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RADIO TEST REPORT

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

Tadiran Telematics Ltd.

EQUIPMENT UNDER TEST:

Meter and monitoring reader board

Model: MMR-FH200

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

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1 Project information

Description of equipment under test

Test items	: Meter and monitoring reader board
Manufacturer	: Tadiran Telematics Ltd
Equipment serial number	: 001188
Types (Models)	: MMR-FH200
Hardware revision	: A1
Software revision	: A1
Equipment FCC code	: DSS

Applicant information

Applicant's responsible person	: Mr. Uzi Erman
Company	: Tadiran Telematics Ltd.
Address	: 26, Hamelaha street
City	: Holon
Postal code	: 58117
Country	: Israel
Telephone number	: +972 3 557 5755
Telefax number	: +972 3 557 5753

Test performance

Project Number:	: 15432
Location	: Hermon Laboratories
Receipt date	: February 4, 2003
Test performed	: February 4, 24, 2003
Purpose of test	Apparatus compliance verification in accordance with emission requirements
Test specification(s)	47CFR Part 15 subpart C, §15.247 and subpart B



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 subpart C, §15.247, and subpart B.

Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
Transmitter characteristics, §15.247								
Frequency hopping systems								
Occupied bandwidth of hopping channels	(a)(1) (i – iii)	X				Mr. M. Feldman, test engineer	February 4, 2003	
Hopping channel frequency separation	(a)(1)	X				Mr. M. Feldman, test engineer	February 4, 2003	
Number of hopping channels	(a)(1) (i – iii)	X				Mr. M. Feldman, test engineer	February 4, 2003	
Average time of occupancy	(a)(1) (i – iii)	X				Mr. M. Feldman, test engineer	February 4, 2003	
Maximum peak output power	b(1), b(2), b(3)	X				Mr. M. Feldman, test engineer	February 4, 2003	
Exposure compliance requirements	b(4)	X						Evaluation
Spurious emissions (conducted)	c	X				Mr. M. Feldman, test engineer	February 4, 2003	
Spurious emissions (radiated)	c			X				
Spurious emissions (radiated) in restricted bands	15.209, 15.205(a,c)	X				Mrs. E. Pitt, test engineer	February 24, 2003	
Unintentional radiation, §15.107, §15.109								
Conducted emissions	15.107				X			
Radiated emissions	15.109	X				Mr. M. Feldman, test engineer	February 4, 2003	
General conditions under Part 15								
The Intentional radiator operates in 905 - 924 MHz frequency range.	15.247	X						
The hopping sequence meets the requirement specified in the definition of a frequency hopping spread spectrum system	15.247, a(1)	X				For an example of a hopping sequence see Appendix C.		

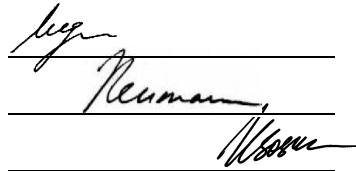


Parameter	Subclause	C	NC	NT	NA	Tested by	Date tested	Remarks
Each of the hopping channels is used equally on average	15.247 a(1)	X						
The associated receiver complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal	15.247 a(1)	X						
The EUT is designed to be capable of operating as a true frequency hopping system	15.247(g)	X						
The EUT does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters	15.247(h)	X						
Examined frequencies:	15.31(m)	X						
Near the top								
Near the middle								
Near the bottom								
The intentional radiator has permanently attached antenna or antenna that uses a unique coupling to the intentional radiator.	15.203				X			
The intentional radiator has a standard connector and must be professionally installed.	15.203	X						
No antenna other than that furnished by the responsible party can be used with the device.	15.203	X						
Antenna technical characteristics, as referred to in "Transmitter description" table in the test report	15.204	X						
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, MSc, certification engineer

Test report approved by: Mr. Yu. Neuman, MSc, EMC group leader

Mr. E. Usoskin, PhD, CEO





3 EUT description

3.1 General description

The EUT, MMR-FH200, is a compact RF transceiver, which operates in 905 – 924 MHz band, using frequency hopping technique.

The device is powered by 3 external 1.5 V lithium batteries.

3.2 EUT test configuration

The EUT ports and lines description is given in Table 3.2.1, test configuration is shown in Figure 3.2.1, clock and oscillator frequencies are provided in Table 3.2.2.

Table 3.2.1

EUT ports and lines

Port type	Port description	Indoor/ outdoor cable	Connector type	Quantity	Cable type description	Cable length, m	Connected to
RF	Antenna	Outdoor	TNC	1	Coax	2.0	Antenna
Signal	RS232	For service purposes only					

Table 3.2.2 EUT clock frequencies

Frequency, MHz	
8	clock1
12.6	clock2
841 - 860	LO1
53.3	LO2

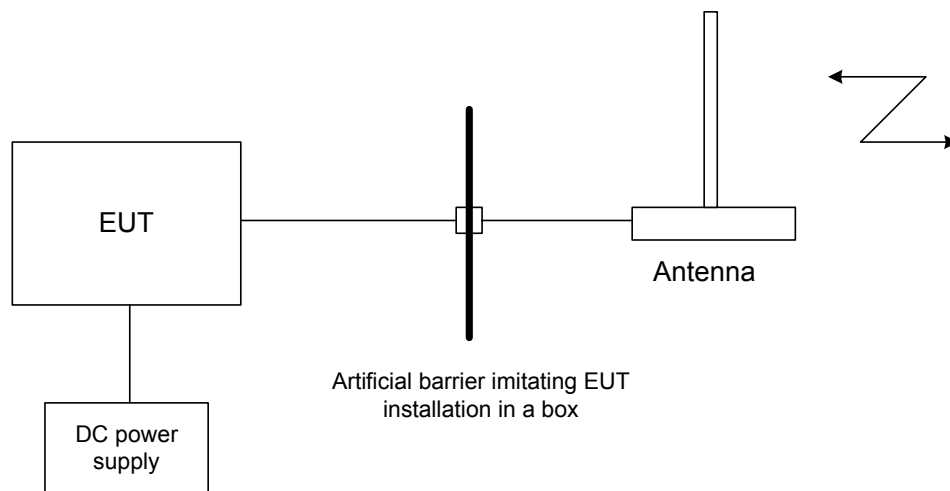
3.2.1 Changes made in EUT

To withstand the standard requirements, 56 pF and 10 pF capacitors were installed between +V_{cc} pin and the GND.

It is manufacturer responsibility to implement the change in the production version of the EUT. In any case the test report applies to the tested item only.



Figure 3.2.1
EUT test configuration





3.3 Transmitter description

Type of equipment			
☒	Stand-alone (Equipment with or without its own control provisions)		
☐	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)		
☐	Plug-in card (Equipment intended for a variety of host systems)		
☐	Other:		
Operating frequency range		905 - 924 MHz	
Spread spectrum technique used			
☒	Frequency hopping (FHSS)		
☐	Direct sequence (DSSS)		
☐	Combined		
Spread spectrum parameters*			
DSSS	chip sequence length (bits)		
	spectrum width (MHz)		
FHSS	total number of hops (units)	26	
	dwel time (milliseconds)	360	
	bandwidth per hop (kHz)	488 max	
	separation of hops (kHz)	560	
Transmitter aggregate data rate (bits per second)		60 kbit/s	
Normal test signal		transmit protocol, FSK	
Maximum rated output power			
At transmitter permanent external 50 Ω rf output connector (dBm)		21	
Effective radiated power (for equipment with integral antenna) (dBm)			
Is transmitter output power variable?	☒	No	
	☐	Yes	continuous variable
	☐		stepped variable
	☐		stepsize (dB):.....
	☐		minimum RF power (dBm):.....
☐		maximum RF power (dBm):.....	
Transmitter power source			
☐	Battery	Nominal rated voltage (VDC)	4.5
☐	Nickel Cadmium		
☒	Lithium		
☐	Other		
☐	DC	Nominal rated voltage (VDC)	
☐	AC mains	Nominal rated voltage (VAC)	
Is there common power source for transmitter and receiver		☒	yes
		☐	no
Antenna technical characteristics			
Integral	with temporary RF connector	Type	Manufacturer
	without temporary RF connector		
External		Closed collinear	Antenex
			B8965C
			6 dBi
External antenna connection			
☒	standard connector		unique coupling

* If more than 1 variant of any spectrum parameter may be used, provide all variations of these parameters.



4 Test results

4.1 Occupied bandwidth of hopping channels and channel carrier frequencies separation according to § 15.247(a)(1)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.7
DATE:	February 4, 2003
RELATIVE HUMIDITY:	43 %
AMBIENT TEMPERATURE:	24 °C
AIR PRESSURE:	1015 hPa
OPERATING FREQUENCY RANGE	905-924 MHz
MODULATION TECHNIQUE	FHSS
HOPPING FUNCTION	Disabled (for occupied bandwidth measurements), Enabled (for channel separation measurements)

Carrier frequency, MHz	Measured 20 dB bandwidth, kHz	Reference to Plot in Appendix A
905.9	438	A1
916.3	450	A2
923.2	488	A3
Measurement uncertainty, dB	± 1.7	

Frequency range, MHz	Channel carrier frequency separation	Reference to Plot in Appendix A
905 – 924	560 kHz	A4
Measurement uncertainty, dB	$\pm 4.5\%$	

TEST EQUIPMENT USED:

HL 0025	HL 0410	HL 0465	HL 0521	HL 0589	HL 0604	HL 0911
HL 1004	HL 1425	HL 2287				

LIMIT

Operating frequency range, MHz	Allowed bandwidth	Channel carrier frequency separation (minimum)
902-928	≤ 500 kHz @ 20 dBc	25 kHz or 20 dB bandwidth, which is greater
2400-2483.5; 5275-5850	≤ 1 MHz @ 20 dBc	
2400-2483.5	> 1 MHz @ 20 dBc	

TEST PROCEDURE

Occupied bandwidth measurements

The EUT RF output was connected to the spectrum analyzer, which settings are shown in the plots.

The measurements were performed in normal mode of operation for carrier (channel) frequency at low and high edges and at the middle of the frequency band.

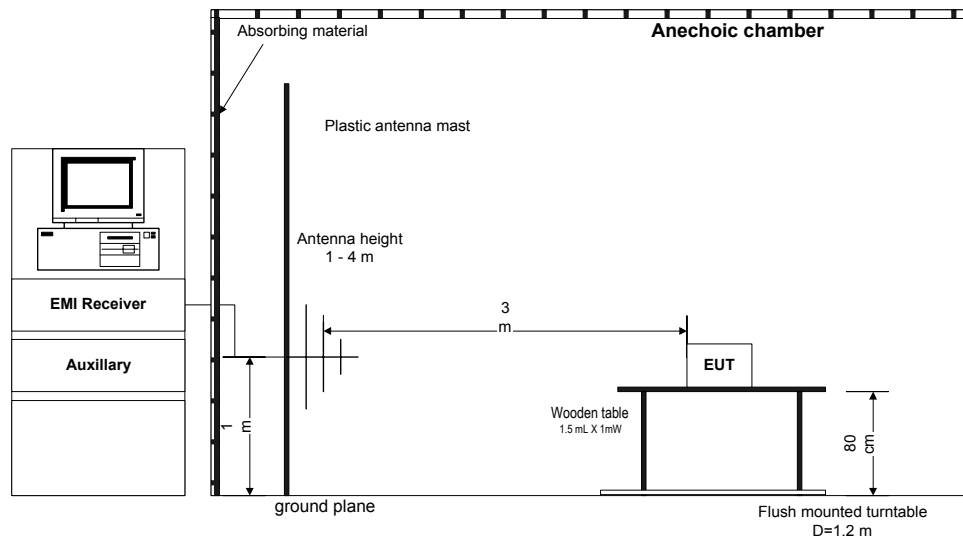
Channel carrier frequency separation

The EUT was set up as shown in Figure 4.1.1. The measuring antenna was connected to spectrum analyzer, which settings are shown in Plots.

The measurements were performed in normal mode of operation.



Figure 4.1.1





4.2 Number of hopping channels according to § 15.247(a)(1)

METHOD OF MEASUREMENT	ANSI 63.4 §13.1.7
DATE:	February 4, 2003
RELATIVE HUMIDITY:	43 %
AMBIENT TEMPERATURE:	24 °C
AIR PRESSURE:	1015 hPa
OPERATING FREQUENCY RANGE	905-924 MHz
MODULATION TECHNIQUE	FHSS
HOPPING FUNCTION	Enabled

Occupied frequency range	Measured 20 dB BW, kHz	Number of channels	Reference to Plot in Appendix A
905-924	438 min	26	A4
Measurement uncertainty, dB		NA	

TEST EQUIPMENT USED:

HL 0465	HL 0521	HL 0589	HL 0604	HL 1004		
---------	---------	---------	---------	---------	--	--

LIMIT

Operating frequency range, MHz	20 dB bandwidth	Number of frequencies
902-928	< 250 kHz	≥ 50
	≥ 250 kHz	≥ 25
2400-2483.5; 5275-5850	≤ 1 MHz	≥ 75
2400-2483.5	> 1 MHz	≥ 15 non-overlapping channels with total span ≥ 75 MHz

TEST PROCEDURE

The setup was the same as in Paragraph 4.1 for channel separation measurements. The measuring antenna was connected to spectrum analyzer, which settings are shown in Plots.



4.3 Average time of hopping frequency occupancy according to § 15.247(a)(1), (f)

METHOD OF MEASUREMENT	ANSI 63.4 §13.1.7
DATE:	February 4, 2003
RELATIVE HUMIDITY:	43 %
AMBIENT TEMPERATURE:	24°C
AIR PRESSURE:	1015 hPa
OPERATING FREQUENCY RANGE	905-924 MHz
MODULATION TECHNIQUE	FHSS
HOPPING FUNCTION	Enabled

Carrier frequency, MHz	Time period between two successive transmissions	Average time of occupancy	Reference to Plot in Appendix A
916.3	11.333 s	360 ms	A5, A6
Measurement uncertainty, ppm		± 0.21	

TEST EQUIPMENT USED:

HL 0025	HL 0410	HL 0911	HL 1425	HL 2287		
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LIMIT

Operating frequency range, MHz	Number of frequencies	Average time of occupancy
902-928	≥ 50	≤ 0.4 s within 20 s period
	≥ 25	≤ 0.4 s within 10 s period
2400-2483.5; 5275-5850	≥ 75	≤ 0.4 s within 30 s period
2400-2483.5	≥ 15 non-overlapping channels with total span ≥ 75 MHz	≤ 0.4 s within the time required to hop through all channels

TEST PROCEDURE

The EUT RF output was connected to the spectrum analyzer, which settings are shown in the plots.



4.4 Maximum peak output power test according to §15.247 (b)(1), (b)(2), (b)(3)

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4
DATE:	February 4, 2003
RELATIVE HUMIDITY:	43 %
AMBIENT TEMPERATURE:	24 °C
AIR PRESSURE:	1015 hPa
OPERATING FREQUENCY RANGE	905-924 MHz
MODULATION TECHNIQUE	FHSS
HOPPING FUNCTION	Disabled

Carrier frequency, MHz	Peak output power, dBm	Limit, dBm	Margin, dB	Reference to Plots in Appendix A
905.62	20.8	24	3.2	A7
916.3	21.13	24	2.87	A8
923.16	21.13	24	2.87	A9
Measurement uncertainty, dB		+0.36/-0.38 dB		

TEST EQUIPMENT USED:

HL 0410	HL 0521	HL 1097				
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LIMIT

Operating frequency range, MHz	Number of hopping channels	Maximum peak output power*, W
902-928 (hopping)	≥ 50	1
	< 50	0.25
2400-2483.5 (hopping)	≥ 75	1
	other admissible	0.125
5275-5850 (hopping)	any admissible	1
902-928; 2400-2483.5; 5275-5850 (direct sequence)	NA	1

TEST PROCEDURE

The EUT RF output was connected to the spectrum analyzer, which settings are shown in the plots.

The measurements were performed in normal mode of operation for carrier (channel) frequency at low and high edges and at the middle of the frequency band.



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

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.5
DATE:	February 4, 2003
RELATIVE HUMIDITY:	43%
AMBIENT TEMPERATURE:	24°C
AIR PRESSURE	1015 hPa
RATED RF OUTPUT POWER	20.7 dBm
OPERATING FREQUENCY RANGE	902-928 MHz
MODULATION TECHNIQUE	FHSS
HOPPING FUNCTION:	Disabled
FREQUENCY RANGE	9 kHz to 9 GHz

The measurements were performed in normal mode of operation for carrier (channel) frequencies at low and high edges and at the middle of the frequency band. All emissions were found more than 30 dB below the limit. The worst case results (at $F_{\text{carrier}} = 923.2$ MHz) are demonstrated in Plots A10 to A20.

TEST EQUIPMENT USED:

HL 0410	HL 0911	HL 1425	HL 2287			
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LIMIT

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

TEST PROCEDURE

The EUT RF output was connected via attenuator to spectrum analyzer, which settings are shown in the plots.



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

METHOD OF MEASUREMENTS	ANSI 63.4 §13.1.4/ §13.1.5
DATE:	February 24, 2003
RELATIVE HUMIDITY:	42 %
AMBIENT TEMPERATURE:	23 °C
RATED RF OUTPUT POWER	20.7 dBm
TEST DISTANCE	3 m
OPERATING FREQUENCY RANGE	905-924 MHz
MODULATION TECHNIQUE	FHSS
HOPPING FUNCTION	Disabled
FREQUENCY RANGE	9 kHz – 9.5 GHz

The measurements were performed in normal mode of operation for carrier (channel) frequencies at low and high edges and at the middle of the frequency band. No spurious emissions were found. The test results are demonstrated in Plots A21 to A55.

TEST EQUIPMENT USED:

HL 0041	HL 0446	HL 0465	HL 0521	HL 0589	HL 0604	HL 1004
HL 1200	HL 1424	HL 1566	HL 1942	HL 1947	HL 2009	HL 2259
HL 2274						

LIMIT

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

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.



4.7 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT: ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4
TEST PERFORMED IN: ANECHOIC CHAMBER
DATE: February 4, 2003
RELATIVE HUMIDITY: 43 %
AMBIENT TEMPERATURE: 24 °C
DISTANCE BETWEEN ANTENNA AND EUT: 3 m
THE EUT WAS TESTED AS: TABLE-TOP
FREQUENCY RANGE: 30 MHz – 5 GHz
DETECTOR TYPE: QUASI-PEAK
RESOLUTION BANDWIDTH: 120 kHz
OPERATING MODE: RECEIVING

	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	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

Frequency, MHz	Antenna polarization	Antenna height, m	Turntable position (°)	Radiated emissions, dB (μV/m)	Limit, dB (μV/m)	Margin, dB	Reference to Plots in Appendix A
192.0	Horizontal	1	295	33.1	43.5	10.4	A56
671.97	Vertical	1	216	27.0	46	19	A56
845.31	Vertical	1.3	335	37.9	46	8.1	A56
863.98	Horizontal	1.3	295	40.3	46	5.7	A56
1056.0	Vertical	1	110	36.2	54	17.8	A57
1344.0	Vertical	1	97	32.7	54	21.3	A57
Measurement uncertainty, dB				+5.42 dB/-5.26 dB			

Table abbreviations:

Antenna polarization: V = vertical, H = horizontal

Turntable position: 0° = EUT front panel faces the receiving antenna

TEST EQUIPMENT USED:

HL 0041	HL 0465	HL 0521	HL 0589	HL 0604	HL 1004	HL 1942
---------	---------	---------	---------	---------	---------	---------

LIMIT (§ 15.109)

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

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.

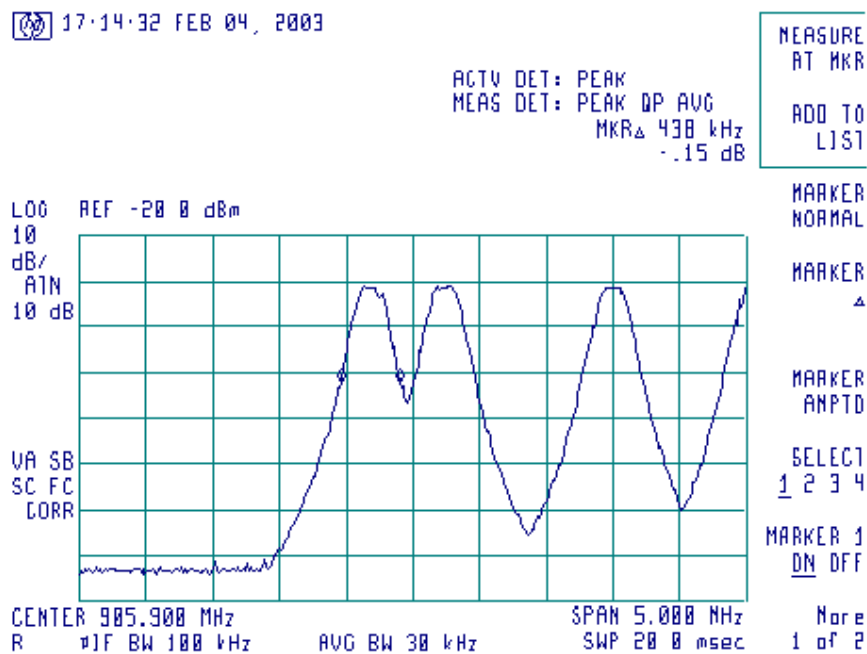


Appendix A Plots

Plot A 1

20 dB bandwidth for hopping system

$F_{low} = 905.9 \text{ MHz}$



Notes

Measured occupied bandwidth: 438 kHz

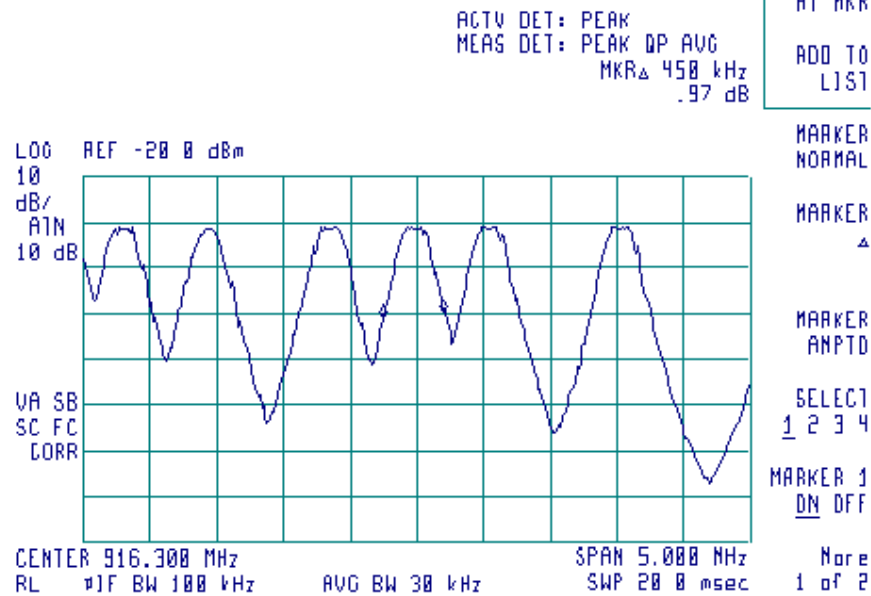


Plot A 2

20 dB bandwidth for hopping system

$F_{\text{middle}} = 916.3 \text{ MHz}$

17:28:05 FEB 04, 2003



Notes

Measured occupied bandwidth: 450 kHz



Plot A 3

20 dB bandwidth for hopping system

$F_{\text{high}} = 923.2 \text{ MHz}$

17:31:32 FEB 04, 2003

ACTV DET: PEAK
MEAS DET: PEAK DP AVG
MKR Δ -488 kHz
-1.98 dB

MEASURE
AT MKR

ADD TO
LIST

MARKER
NORMAL

MARKER
 Δ

MARKER
ANPTD

SELECT
1 2 3 4

MARKER 1
ON OFF

L00 REF -20.0 dBm

10
dB/
ATTN
10 dB

VA SB
SC FC
CORR

CENTER 923.200 MHz

RL 11F BW 100 kHz

AVG BW 30 kHz

SPAN 5.000 MHz

SWP 20.0 msec

None

1 of 2

Notes

Measured occupied bandwidth: 488 kHz



Plot A 4

Frequency separation

12:00:10 FEB 04, 2003

MARKER Δ
560 kHz
-.07 dB

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR Δ 560 kHz
-.07 dB

MEASURE
AT MKR

ADD TO
LIST

MARKER
NORMAL

MARKER
 Δ

MARKER
AMPTD

SELECT
1 2 3 4

MARKER 1
ON OFF

More
1 of 2

LOG REF 120.0 dB μ V

10
dB/
ATN
40 dB

VA SB
SC FC
ACORR

START 902.00 MHz STOP 930.00 MHz
RL #1F BW 120 kHz AVG BW 300 kHz SWP 26.3 msec

Notes

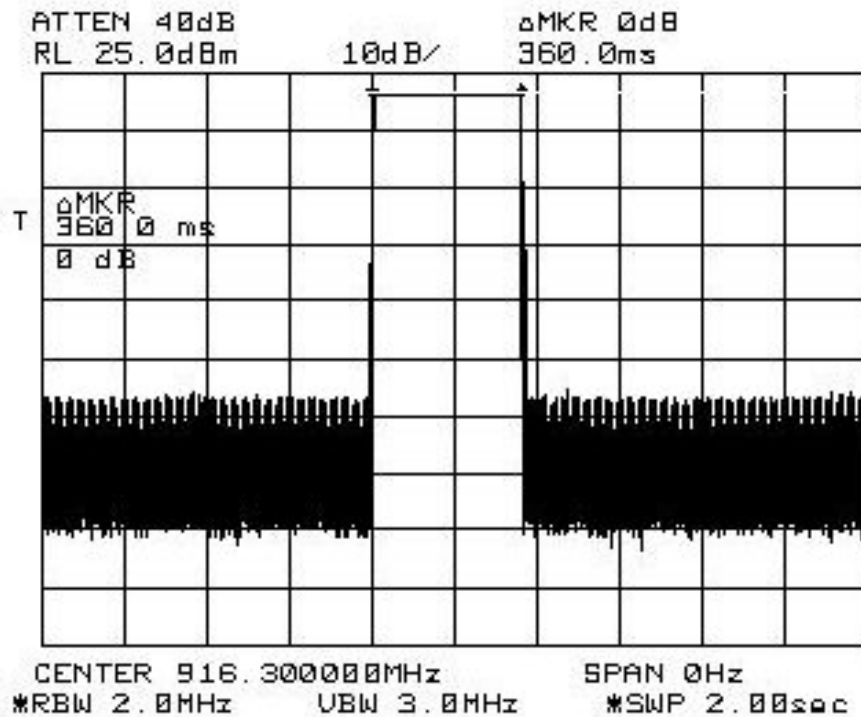
Measured interval between two hops: 560 kHz

Total number of hops = 26



Plot A 5

Average time of hopping frequency occupancy



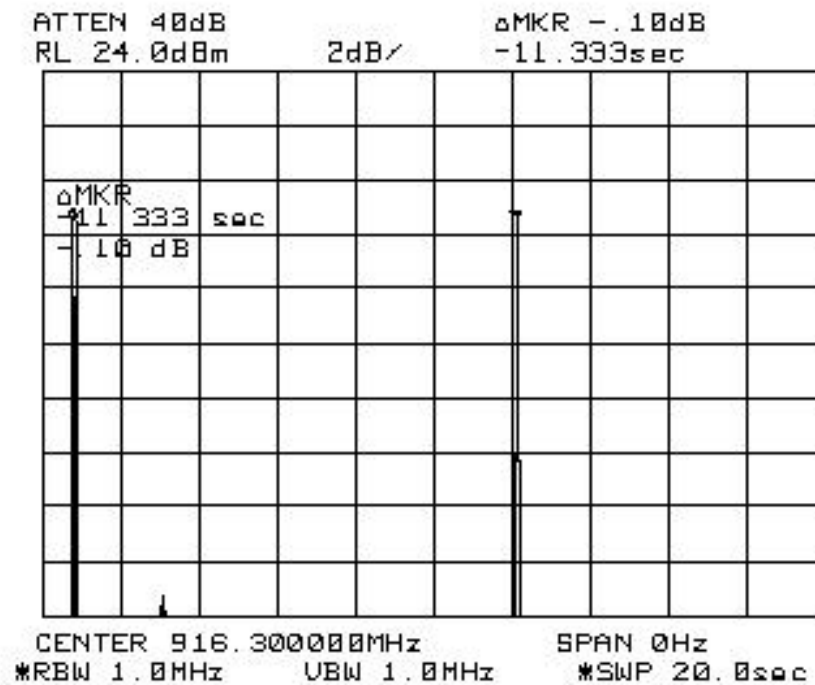
Notes

Average time of hopping frequency occupancy is 360.0 ms



Plot A 6

Average time of hopping frequency occupancy
in 10 s interval



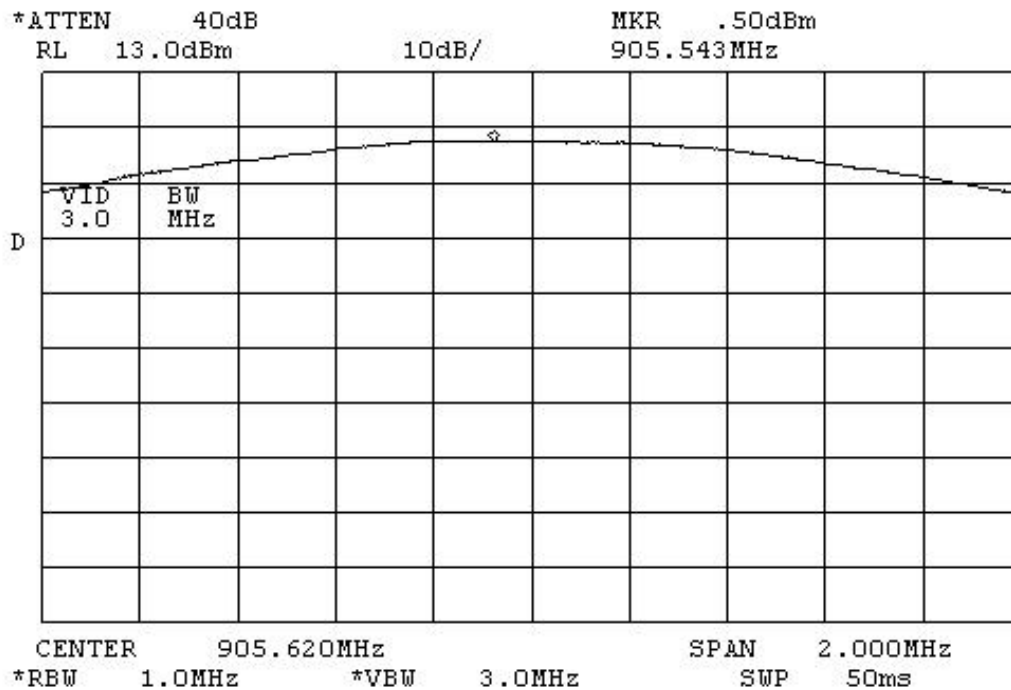
Notes

The average time of hopping frequency occupancy in 10 s interval is 360.0 ms < 0.4 s.



Plot A 7

Peak output power measurements



Notes

$F_{low} = 905.54 \text{ MHz}$

External attenuation: 20 dB

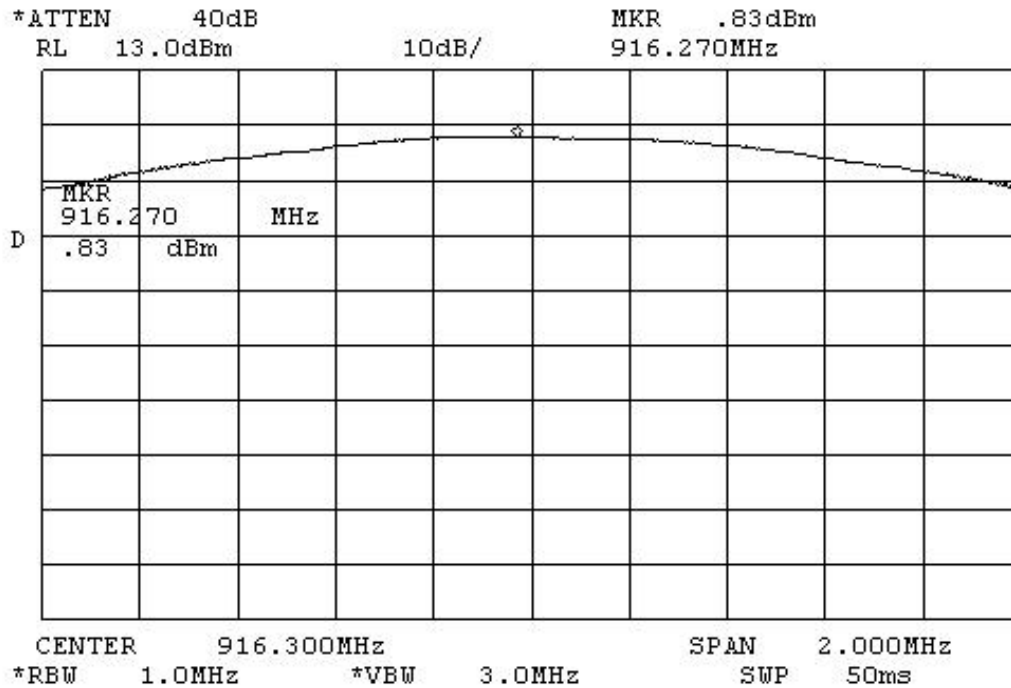
Cable loss (CL): 0.3 dB

$P = 0.5 \text{ dBm (measured)} + 20 \text{ dB (ext. att.)} + 0.3 \text{ dB (CL)} = 20.8 \text{ dBm}$



Plot A 8

Peak output power measurements



Notes

$F_{\text{middle}} = 916.27 \text{ MHz}$

External attenuation: 20 dB

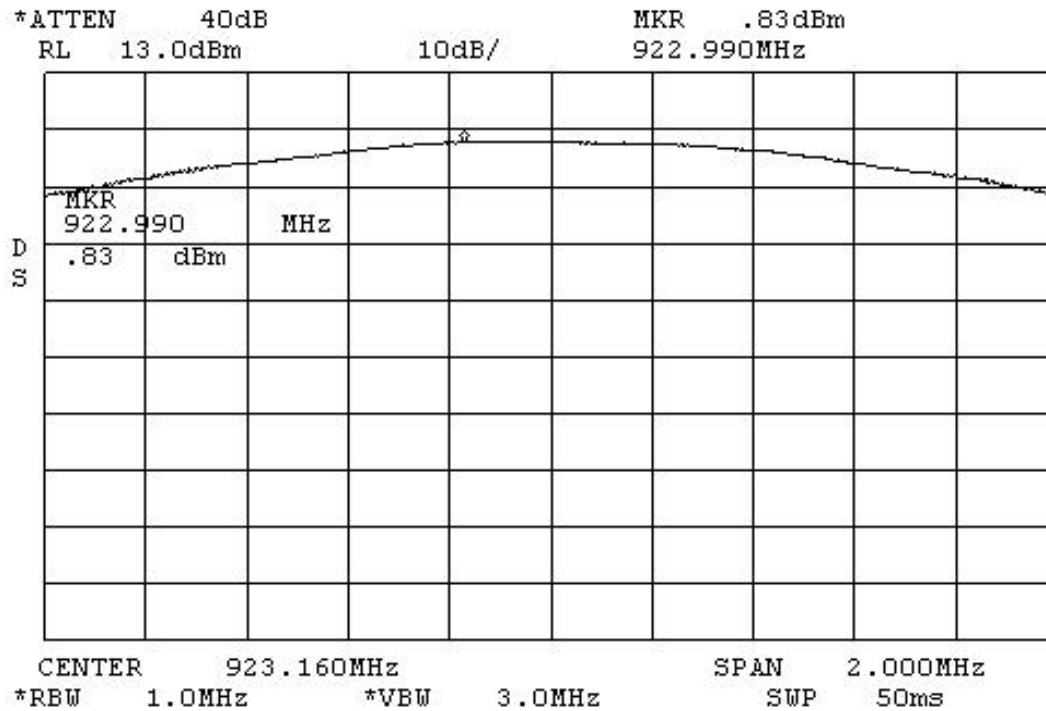
Cable loss 0.3 dB

$P = 0.83 \text{ dBm (measured)} + 20 \text{ dB (ext. att.)} + 0.3 \text{ dB (CL)} = 21.13 \text{ dBm}$



Plot A 9

Peak output power measurements



Notes

$F_{\text{high}} = 922.99 \text{ MHz}$

External attenuation: 20 dB
Cable loss 0.3 dB

$P = 0.83 \text{ dBm (measured)} + 20 \text{ dB (ext. att.)} + 0.3 \text{ dB (CL)} = 21.13 \text{ dBm}$



Plot A 10

Conducted spurious emission measurements
in 9 kHz – 150 kHz range

17:08:42 FEB 04, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 9.0 kHz
-47.86 dBm

MEASURE
AT MKR
ADD TO
LIST

CLEAR
WRITE A

MAX
HOLD A

VIEW A

BLANK A

Trace
A B C

More
1 of 3

LOG REF -20.0 dBm

10
dB/
ATTN
10 dB

DL
-30.0
dBm
VA SB
SC FC
ACORR

START 9.0 kHz

RL 11F BW 1.0 kHz

AVG BW 1 kHz

STOP 150.0 kHz

SWP 700 msec

Notes

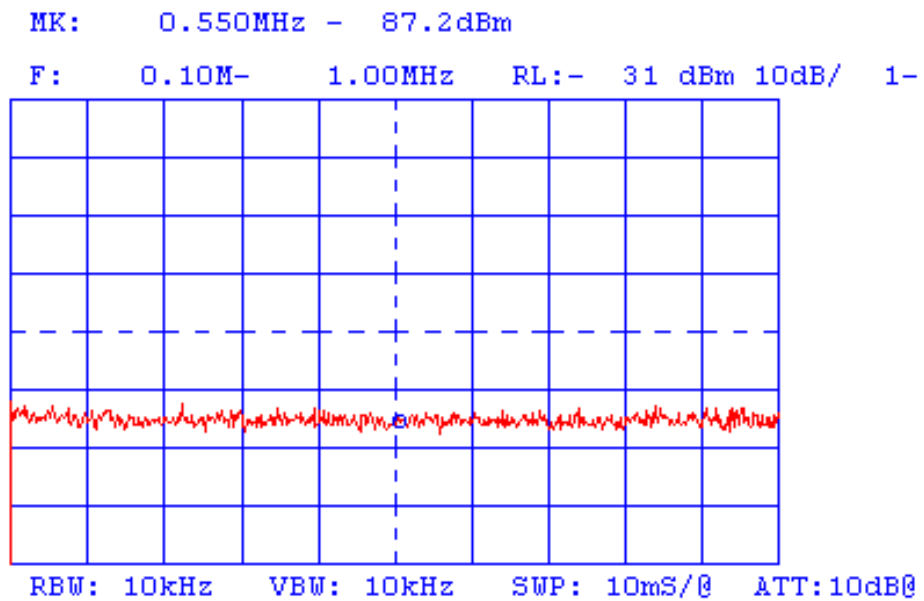
Conducted spurious emission limit =
= 20 dBm (measured output power) – 20 dB (§15.247 (5) (c) requirement) = 0 dBm.
External attenuation: 30 dB

No spurious emissions were found



Plot A 11

Conducted spurious emission measurements
in 100 kHz – 10 MHz range



Notes

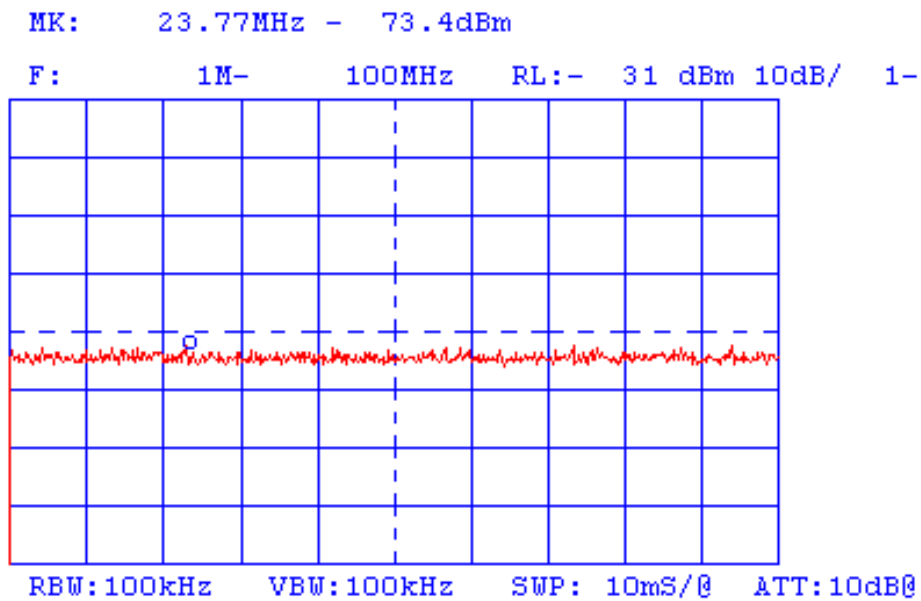
Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

No spurious emissions were found



Plot A 12

Conducted spurious emission measurements
in 1 – 100 MHz range



Notes

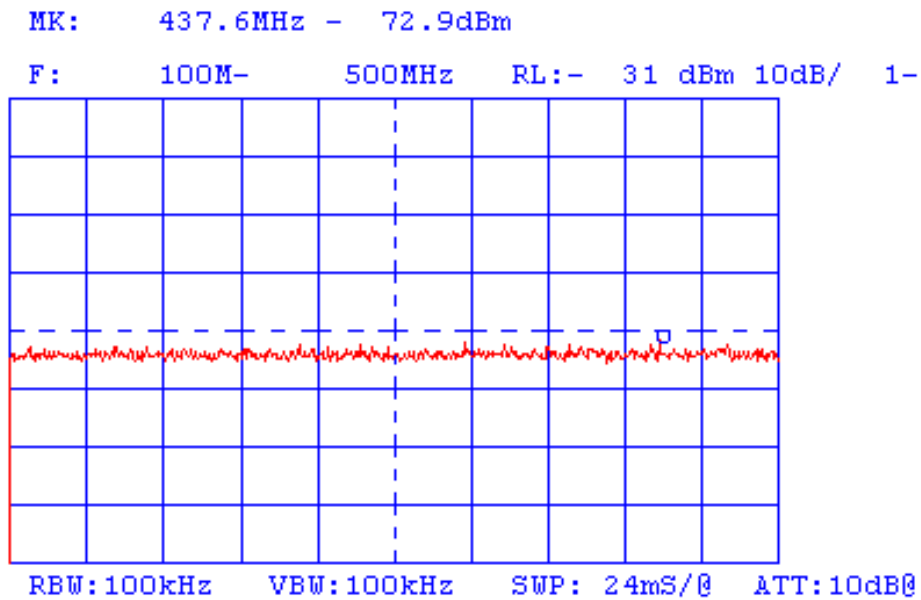
Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

No spurious emissions were found



Plot A 13

Conducted spurious emission measurements
in 100 – 500 MHz range



Notes

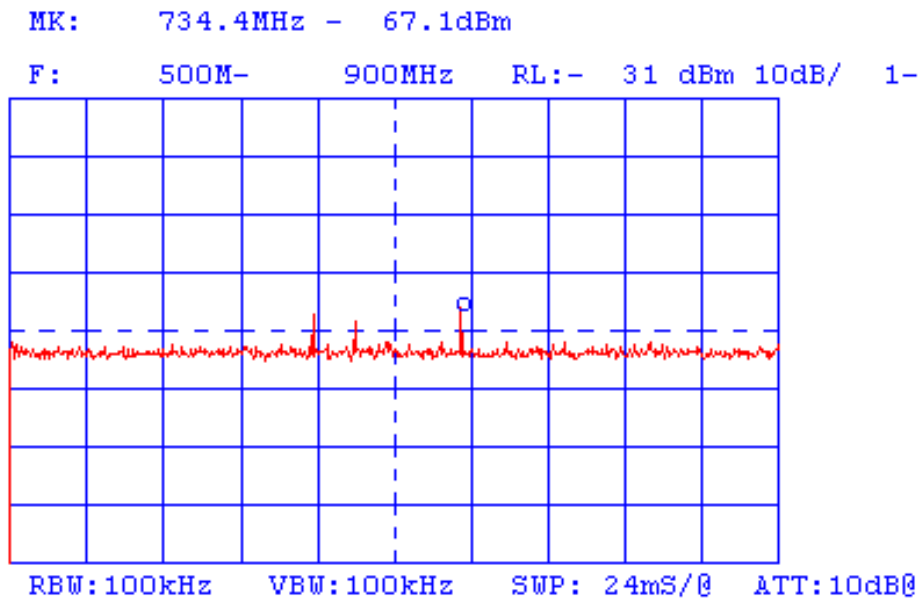
Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

No spurious emissions were found



Plot A 14

Conducted spurious emission measurements
in 500 – 900 MHz range



Notes

Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

Maximum emission level in 500 – 900 MHz range: -67.1 dBm (measured) + 31 dB (ext. att.) = -36 dBm

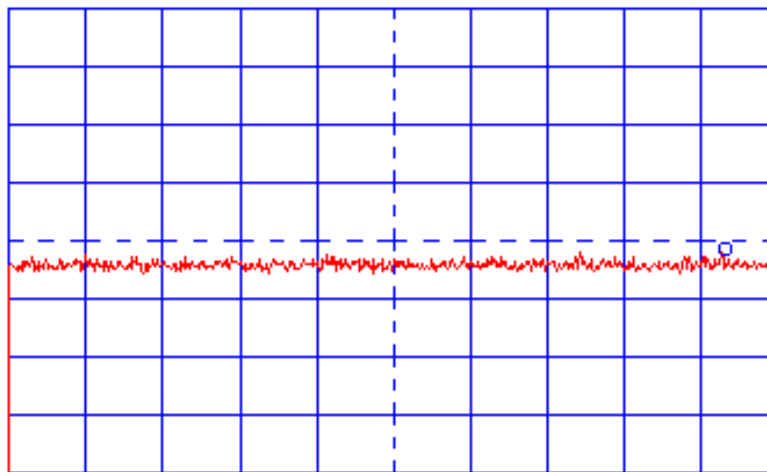


Plot A 15

Conducted spurious emission measurements
in 900 – 902 MHz range

MK: 901.852MHz - 73.0dBm

F: 900.00MHz - 902.00MHz RL:- 31 dBm 10dB/ 1-



RBW:100kHz VBW:100kHz SWP: 10mS/0 ATT:10dB0

Notes

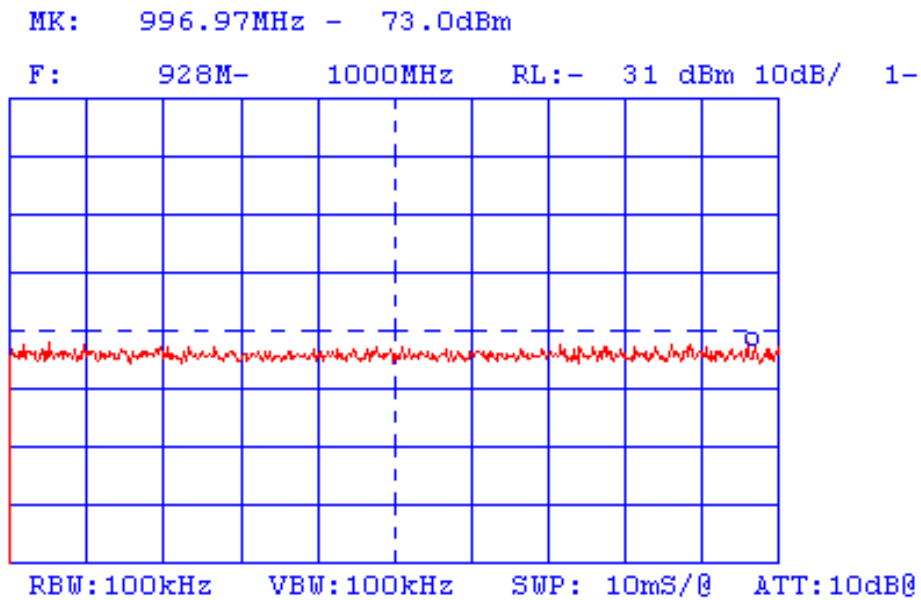
Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

No spurious emissions were found



Plot A 16

Conducted spurious emission measurements
in 928 – 1000 MHz range



Notes

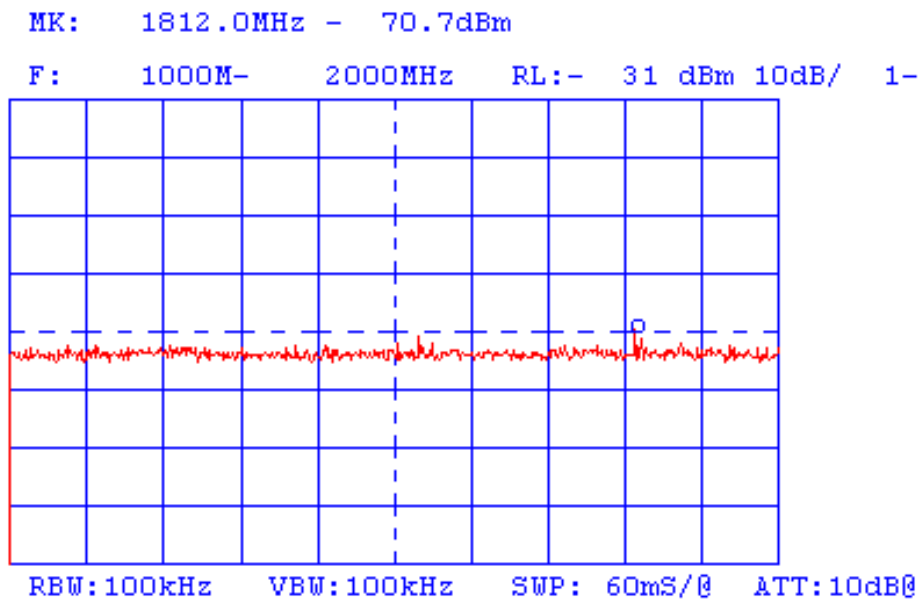
Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

No spurious emissions were found



Plot A 17

Conducted spurious emission measurements
in 1 – 2 GHz range



Notes

Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

Maximum emission level in 1 – 2 GHz range: -70.7 dBm (measured) + 31 dB (ext. att.) = -39.7 dBm

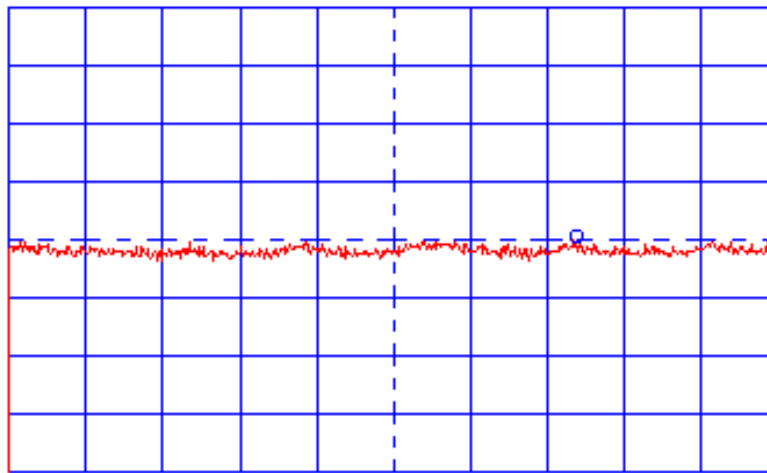


Plot A 18

Conducted spurious emission measurements
in 2 – 4 GHz range

MK: 3.4680GHz - 71.0dBm

F: 2.00G- 4.00GHz RL:- 31 dBm 10dB/ 1-



RBW:100kHz VBW:100kHz SWP:120mS/0 ATT:10dB0

Notes

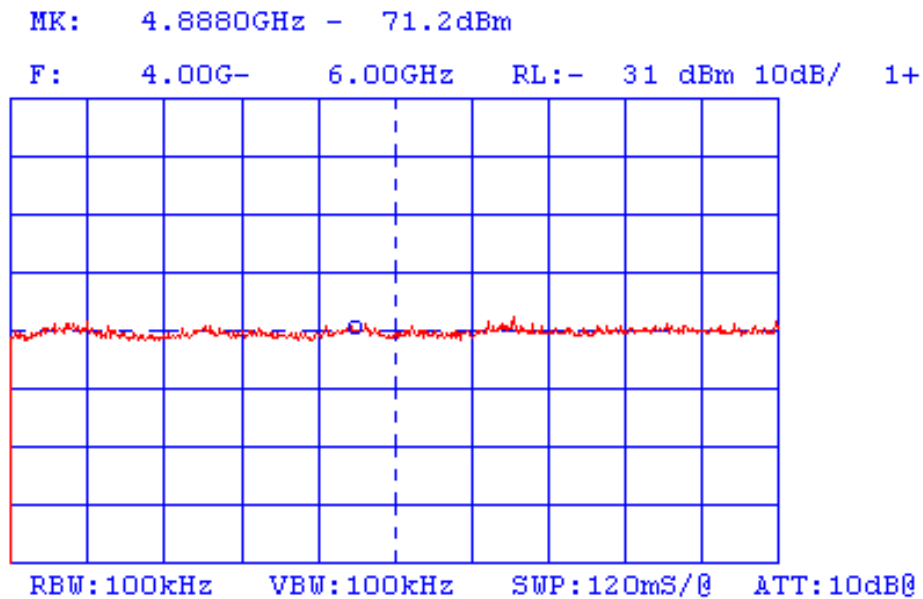
Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

No spurious emissions were found



Plot A 19

Conducted spurious emission measurements
in 4 – 6 GHz range



Notes

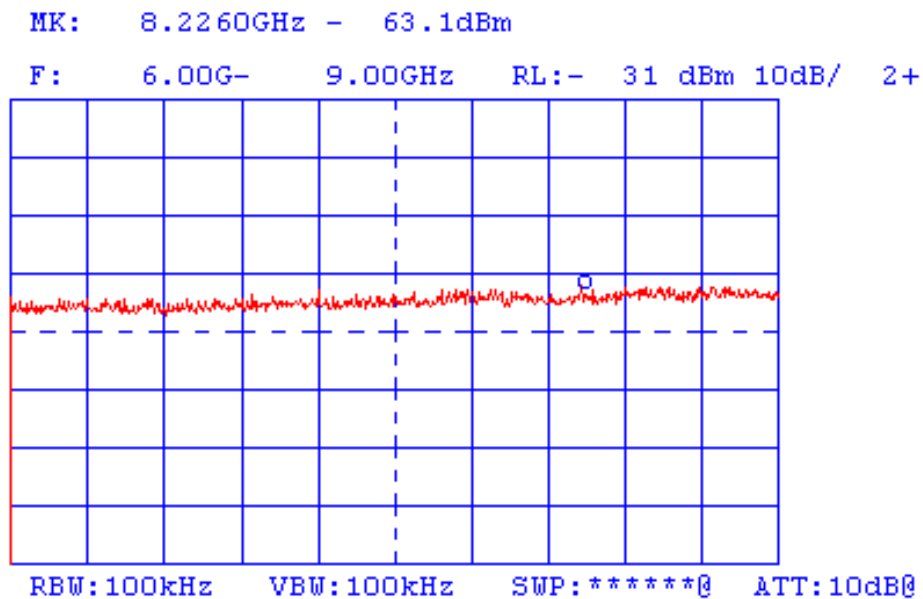
Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

No spurious emissions were found



Plot A 20

Conducted spurious emission measurements
in 6 – 9 GHz range



Notes

Conducted spurious emission limit = 0 dBm.
External attenuation: 31 dB

No spurious emissions were found



Plot A 21

Radiated spurious emission in restricted band measurements
in 9 – 150 kHz range,
 $F_{low} = 905.56 \text{ MHz}$

14:05:03 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 9.4 kHz
62.51 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 130.0 dB μ V/m

10
dB/
ATN
50 dB

VA SB
SC FC
ACORR

START 9.0 kHz STOP 150.0 kHz
R #1F BW 200 Hz AVG BW 300 Hz SWP 10.3 sec



Plot A 22

Radiated spurious emission in restricted band measurements
in 150 kHz – 30 MHz range,
 $F_{low} = 905.56 \text{ MHz}$

14:02:36 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 160 kHz
60.37 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
+ CF

MARKER
 Δ

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 105.0 dB μ V/m

10
dB/
ATN
30 dB

VA SB
SC FC
ACORR

START 150 kHz STOP 30.00 MHz
RL #1F BW 9.0 kHz AVG BW 30 kHz SWP 2.49 sec



Plot A 23

Radiated spurious emission in restricted band measurements
in 30 – 614 MHz range,
 $F_{low} = 905.56 \text{ MHz}$

13:20:33 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 563.3 MHz
31.39 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 60.0 dB μ V/m

10
dB/
#ATN
0 dB

VA SB
SC FC
ACORR

START 30.0 MHz STOP 614.0 MHz
RL #1F BW 120 kHz #AVG BW 1 MHz SWP 700 msec

Notes

Antenna polarization: vertical & horizontal



Plot A 24

Radiated spurious emission in restricted band measurements
in 960 – 1000 MHz range,
 $F_{low} = 905.56 \text{ MHz}$

13:15:30 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 960.22 MHz
36.32 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

LOG REF 60.0 dB μ V/m

10
dB/
#ATN
0 dB

VA SB
SC FC
ACORR

START 960.00 MHz STOP 1.00000 GHz
RL #1F BW 120 kHz #AVG BW 1 MHz SWP 700 msec

More
1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 25

Radiated spurious emission in restricted band measurements
in 1 – 1.73 GHz range,
 $F_{\text{low}} = 905.56 \text{ MHz}$

10:41:00 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 1.7136 GHz
43.30 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 1.0000 GHz

STOP 1.7300 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 26

Radiated spurious emission in restricted band measurements
in 2.2 – 2.9 GHz range,
 $F_{low} = 905.56 \text{ MHz}$

10:46:33 FEB 24, 2003

STOP
2.9000 GHz

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.2595 GHz
50.22 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 2.2000 GHz

STOP 2.9000 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 27

Radiated spurious emission in restricted band measurements
in 3.26 – 4 GHz range,
 $F_{\text{low}} = 905.56 \text{ MHz}$

11:02:19 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 3.3766 GHz
47.21 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 3.2600 GHz

STOP 4.0000 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 28

Radiated spurious emission in restricted band measurements
in 4 – 5.5 GHz range,
 $F_{\text{low}} = 905.56 \text{ MHz}$

11:00:16 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 5.200 GHz
48.20 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 4.000 GHz STOP 5.500 GHz
RL #1F BW 1.0 MHz #AVG BW 1 MHz SWP 30.0 msec

More
1 of 2

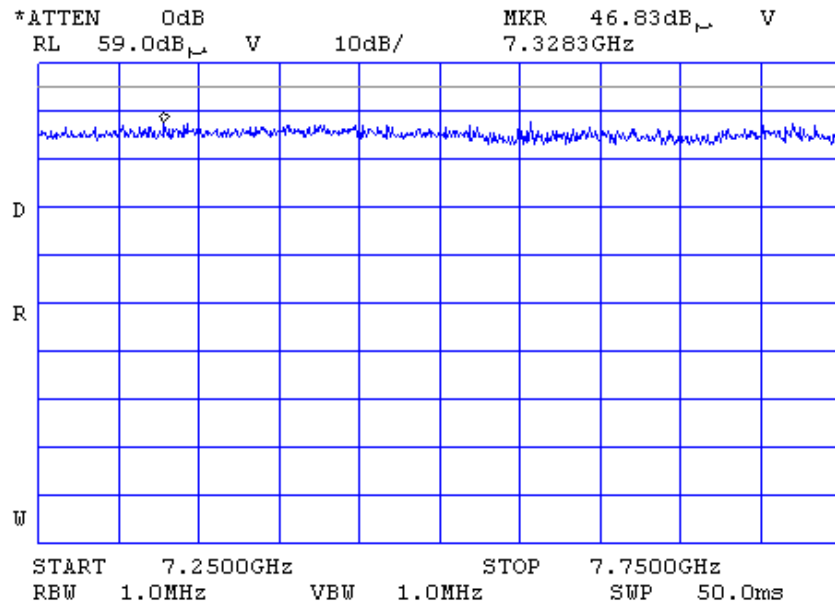
Notes

Antenna polarization: vertical & horizontal



Plot A 29

Radiated spurious emission in restricted band measurements
in 7.25 – 7.75 GHz range,
 $F_{low} = 905.56 \text{ MHz}$



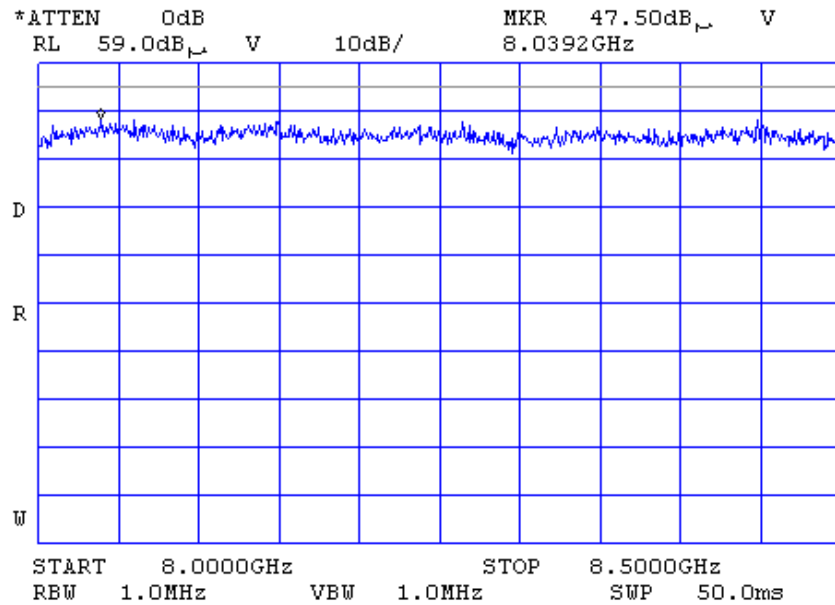
Notes

Antenna polarization: vertical & horizontal



Plot A 30

Radiated spurious emission in restricted band measurements
in 8 – 8.5 GHz range,
 $F_{low} = 905.56 \text{ MHz}$



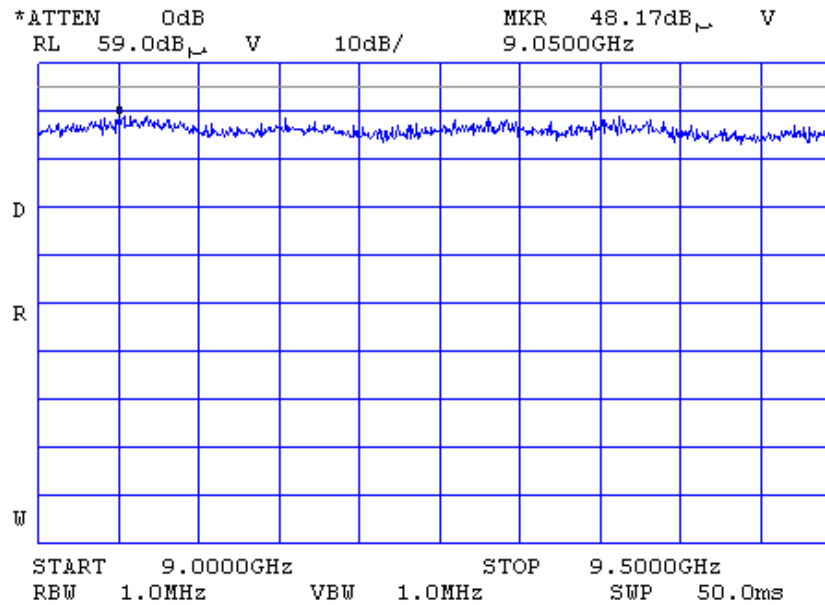
Notes

Antenna polarization: vertical & horizontal



Plot A 31

Radiated spurious emission in restricted band measurements
in 9 – 9.5 GHz range,
 $F_{low} = 905.56 \text{ MHz}$



Notes

Antenna polarization: vertical & horizontal



Plot A 32

Radiated spurious emission in restricted band measurements
in 9 – 150 kHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$

13:55:32 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 12.6 kHz
63.73 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 130.0 dB μ V/m

10
dB/
ATN
50 dB

VA SB
SC FC
ACORR

START 9.0 kHz STOP 150.0 kHz
RL #1F BW 200 Hz AVG BW 300 Hz SWP 10.3 sec



Plot A 33

Radiated spurious emission in restricted band measurements
in 150 kHz – 30 MHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$

13:58:20 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 100 kHz
58.53 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 105.0 dB μ V/m

10
dB/
ATN
30 dB

UA SB
SC FC
ACORR

START 150 kHz STOP 30.00 MHz
RL #1F BW 9.0 kHz AVG BW 30 kHz SWP 2.49 sec



Plot A 34

Radiated spurious emission in restricted band measurements
in 30 – 614 MHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$

13:27:12 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 598.8 MHz
34.49 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

CLEAR
WRITE B

MAX
HOLD B

VIEW B

BLANK B

Trace
A B C

More
1 of 3

LOG REF 60.0 dB μ V/m

10
dB/
#ATN
0 dB

VA SB
SC FC
ACORR

START 30.0 MHz

RL #1F BW 120 kHz

#AVG BW 1 MHz

STOP 614.0 MHz

SWP 700 msec

Notes

Antenna polarization: vertical & horizontal



Plot A 35

Radiated spurious emission in restricted band measurements
in 960 – 1000 MHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$

13:32:07 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 983.49 MHz
35.12 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

LOG REF 60.0 dB μ V/m

10
dB/
#ATN
0 dB

VA SB
SC FC
ACORR

START 960.00 MHz STOP 1.00000 GHz
R #1F BW 120 kHz #AVG BW 1 MHz SWP 700 msec

More
1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 36

Radiated spurious emission in restricted band measurements
in 1 – 1.73 GHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$

11:30:39 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 1.7154 GHz
43.19 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 1.0000 GHz

STOP 1.7300 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 37

Radiated spurious emission in restricted band measurements
in 2.2 – 2.5 GHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$

11:33:10 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.4333 GHz
49.31 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 2.2000 GHz

STOP 2.5000 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 38

Radiated spurious emission in restricted band measurements
in 2.65 – 2.9 GHz range
 $F_{\text{middle}} = 916.3 \text{ MHz}$

11:26:02 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.8559 GHz
48.50 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

CLEAR
WRITE A

MAX
HOLD A

VIEW A

BLANK A

Trace
A B C

More
1 of 3

LOG REF 60.0 dB μ V/m

PREAMP ON

10
dB/
#ATN
0 dB

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

START 2.6550 GHz

STOP 2.9000 GHz

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

Notes

Antenna polarization: vertical & horizontal



Plot A 39

Radiated spurious emission in restricted band measurements
in 3.26 – 4 GHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$

11:38:14 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 3.4876 GHz
46.34 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 60.0 dB μ V/m

PREAMP ON

10
dB/
#ATN
0 dB

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

START 3.2600 GHz

STOP 4.0000 GHz

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

Notes

Antenna polarization: vertical & horizontal



Plot A 40

Radiated spurious emission in restricted band measurements
in 4 – 5.5 GHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$

11:36:15 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 4.356 GHz
47.77 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 4.000 GHz

STOP 5.500 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 30.0 msec

1 of 2

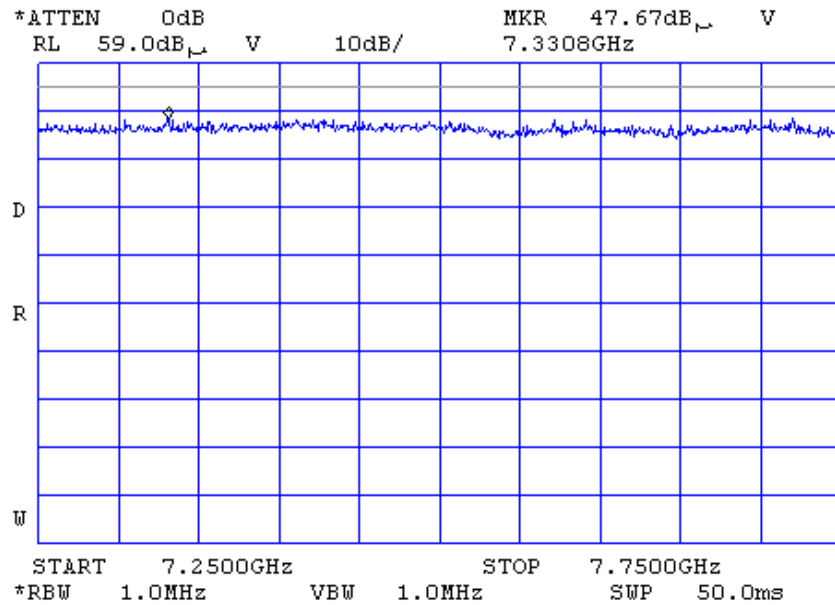
Notes

Antenna polarization: vertical & horizontal



Plot A 41

Radiated spurious emission in restricted band measurements
in 7.25 – 7.75 GHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$



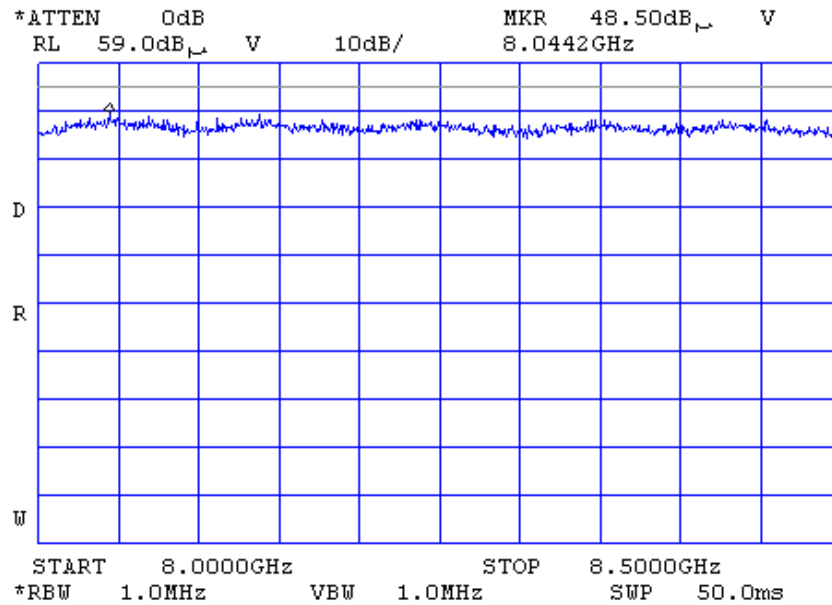
Notes

Antenna polarization: vertical & horizontal



Plot A 42

Radiated spurious emission in restricted band measurements
in 8 – 8.5 GHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$



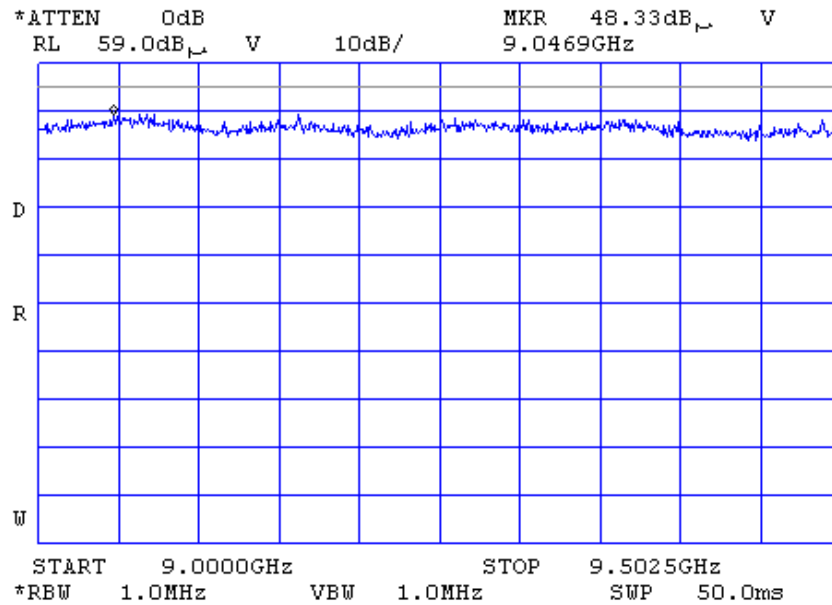
Notes

Antenna polarization: vertical & horizontal



Plot A 43

Radiated spurious emission in restricted band measurements
in 9 – 9.5 GHz range,
 $F_{\text{middle}} = 916.3 \text{ MHz}$



Notes

Antenna polarization: vertical & horizontal



Plot A 44

Radiated spurious emission in restricted band measurements
in 9 – 150 kHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$

13:52:39 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 107.1 kHz
58.65 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 130.0 dB μ V/m

10
dB/
ATN
50 dB

VA SB
SC FC
ACORR

START 9.0 kHz STOP 150.0 kHz
RL #1F BW 200 Hz AVG BW 300 Hz SWP 10.3 sec



Plot A 45

Radiated spurious emission in restricted band measurements
in 150 kHz – 30 MHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$

13:49:46 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 160 kHz
59.64 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

LOG REF 105.0 dB μ V/m

10
dB/
ATN
30 dB

VA SB
SC FC
ACORR

START 150 kHz STOP 30.00 MHz
RL #1F BW 9.0 kHz AVG BW 30 kHz SWP 2.49 sec

More
1 of 2



Plot A 46

Radiated spurious emission in restricted band measurements
in 30 – 614 MHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$

13:39:50 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 603.9 MHz
28.71 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 60.0 dB μ V/m

10
dB/
#ATN
0 dB

UA SB
SC FC
ACORR

START 30.0 MHz STOP 614.0 MHz
RL #1F BW 120 kHz #AVG BW 1 MHz SWP 700 msec

Notes

Antenna polarization: vertical & horizontal



Plot A 47

Radiated spurious emission in restricted band measurements
in 960 – 1000 MHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$

13:38:28 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 976.63 MHz
34.14 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
CF

MARKER
A

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

LOG REF 60.0 dB μ V/m
10
dB/
#ATN
0 dB

VA SB
SC FC
ACORR

START 960.00 MHz STOP 1.00000 GHz
RL #1F BW 120 kHz #AVG BW 1 MHz SWP 700 msec

More
1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 48

Radiated spurious emission in restricted band measurements
in 1 – 1.73 GHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$

11:45:48 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 1.7172 GHz
42.39 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
CF

10
dB/
#ATN
0 dB

MARKER
A

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 1.0000 GHz

STOP 1.7300 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 49

Radiated spurious emission in restricted band measurements
in 2.2 – 2.5 GHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$

11:47:31 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.2435 GHz
49.65 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

MARKER
↓ CF

MARKER
△

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

More
1 of 2

LOG REF 60.0 dB μ V/m

PREAMP ON

10
dB/
#ATN
0 dB

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

START 2.2000 GHz

STOP 2.5000 GHz

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

Notes

Antenna polarization: vertical & horizontal



Plot A 50

Radiated spurious emission in restricted band measurements
in 2.65 – 2.9 GHz range
 $F_{\text{high}} = 923.2 \text{ MHz}$

12:04:19 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.7536 GHz
48.42 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 2.6550 GHz

STOP 2.9000 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 51

Radiated spurious emission in restricted band measurements
in 3.26 – 4 GHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$

12:01:10 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 3.4500 GHz
46.80 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 3.2600 GHz

STOP 4.0000 GHz

More

R #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

1 of 2

Notes

Antenna polarization: vertical & horizontal



Plot A 52

Radiated spurious emission in restricted band measurements
in 4 – 5.5 GHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$

12:10:46 FEB 24, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 5.256 GHz
48.63 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

LOG REF 60.0 dB μ V/m

PREAMP ON

MARKER
↓ CF

10
dB/
#ATN
0 dB

MARKER
△

DL
54.0
dB μ V/m
VA SB
SC FC
ACORR

NEXT
PEAK

NEXT PK
RIGHT

NEXT PK
LEFT

START 4.000 GHz

STOP 5.500 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 30.0 msec

1 of 2

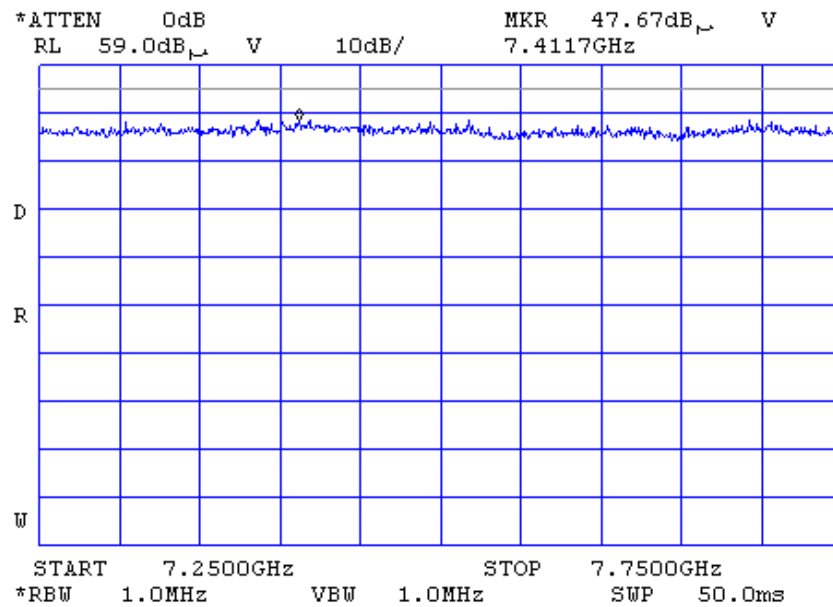
Notes

Antenna polarization: vertical & horizontal



Plot A 53

Radiated spurious emission in restricted band measurements
in 7.25 – 7.75 GHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$



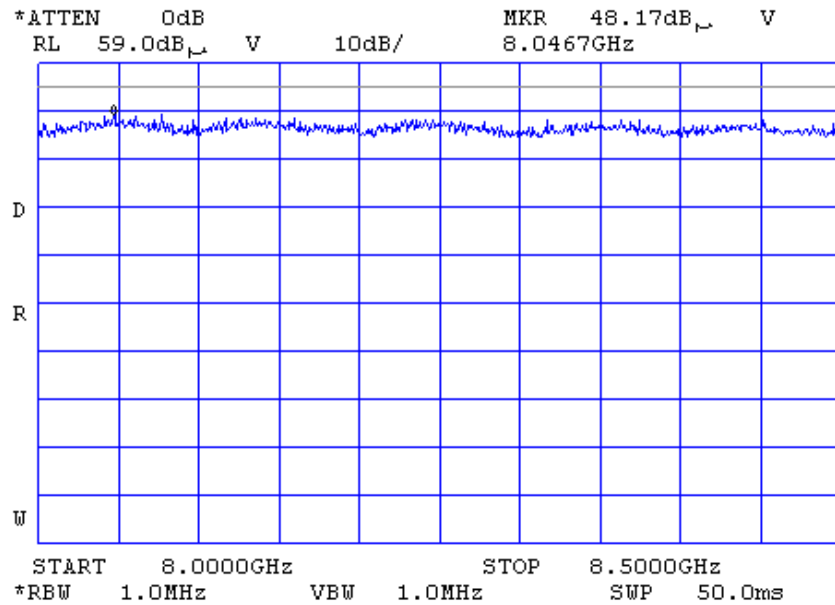
Notes

Antenna polarization: vertical & horizontal



Plot A 54

Radiated spurious emission in restricted band measurements
in 8 – 8.5 GHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$



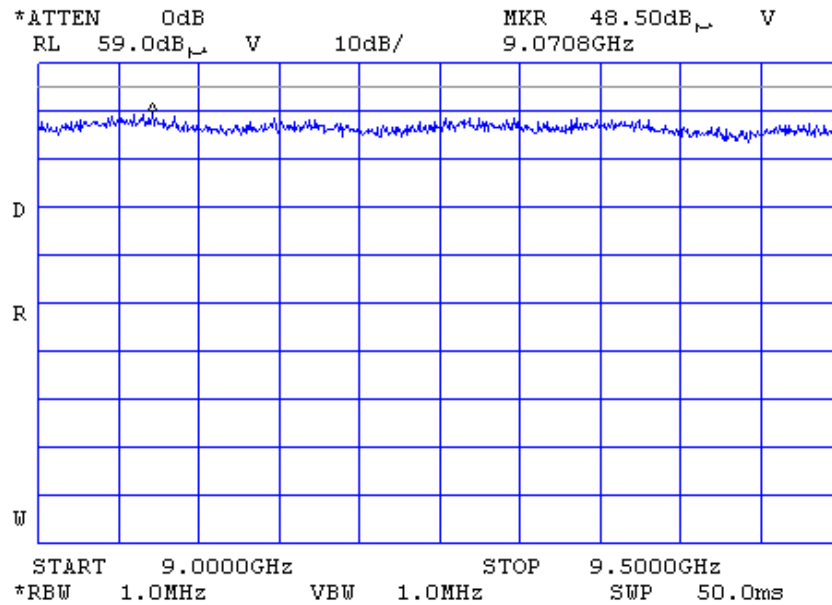
Notes

Antenna polarization: vertical & horizontal



Plot A 55

Radiated spurious emission in restricted band measurements
in 9 – 9.5 GHz range,
 $F_{\text{high}} = 923.2 \text{ MHz}$



Notes

Antenna polarization: vertical & horizontal



Plot A 56

Unintentional radiated emission measurements
in 30 – 1000 MHz range

11:45:15 FEB 13, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 857.6 MHz
37.29 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

CLEAR
WRITE A

MAX
HOLD A

VIEW A

BLANK A

Trace
A B C

More
1 of 3

LOG REF 60.0 dB μ V/m

PREAMP ON

10
dB/
#ATN
0 dB

PASS LIMIT

VA SB
SC FC
ACORR

START 30.0 MHz

STOP 1.0000 GHz

RL 1F BW 120 kHz

AVG BW 300 kHz

SWP 909 msec

Notes

Mode: Rx

Antenna polarization: vertical & horizontal



Plot A 57

Unintentional radiated emission measurements
in 1 – 5 GHz range

Customer Name Tadiran Telematics
Notes t-24 C H-43 % HL 25; 911; 2287; 410; 1425
Rx mode

12:26:07 FEB 13, 2003

ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 1.050 GHz
39.37 dB μ V/m

MEASURE
AT MKR

ADD TO
LIST

CLEAR
WRITE A

MAX
HOLD A

VIEW A

BLANK A

Trace
A B C

More
1 of 3

LOG REF 60.0 dB μ V/m

PREAMP ON

10
dB/
#ATN
0 dB

VA SB
SC FC
ACORR

START 1.000 GHz STOP 5.000 GHz
RL #1F BW 1.0 MHz #AVG BW 1 MHz SWP 00.0 msec

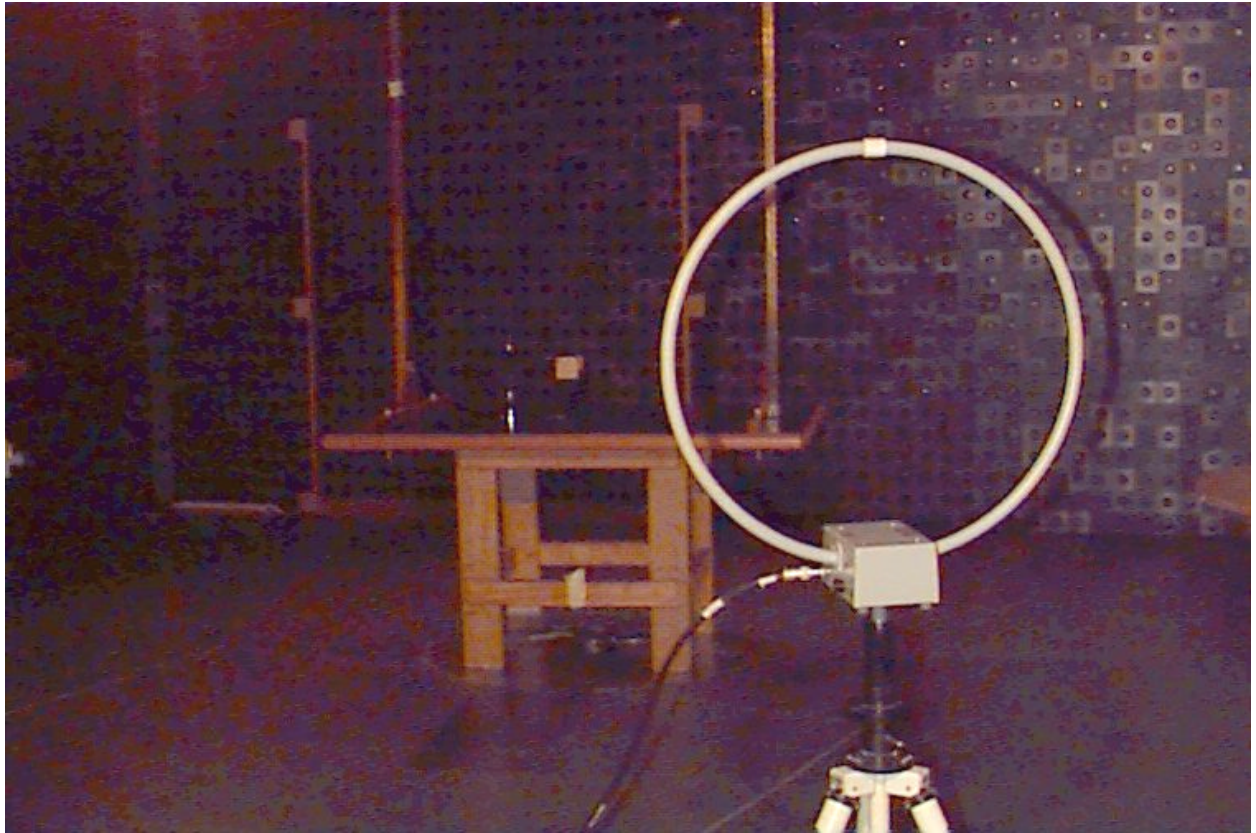
Notes
Mode: Rx
Antenna polarization: vertical & horizontal



Appendix B Setup photographs

Photograph 1

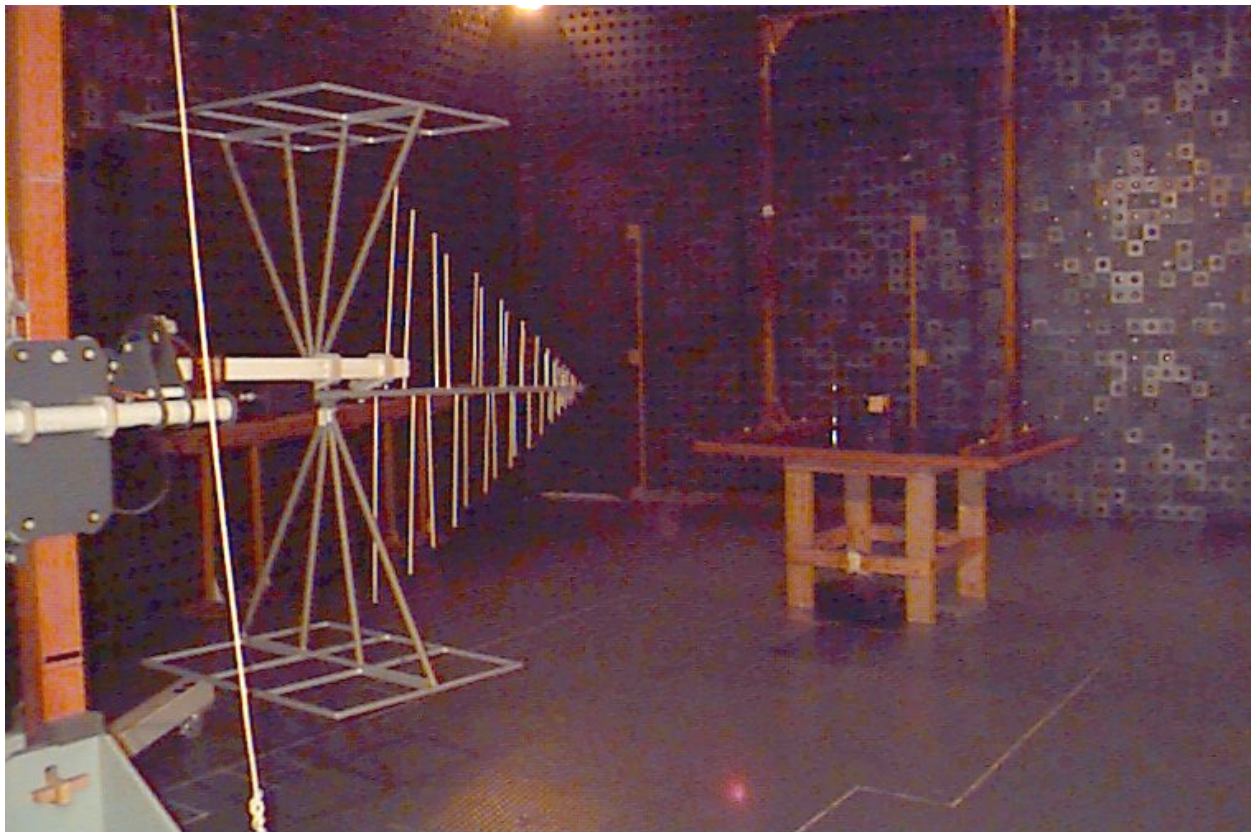
RADIATED SPURIOUS EMISSIONS MEASUREMENTS WITH LOOP ANTENNA





Photograph 2

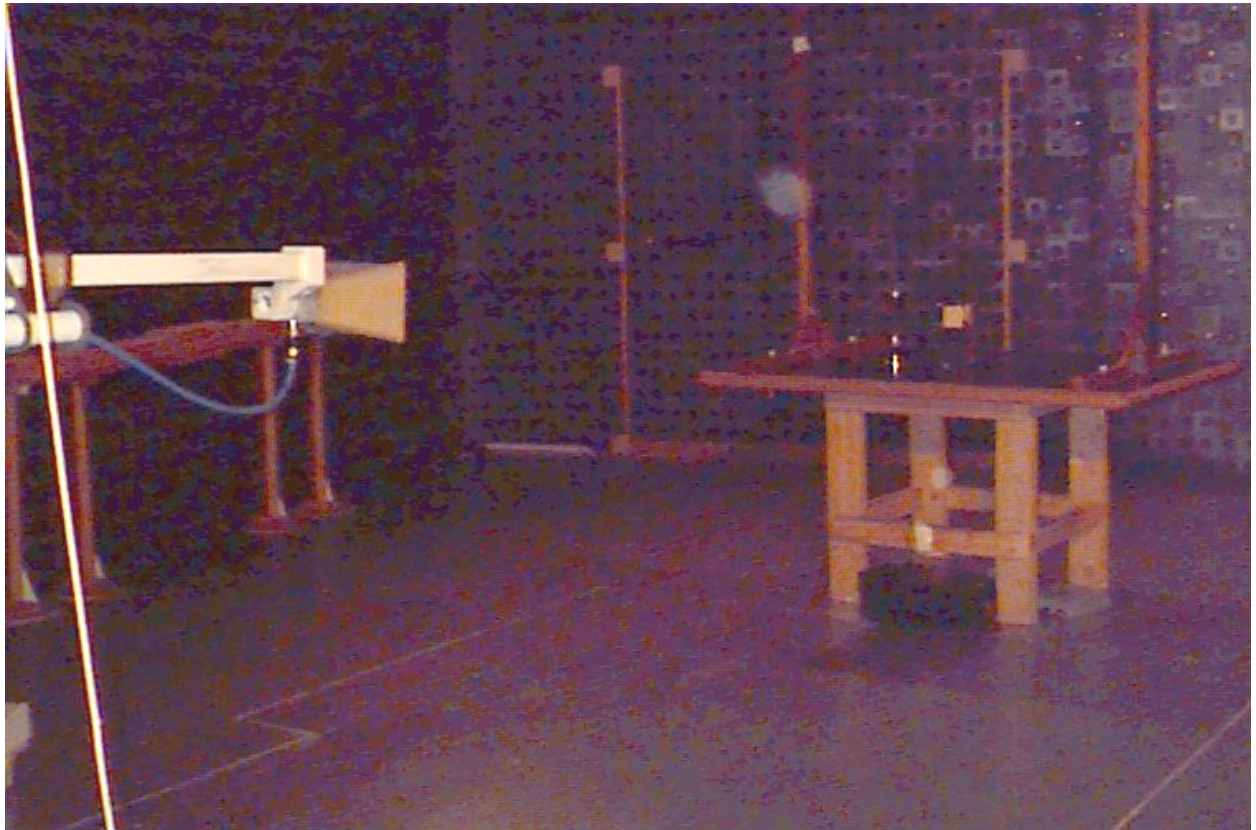
RADIATED SPURIOUS EMISSIONS MEASUREMENTS WITH BICONILOG ANTENNA





Photograph 3

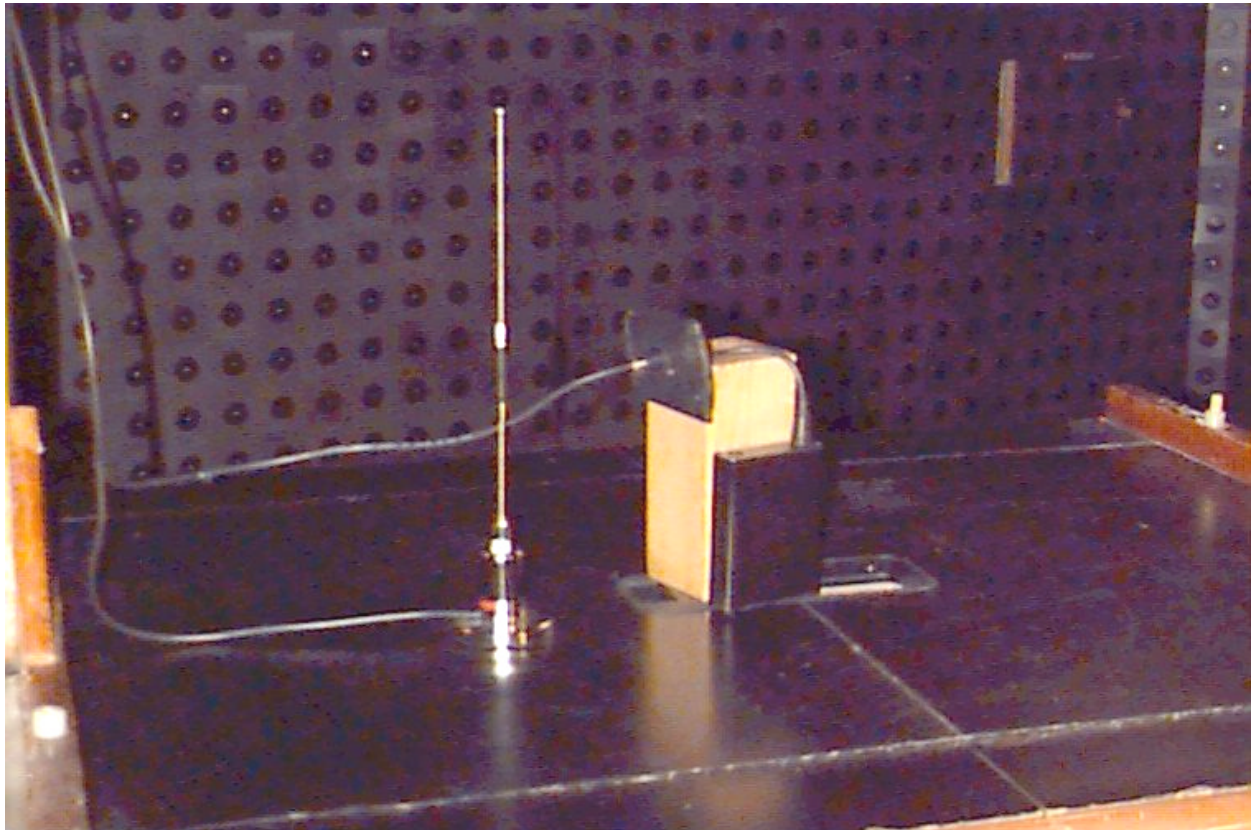
RADIATED SPURIOUS EMISSIONS MEASUREMENTS WITH HORN ANTENNA





Photograph 4

RADIATED SPURIOUS EMISSIONS MEASUREMENTS, SETUP





Photograph 5

CONDUCTED EMISSION MEASUREMENTS SETUP VIEW





Appendix C Example of frequency hopping sequence

Frequency Hopping Sequence Table

	Frequency [MHz]	Frequency Assignment
1.	916.2999	F1
2.	913.0274	F2
3.	909.1516	F3
4.	910.3006	F4
5.	907.3999	F5
6.	920.0465	F6
7.	914.7650	F7
8.	913.5562	F8
9.	911.3666	F9
10.	915.6513	F10
11.	917. 8524	F11
12.	908.4797	F12
13.	905.6002	F13
14.	922.4692	F14
15.	916.8810	F15
16.	919.1790	F16
17.	912.4007	F17
18.	907.9308	F18
19.	906.6656	F19
20.	910.8174	F20
21.	921.2262	F21
22.	906.1438	F22
23.	923.1750	F23
24.	921.7514	F24
25.	909.7223	F25
26.	914.1498	F26



Appendix D 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	10/03
0041	Double ridged guide antenna, 1-18 GHz	Electro-Metrics	RGA 50/60	2811	3/04
0410	Cable, Coax, Microwave, DC-18 GHz, N-N, 1 m	Gore	PFP01P01039.4	9338767	9/03
0446	Active Loop Antenna, 10 kHz-30 MHz	Electro-Mechanics	6502	2857	10/03
0465	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	11/03 check
0521	Spectrum Analyzer with RF filter section (EMI Receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/03
0589	Cable Coaxial, GORE A2POL118.2, 3m	Hermon Labs	GORE-3	589	12/03
0604	Antenna Biconilog Log-Periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	01/04
0911	Coupler dual directional, 20 dB, 0.1 – 2.0 GHz	Hewlett Packard	778D	1144A07827	3/04
1004	Cable coaxial, ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/03
1097	Attenuator, 50 Ohm, 2 W, DC to 8 GHz, 20 dB	Midwest Microwave	0793-20-NN-07	1097	1/04
1200	Quadruplexer	Eletronica	UE 84	0240	4/04 check
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/03
1425	EMI Receiver System, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3710A00222	9/03
1566	Cable RF, 2 m	Huber-Suhner	Sucoflex 104PE	13094/4PE	12/03
1942	Cable 18 GHz, 4 m, blue	Rhophase Microwave Ltd	SPS-1803A-4000-NPS	T4658	10/03
1947	Cable 18 GHz, 6.5 m, blue	Rhophase Microwave Ltd	NPS-1803A-6500-NPS	T4974	10/03
2009	Cable RF, 8 m	Alpha Wire	RG-214	NA	12/03
2259	Amplifier Low Noise 2-20 GHz	Sophia Wireless	LNA0220-C	0223	11/03
2274	Power Supply 11V for HL2258, HL2259, HL2260, HL2261	Hermon Labs	S-11	NA	12/03 check
2287	Attenuator 10 dB, DC-18 GHz	Weinschel	NA	5776	1/04



Appendix E Test equipment correction factors

**Antenna factor, Active Loop Antenna
Model 6502
S/N 2857**

Frequency, MHz	Antenna Factor, dB
0.009	-32.8
0.010	-33.8
0.020	-38.3
0.050	-41.1
0.075	-41.3
0.100	-41.6
0.150	-41.7
0.250	-41.6
0.500	-41.8
0.750	-41.9
1.000	-41.4
2.000	-41.5
3.000	-41.4
4.000	-41.4
5.000	-41.5
10.000	-41.9
15.000	-41.9
20.000	-42.2
25.000	-42.8
30.000	-44.0

Antenna factor is to be added to receiver meter reading in dB(μ V) to convert it to field intensity in dB(μ V/m)



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(μ V) to convert it to field intensity in dB(μ V/m).



**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(μ V) to convert it to field intensity in dB(μ V/m)



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 Loss	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	Insertion Loss	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	-			



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



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



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				



Cable RF, 2m, model: Sucoflex 104PE, s/n 13094/4PE (HL 1566)
Calibration data

No.	Parameter	SET, MHz	Measured, dB	Deviation, dB	Tolerance (Specification), dB	Meas. Uncert., dB	Notes
1	Insertion Loss	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	Insertion Loss	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	Insertion Loss	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				



Cable, 1 m, coax, microwave, DC-18 GHz, N-N (HL 0410)
Calibration data

No.	Parameter	SET, GHz	Measured, dB	Deviation	Tolerance (Specification), dB	Meas. Uncert., dB
1	Insertion Loss	0.5	0.16	-	≤ 0.30	± 0.12
2		1	0.28	-	≤ 0.39	
3		2	0.38	-	≤ 0.51	
4		4	0.55	-	≤ 0.70	
5		6	0.85	-	≤ 0.86	
6		8	0.90	-	≤ 1.01	± 0.17
7		10	1.07	-	≤ 1.14	
8		12	1.11	-	≤ 1.25	
9		14	1.29	-	≤ 1.35	± 0.26
10		16	1.41	-	≤ 1.46	
11		18	1.73	-	≤ 2.0 *	

***Revised Tolerance (Manufacturer's Tolerance is ≤ 1.55 dB).**



Appendix F 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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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(μ V)	decibel referred to one microvolt
dB(μ V/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.