more than 15 dB below limit				A4
928 – 1000	All emissions were found more than 10 dB below limit				A5
1000 – 2000	No spurious emissions except harmonics were found				A6
2000 – 4000	No spurious emissions except harmonics were found				A8
4000 – 6000	No spurious emissions were found				A11
6000 – 9300	No spurious emissions were found				A12
Measurement uncertainty, dB	+5.73 dB / -5.57 dB				

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

TEST EQUIPMENT USED:

HL 0041	HL 0521	HL 0554	HL 0589	HL 0604	HL 1003	HL 1200
HL 1424	HL 1915	HL 1942				

LIMIT

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

TEST PROCEDURE

9 kHz – 30 MHz frequency range. The EUT was placed on a wooden 80 cm height turntable. The loop antenna was positioned with its plane vertical. The loop center was 1 meter above the ground plane. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated about its vertical axis.

30 MHz – 9.5 GHz frequency range. The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

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4.4 Receiver spurious emissions, according to §15.109

METHOD OF MEASUREMENT:	ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
DATE	July 9, 2002
RELATIVE HUMIDITY	42%
AMBIENT TEMPERATURE:	24°C
TEST PERFORMED IN:	ANECHOIC CHAMBER
TEST DISTANCE:	3 m
RECEIVER OPERATING FREQUENCIES	916.3
FREQUENCY RANGE:	30 – 5000 MHz

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

Frequency, MHz	Antenna polarization	Antenna height, m	Turntable position (^{o})	Radiated emissions, dB (µV/m)	Limit, dB (µV/m)	Margin, dB	Reference to Plots in Appendix A
952.3	Vertical	1.0	16	35.5	46	10.5	A13 to A15
Measurement uncertainty, dB				+5.42 dB/-5.26 dB			

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

TEST EQUIPMENT USED:

HL 0041	HL 0465	HL 0521	HL 0589	HL 1004	HL 1947	

LIMIT

(§ 15.109)

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

TEST PROCEDURE

The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360^o, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

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4.5 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT: ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
TEST PERFROMED IN: ANECHOIC CHAMBER
DATE: July 9, 2002
RELATIVE HUMIDITY: 42 %
AMBIENT TEMPERATURE: 24 °C
DISTANCE BETWEEN ANTENNA AND EUT: 3 m
THE EUT WAS TESTED AS: TABLE-TOP
FREQUECNY RANGE: 30 MHz – 5 GHz

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

Refer to paragraph 4.4 – receiver spurious emissions.

TEST EQUIPMENT USED:

LIMIT (§ 15.109)

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

TEST PROCEDURE

The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

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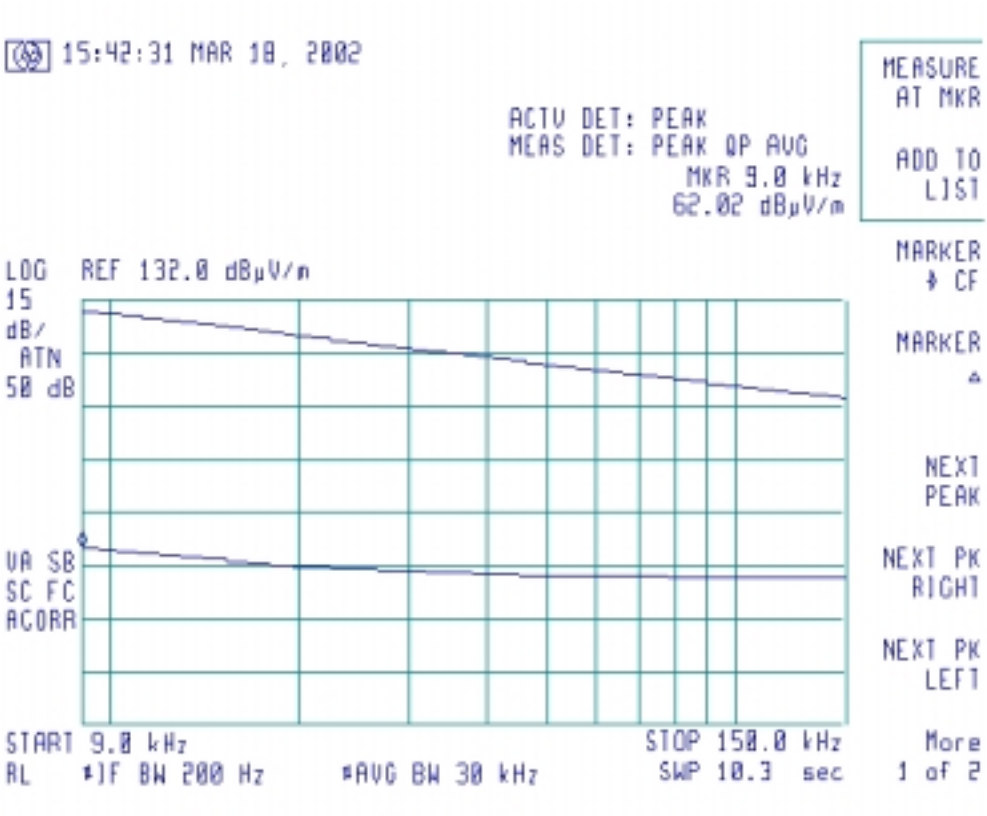
Appendix A Plots

Plot A 1

Spurious emission measurements
9 kHz – 150 kHz frequency range



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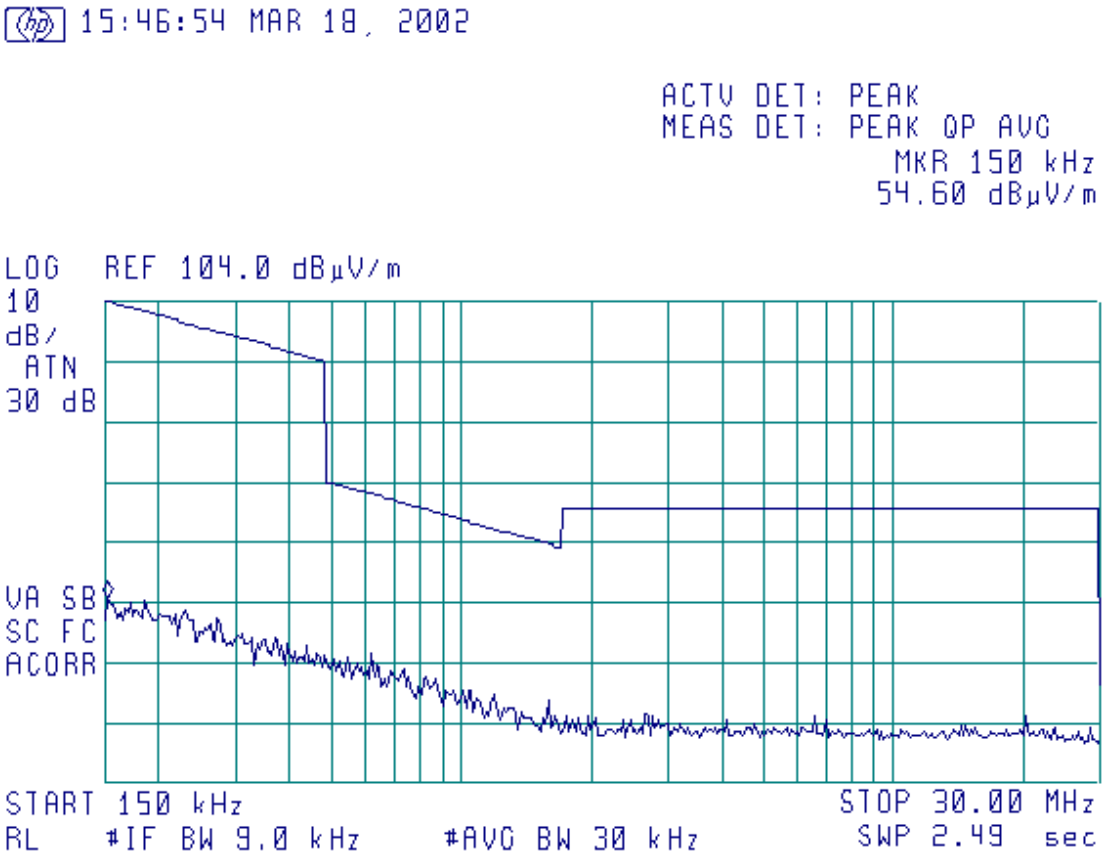
Plot A 2

Spurious emission measurements
150 kHz – 30 MHz frequency range



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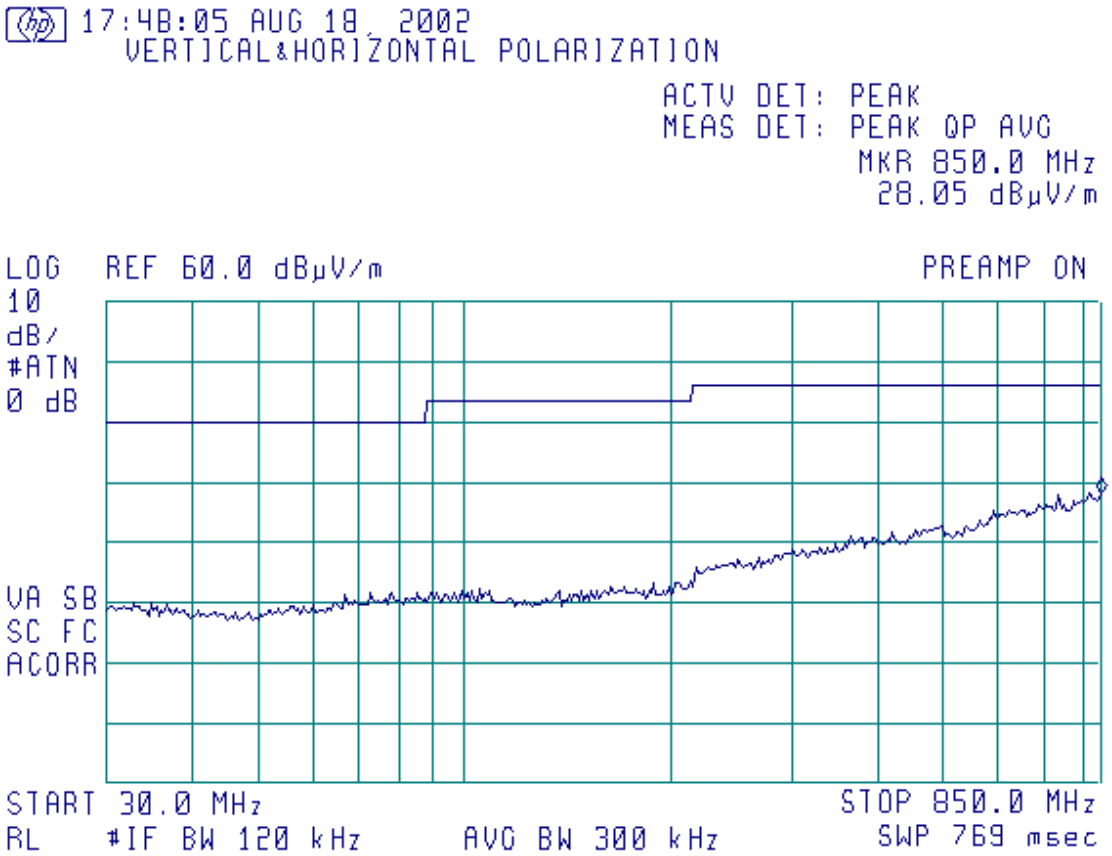
Plot A 3

Spurious emission measurements
30 – 850 MHz frequency range



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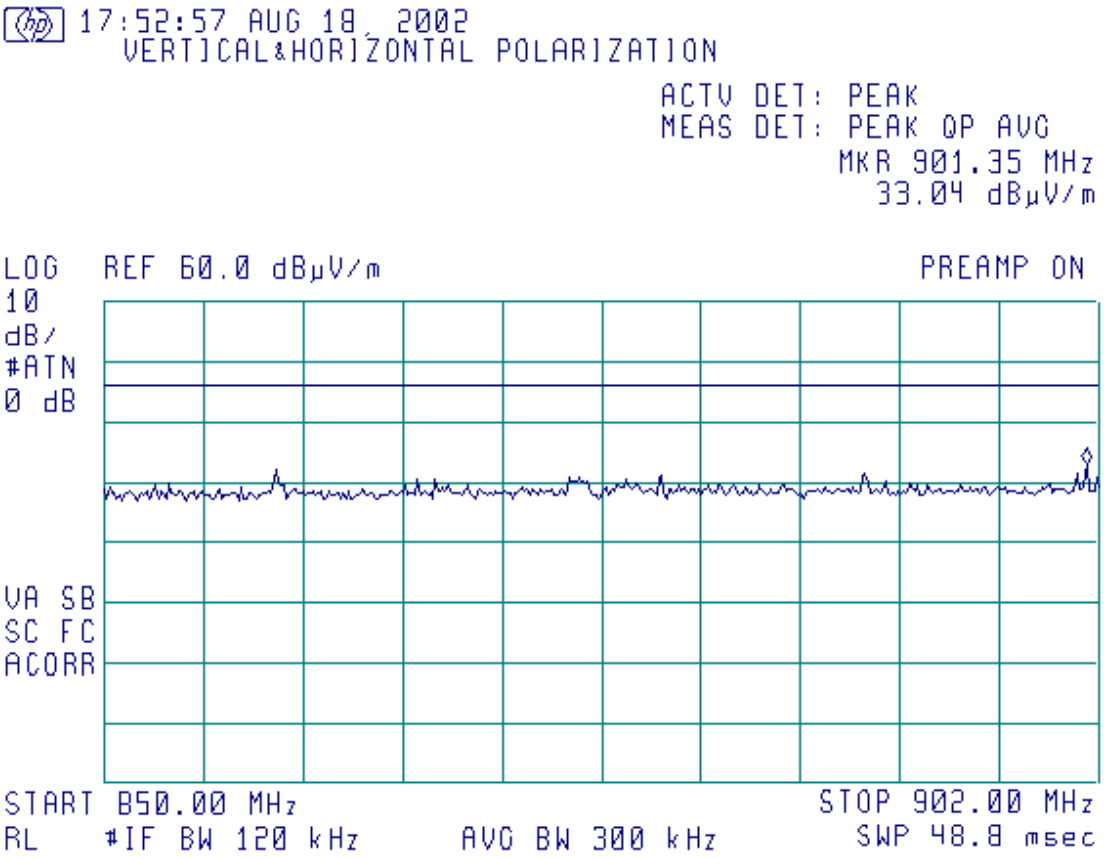
Plot A 4

Spurious emission measurements
850 – 902 MHz frequency range



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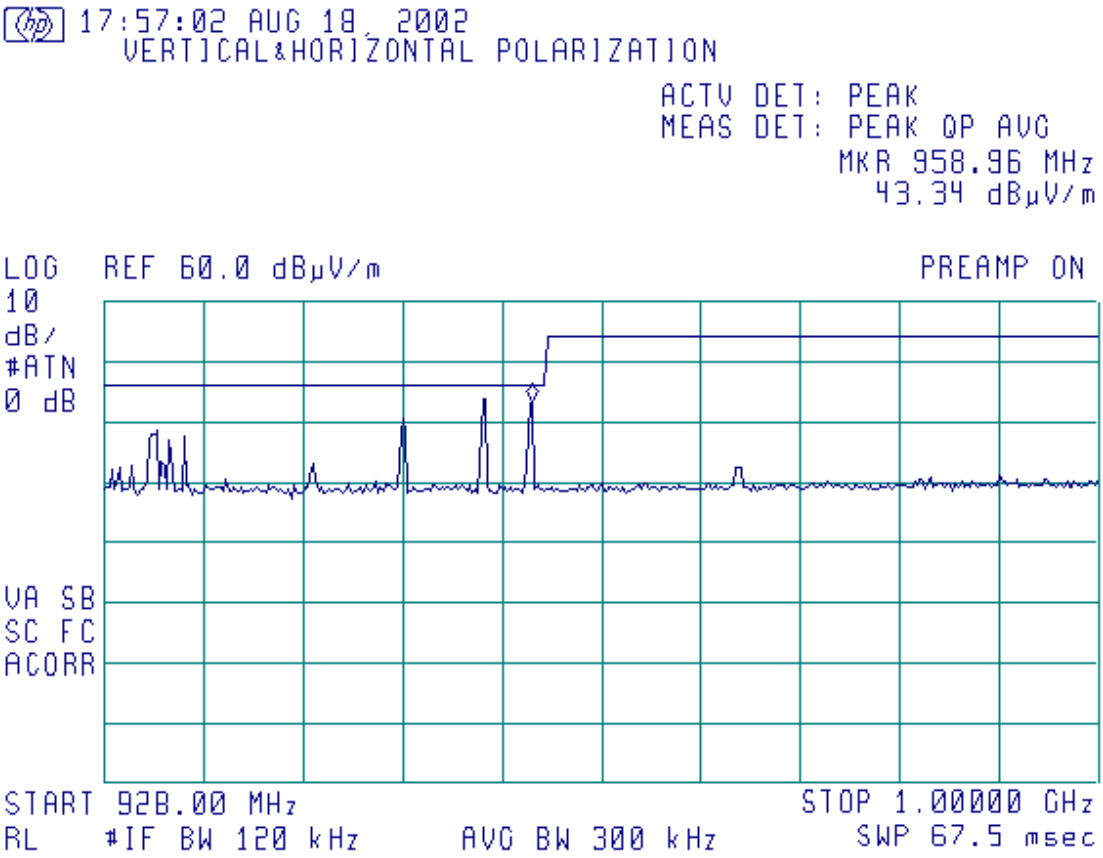
Plot A 5

Spurious emission measurements
928 – 1000 MHz frequency range



All these spurious are not in restricted bands.

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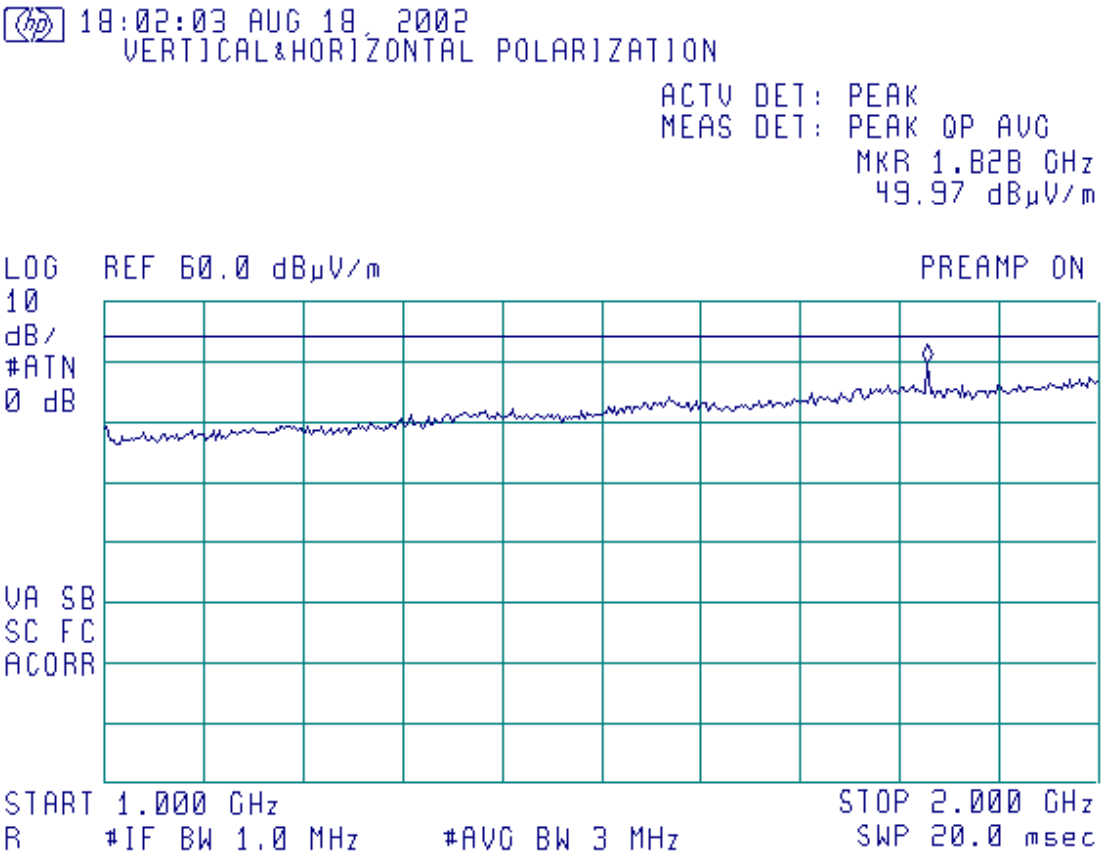
Plot A 6

Spurious emission measurements
1000 – 2000 MHz frequency range



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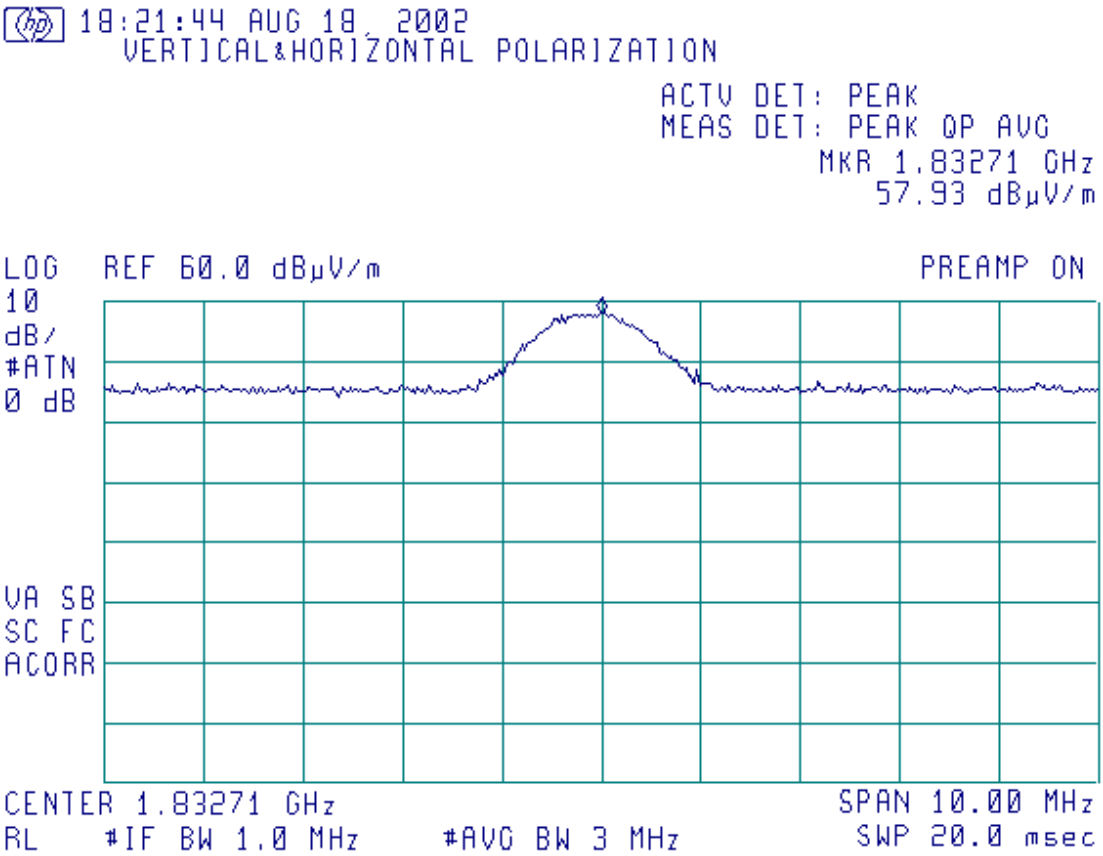
Plot A 7

Spurious emission measurements
Center frequency 1832.7 MHz



The second harmonic of fundamental.

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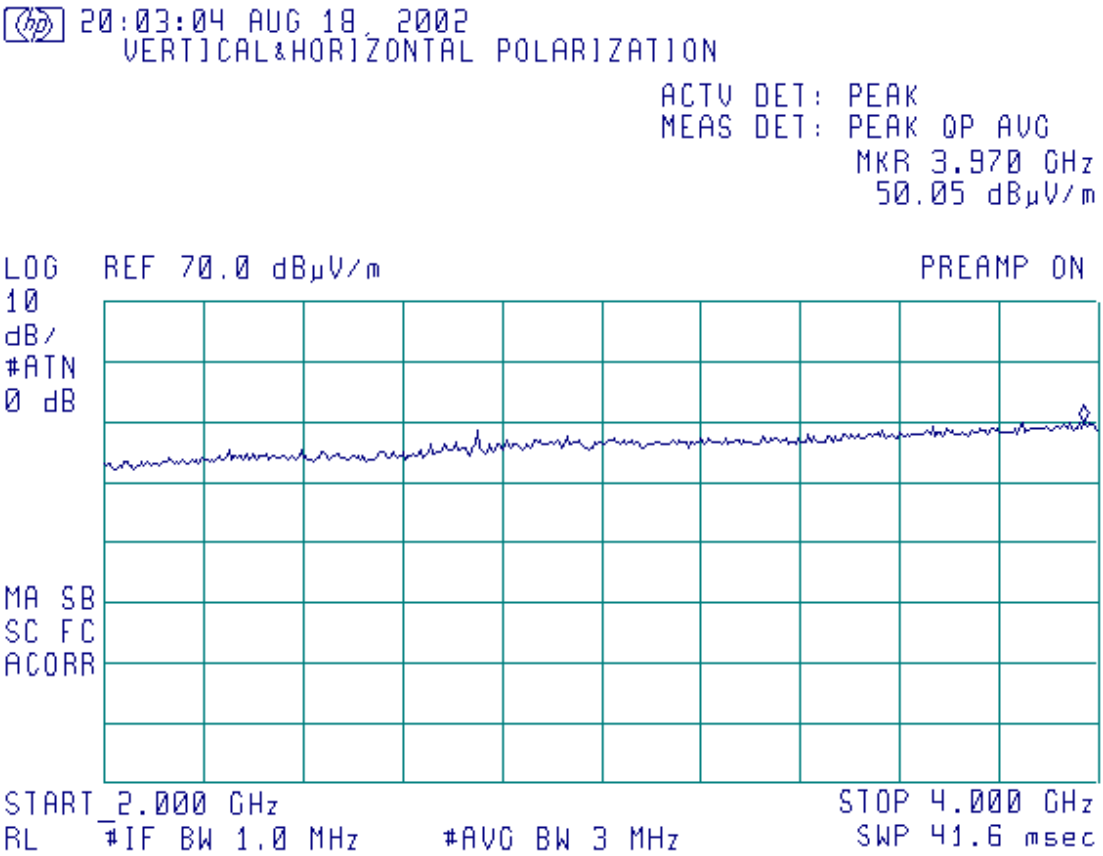
Plot A 8

Spurious emission measurements
2000 – 4000 MHz frequency range



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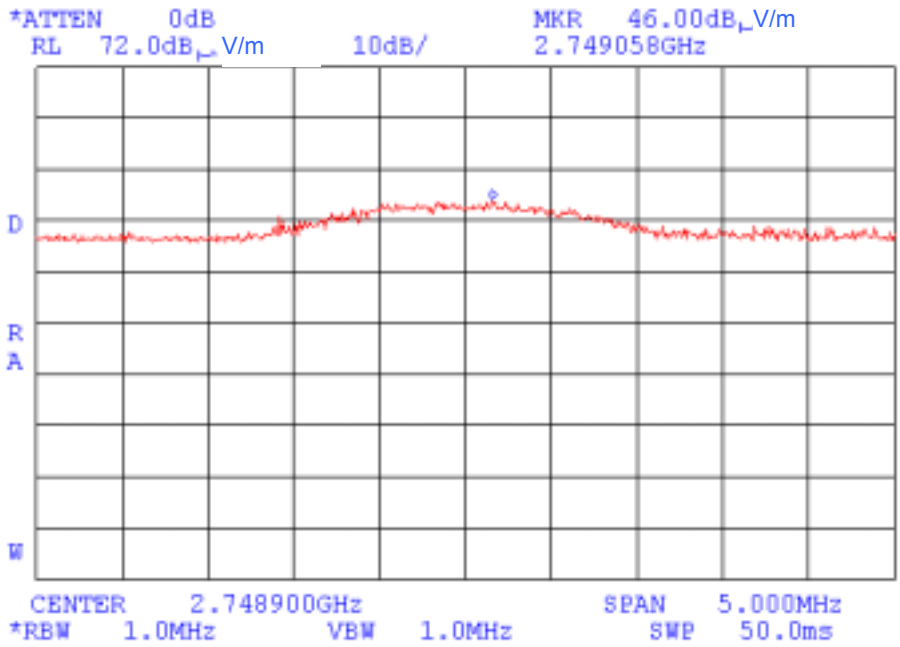
Plot A 9

Spurious emission measurements
Center frequency 2748.9 MHz



The 3rd harmonic of fundamental.

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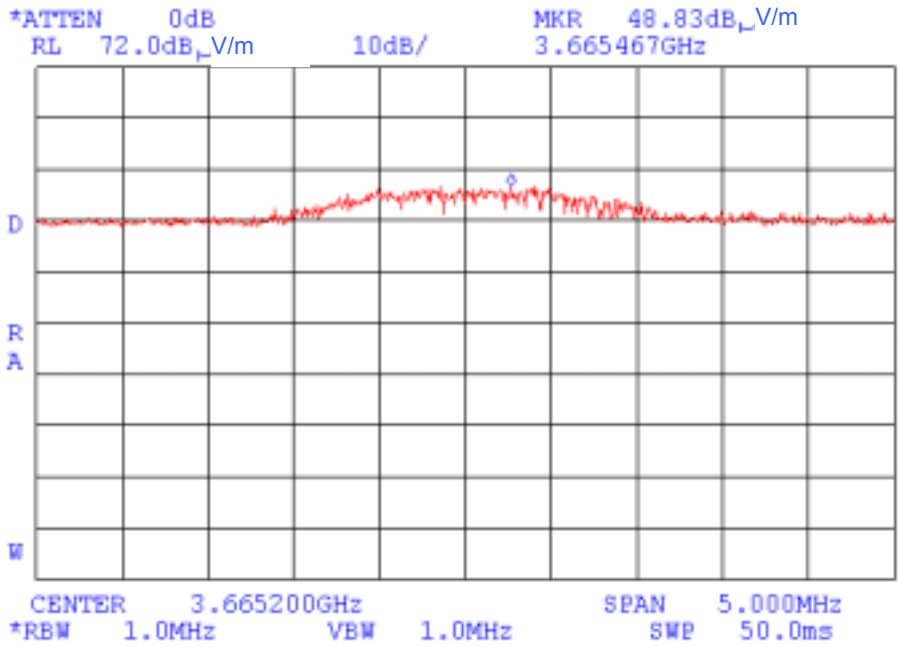
Plot A 10

Spurious emission measurements
Center frequency 3665.2 MHz



The 4th harmonic of fundamental.

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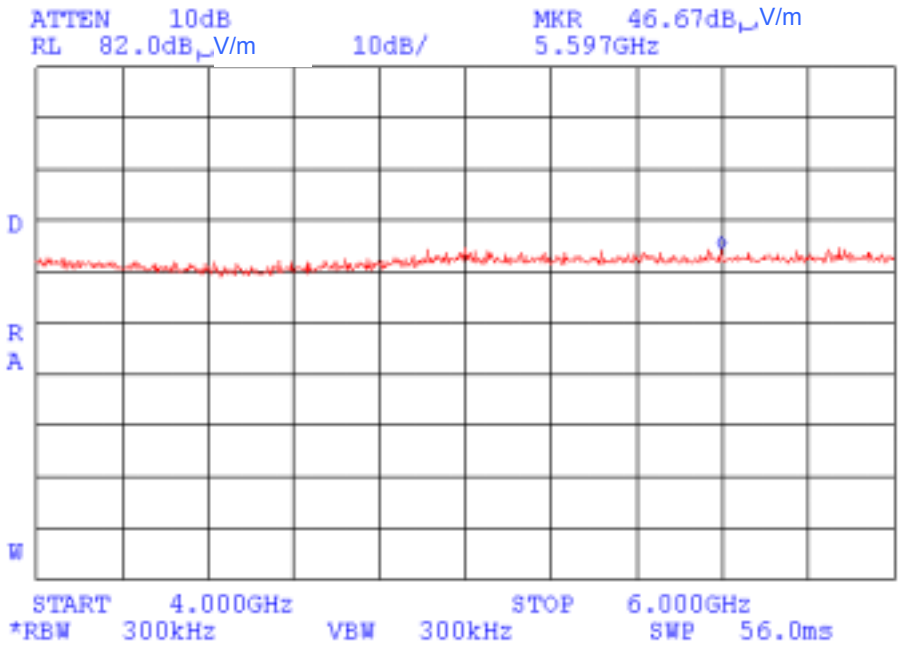
Plot A 11

Spurious emission measurements
4000 – 6000 MHz frequency range



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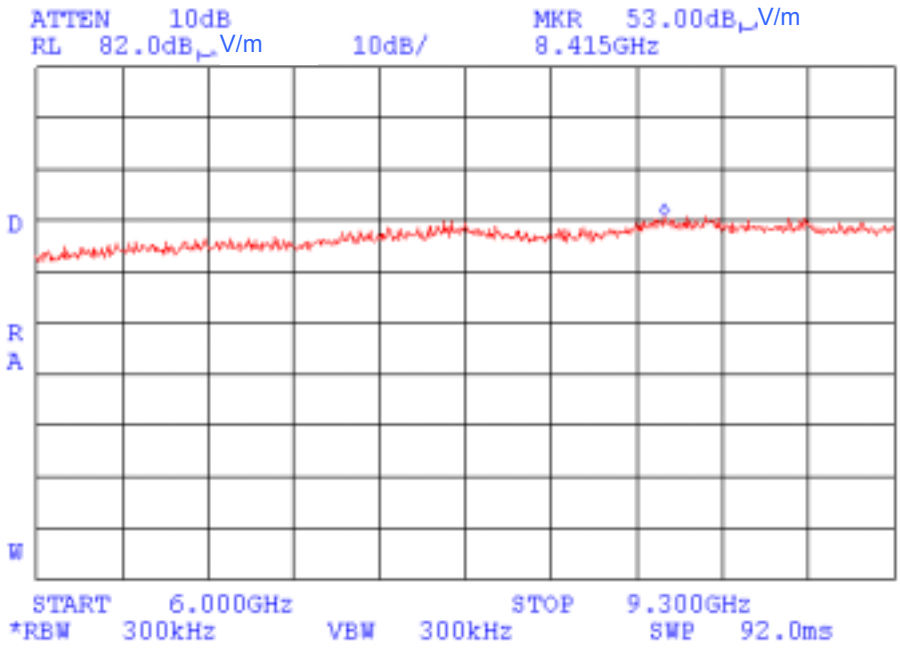
Plot A 12

Spurious emission measurements
6000 – 9300 MHz frequency range



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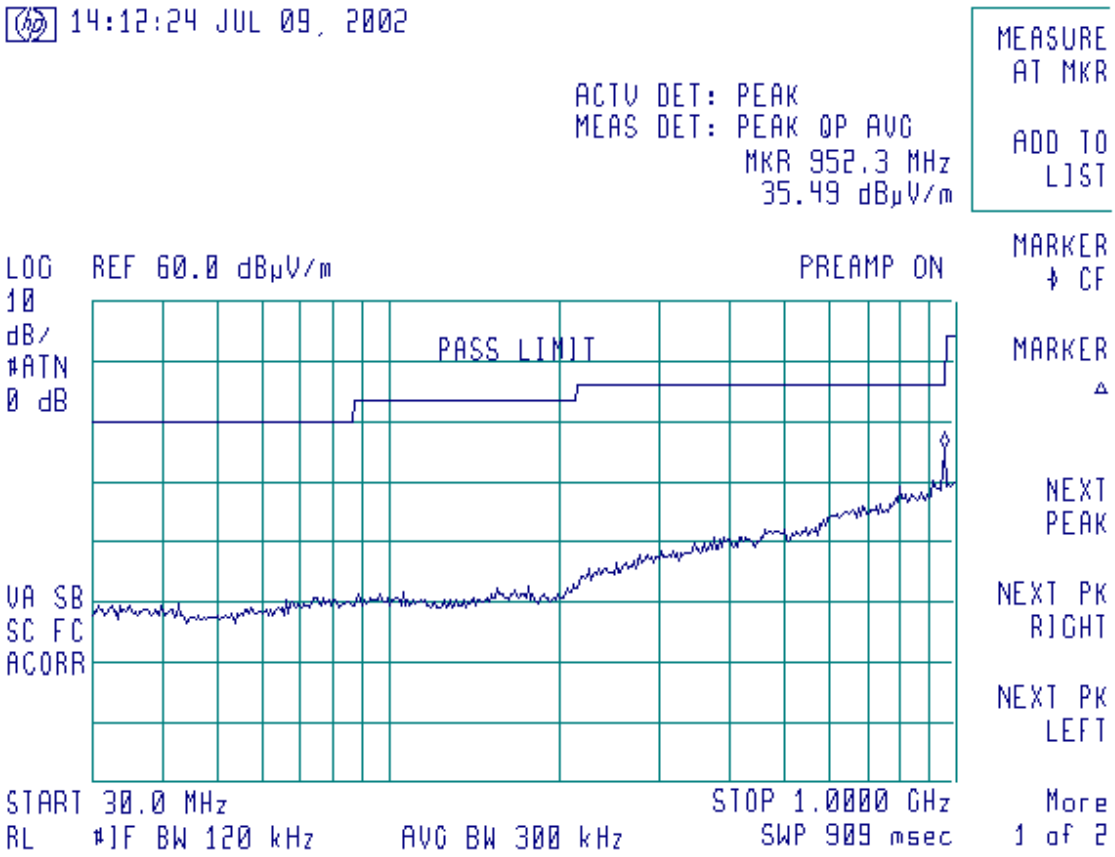
Plot A 13

Unintentional radiation measurements
30 MHz – 1000 MHz frequency range



Notes
Mode: Rx
Antenna. Polarization-Vertical & Horizontal

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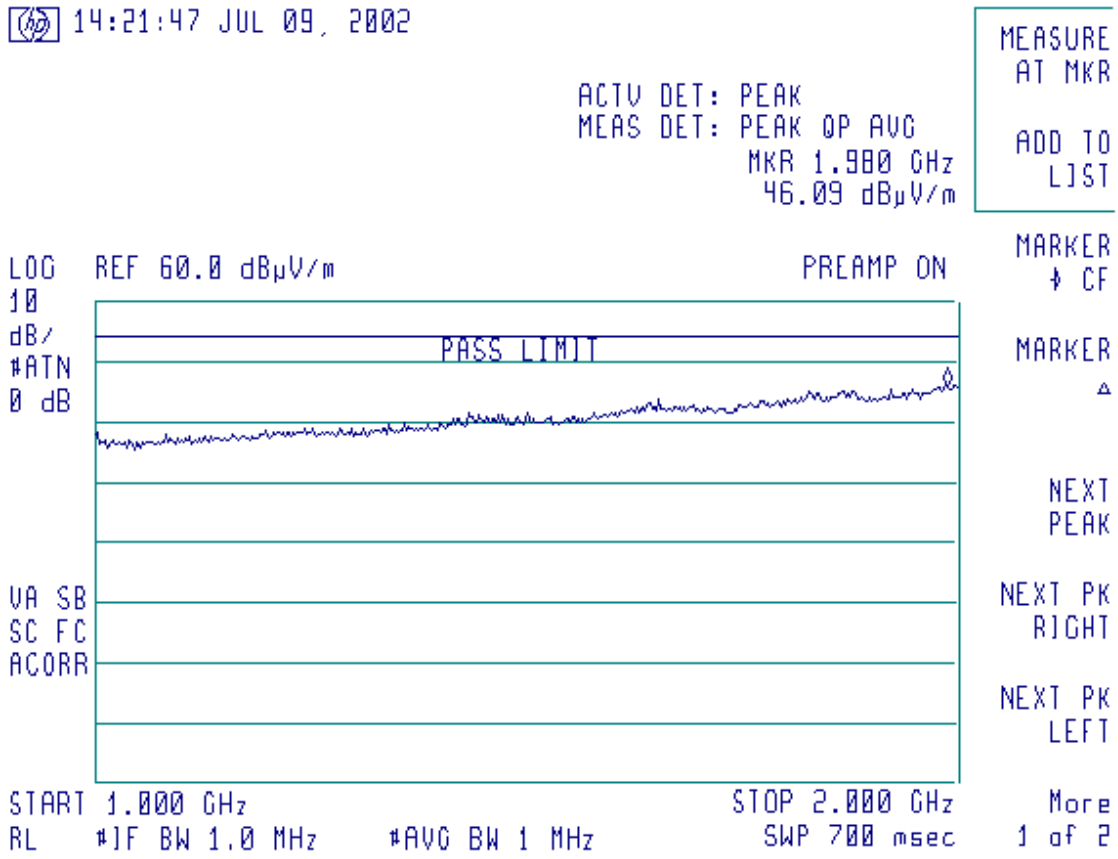
Plot A 14

Unintentional radiation measurements
1000 MHz – 2000 MHz frequency range



Notes
Mode: Rx
Antenna. Polarization-Vertical & Horizontal

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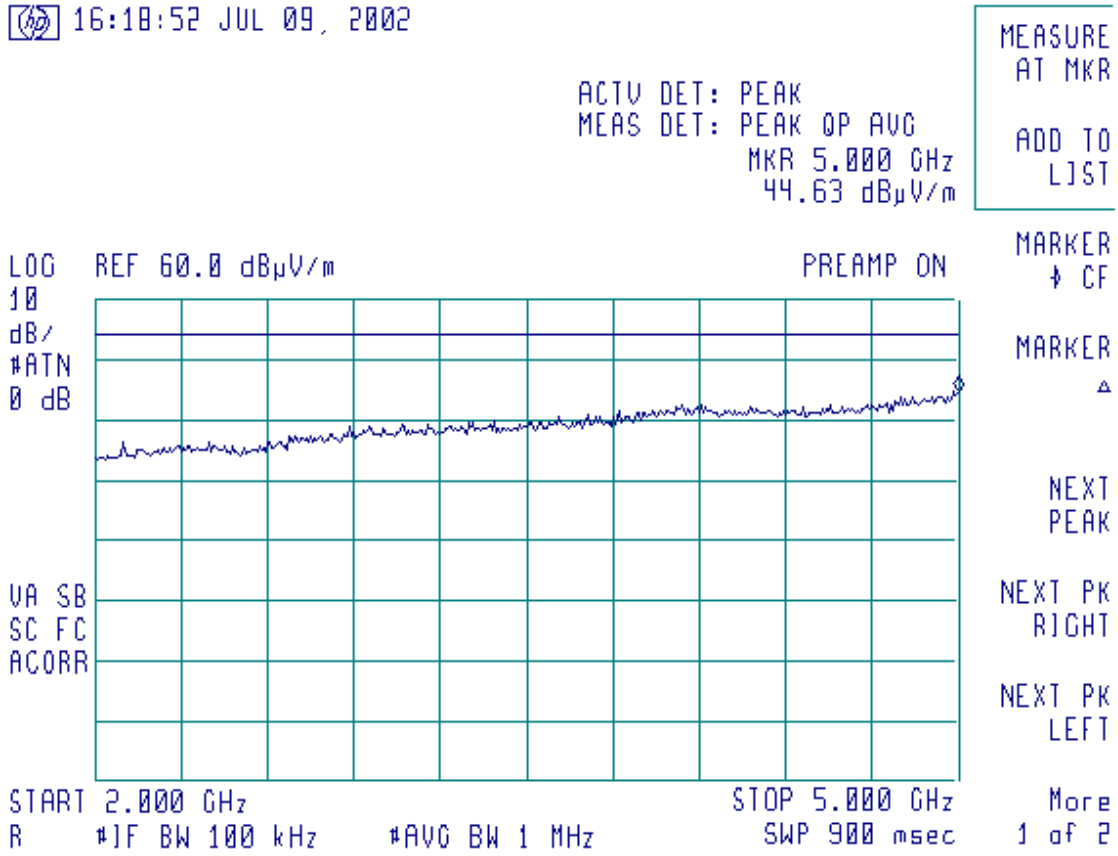
Plot A 15

Unintentional radiation measurements
2000 MHz – 5000 MHz frequency range



Notes
Mode: Rx
Antenna. Polarization-Vertical & Horizontal

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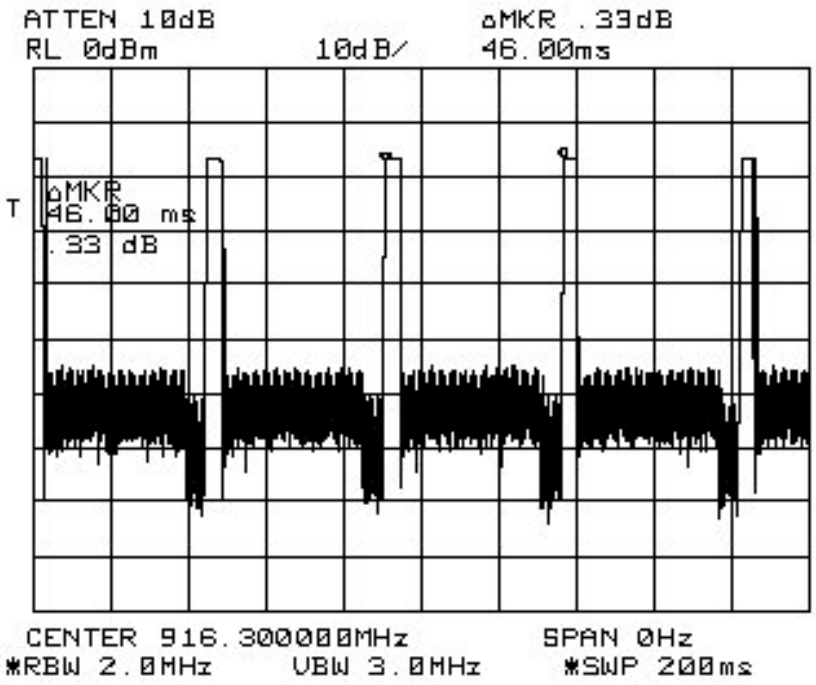
Plot A 16

Pulse repetition period



Pulse repetition period is 46 ms

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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.	
0026	Spectrum analyzer, 100 Hz-2.2 GHz	Anritsu	MS 2601A	3460	9/03
0034	Log periodic antenna, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	1988	1/03
0038	Antenna Mast, 1-4 m	Hermon Labs	AM-1	028	2/03 Check
0041	Double ridged guide antenna, 1-18 GHz	Electro-Metrics	RGA 50/60	2811	3/03
0465	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	11/02 check
0521	Spectrum Analyzer with RF filter section (EMI Receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/03
0554	Amplifier, 2 – 18 GHz RF	Miteq	AFD-4	4300	12/02
0589	Cable Coaxial, GORE A2POL118.2, 3m	Hermon Labs	GORE-3	589	12/02
0604	Antenna Biconilog Log-Periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	01/03
1003	Cable coaxial, M17/164, 10 m	Hermon Labs	C17164-10	161	11/02
1004	Cable coaxial, ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/02
1200	Quadruplexer	Elettronica	UE 84	0240	4/03 check
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/03
1538	Cable RF, 5.0 m	Alpha wire	RG-213	NA	9/03
1915	Active receiving loop antenna, 1 kHz – 30 MHz	EMC test systems	6507	1457	06/03
1942	Cable 18 GHz, 4 m, blue	Rhophase Microwave Ltd	SPS-1803A-4000-NPS	T4658	10/02
1947	Cable 18 GHz, 6.5 m, blue	Rhophase Microwave Ltd	NPS-1803A-6500-NPS	T4974	10/02
2009	Cable RF, 8 m	Alpha Wire	RG-214	NA	12/02

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Appendix C Test equipment correction factors

Antenna Factors for Loop Antenna
Manufactured by EMC Test Systems
Model Number: 6507 Serial Number: 1457

Frequency (MHz)	Magnetic Antenna Factor (dBS/m)	Electric Antenna Factor (dB)
0.001	-0.8	50.7
0.002	-6.1	45.4
0.003	-10.0	41.5
0.005	-15.3	36.2
0.007	-18.5	33.0
0.009	-20.8	30.7
0.010	-21.9	29.7
0.020	-27.1	24.5
0.050	-31.0	20.5
0.075	-31.7	19.8
0.100	-31.9	19.6
0.150	-32.1	19.4
0.250	-32.3	19.2
0.500	-32.6	18.9
0.750	-32.7	18.8
1.000	-32.8	18.7
2.000	-33.2	18.3
3.000	-33.5	18.0
4.000	-33.9	17.6
5.000	-34.1	17.4
10.000	-34.8	16.7
15.000	-35.3	16.3
20.000	-35.3	16.3
25.000	-35.8	15.7
30.000	-35.9	15.7

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Antenna factor, 3 m test distance
Log periodic antenna
Electro-Metrics, model LPA-25/30
Ser.No.1988

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 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
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 Antenna
Model RGA-50/60
S/N 2811

Frequency, MHz	Antenna Factor, dB
1000	24.3
1500	25.4
2000	28.4
2500	29.2
3000	30.5
3500	31.6
4000	33.7
4500	32.2
5000	34.5
5500	34.5
6000	34.6
6500	35.3
7000	35.5
7500	35.9
8000	36.6
8500	37.3
9000	37.7
9500	37.7
10000	38.2
10500	38.5
11000	39.0
11500	40.1
12000	40.2
12500	39.3
13000	39.9
13500	40.6
14000	41.1
14500	40.5
15000	39.9
15500	37.8
16000	39.1
16500	41.1
17000	41.7
17500	45.1
18000	44.3

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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Cable Coaxial, GORE A2P01POL118, 2.3 m, model:GORE-3, s/n 176 (HL 0589)
+ Cable Coaxial, ANDREW PSWJ4, 6m, model: ANDREW-6, s/n 163 (HL 1004)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation, dB	Tolerance (Specification), dB	Meas. Uncert., dB	Notes
1	Insertion	30	0.33	-			
2	Loss	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	-	≤ 6.5	±0.12	
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	Insertion	2800	3.21	-	≤ 6.5	±0.12	
17	Loss	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 coaxial M17/164
Model: C17164-10, s/n 161 (HL 1003)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation, dB	Tolerance (Specification), dB	Meas. Uncert., dB	Notes
1	Insertion	30	0.41	-	≤ 12.5	±0.12	
2	Loss	50	0.52	-			
3		100	0.75	-			
4		300	1.45	-			
5		500	2.01	-			
6		800	2.71	-			
7		1000	3.14	-			
8		1200	3.56	-			
9		1400	3.93	-			
10		1600	4.31	-			
11		1800	4.63	-			
12		2000	4.97	-			
13		2200	5.32	-			
14		2400	5.65	-			
15		2600	6.01	-			
16	Insertion	2800	6.42	-	≤ 12.5	±0.12	
17	Loss	3000	6.76	-			
18		3300	7.12	-			
19		3600	7.53	-			
20		3900	7.95	-			
21		4200	8.32	-		±0.17	
22		4500	8.72	-			
23		4800	9.14	-			
24		5100	9.59	-			
25		5400	10.00	-			
26		5700	10.49	-			
27		6000	11.07	-			
28		6500	11.80	-			

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Cable 18GHz, 6.5 m, blue, model: NPS-1803A-6500-NPS, s/n T4974 (HL 1947)
Calibration data

Frequency, GHz	Insertion Loss, dB
	HL1947
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	Insertion Loss, dB
	HL1947
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 18GHz, 4 m, blue, model: SPS-1803A-4000-NPS, s/nT4658 (HL 1942)
Calibration data

Frequency, GHz	Insertion Loss, dB
	HL1942
0.03	0.21
0.05	0.26
0.10	0.36
0.20	0.50
0.30	0.61
0.40	0.70
0.50	0.78
0.60	0.85
0.70	0.93
0.80	0.99
0.90	1.04
1.00	1.10
1.10	1.16
1.20	1.22
1.30	1.26
1.40	1.31
1.50	1.35
1.60	1.41
1.70	1.45
1.80	1.49
1.90	1.53
2.00	1.57
2.10	1.61
2.20	1.65
2.30	1.69
2.40	1.72
2.50	1.76
2.60	1.79
2.70	1.83
2.80	1.87
2.90	1.90
3.10	1.97
3.30	2.04
3.50	2.11
3.70	2.18
3.90	2.24
4.10	2.31
4.30	2.38
4.50	2.43
4.70	2.53
4.90	2.53
5.10	2.63
5.30	2.65
5.50	2.72
5.70	2.76
5.90	2.79

Frequency, GHz	Insertion Loss, dB
	HL1942
6.10	2.88
6.30	2.90
6.50	2.97
6.70	3.02
6.90	3.04
7.10	3.07
7.30	3.12
7.50	3.13
7.70	3.19
7.90	3.24
8.10	3.30
8.30	3.36
8.50	3.45
8.70	3.41
8.90	3.45
9.10	3.42
9.30	3.55
9.50	3.48
9.70	3.58
9.90	3.61
10.10	3.66
10.30	3.68
10.50	3.70
10.70	3.70
10.90	3.75
11.10	3.78
11.30	3.86
11.50	3.98
11.70	4.10
11.90	4.12
12.10	4.09
12.40	4.13
13.00	4.23
13.50	4.35
14.00	4.40
14.50	4.44
15.00	4.57
15.50	4.66
16.00	4.64
16.50	4.66
17.00	4.75
17.50	4.85
18.00	4.93

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Cable loss
Cable RF, 5 m, model RG-213 (HL 1538)

Calibration Data

No.	Frequency	Measured attenuation	Measurement uncertainty
1	10 MHz	0.10 dB	±0.05 dB
2	20 MHz	0.19 dB	±0.05 dB
3	30 MHz	0.18 dB	±0.05 dB
4	40 MHz	0.23 dB	±0.05 dB
5	50 MHz	0.28 dB	±0.05 dB
6	60 MHz	0.30 dB	±0.05 dB
7	70 MHz	0.34 dB	±0.05 dB
8	80 MHz	0.41 dB	±0.05 dB
9	90 MHz	0.40 dB	±0.05 dB
10	100 MHz	0.45 dB	±0.05 dB
11	200 MHz	0.64 dB	±0.05 dB
12	300 MHz	0.83 dB	±0.05 dB
13	400 MHz	0.99 dB	±0.05 dB
14	500 MHz	1.10 dB	±0.05 dB
15	600 MHz	1.26 dB	±0.05 dB
16	700 MHz	1.43 dB	±0.05 dB
17	800 MHz	1.56 dB	±0.05 dB
18	900 MHz	1.71 dB	±0.05 dB
19	1000 MHz	1.78 dB	±0.05 dB
20	1500 MHz	2.13 dB	±0.05 dB
21	2000 MHz	2.54 dB	±0.05 dB

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Cable RF, 8 m, model:RG-214, s/n C-56 (HL 2009)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation	Tolerance (Specification)	Meas. Uncert., dB	Notes
1	Insertion Loss	1	0.10	NA	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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Appendix D General information

Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private EMC, Safety and Telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47) and by Industry Canada for electromagnetic emissions (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, Telecommunications, Safety standards, and by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for Electromagnetic Compatibility, Product Safety, Telecommunications Testing and Environmental Simulation (for exact scope please refer to Certificate No. 839.01).

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Person for contact: Mr. Alex Usoskin, QA manager.

Abbreviations and acronyms

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

AC	alternating current
AE	auxiliary equipment
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
EMC	electromagnetic compatibility
EUT	equipment under test
GHz	gigahertz
H	height
Hz	hertz
kHz	kilohertz
kV	kilovolt
L	length
LISN	line impedance stabilization network
m	meter
MHz	megahertz
NA	not applicable
QP	quasi-peak
RF	radio frequency
RE	radiated emission
rms	root mean square
s	second
V	volt
W	width

Specification references

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