ELECTROMAGNETIC EMISSIONS TEST REPORT

ACCORDING TO FCC Part 15 subpart C and subpart B

for

TELESCICOM LTD.

EQUIPMENT UNDER TEST:

CUSTOMER PREMISE EQUIPMENT (CPE)

FCC ID:N7HPTPMEGACELL

Prepared by: _____
Mrs. M. Cherniavsky, certif. engineer
Hermon Labs

Approved by: _____
Mr. A. Usoskin, QA manager
Hermon Labs

Approved by: _____
Dr. E. Usoskin, C.E.O.
Hermon Labs

Approved by: _____
Mr. Dov Sverdlov, general manager
TelesciCOM Ltd.

Hermon Laboratories Ltd.
P.O.Box 23
Binyamina 30550, Israel
Tel.+972-6628-8001
Fax.+972-6628-8277
Email:hermon@Netvision.net.il

ACCREDITED
839.01

This test report must not be reproduced in any form except in full, with the approval of Hermon Laboratories Ltd.

Description of equipment under test

Test items	Customer premise equipment (direct sequence spread spectrum transceiver) of the MegaCell system
Manufacturer	TelesciCOM Ltd.
Brand Mark	TelesciCOM
Type (Model)	CPE

Applicant information

Applicant	TelesciCOM Ltd.
Address	6 Hamachtesh St.
Postal code	58810
City	Holon
Country	Israel
Telephone number	+972 3558 9595
Telefax number	+972 3558 9292
Applicant's responsible person	Mr. Dov Sverdlov, general manager

Test performance

Location of the test	Hermon Laboratories, Binyamina, Israel
Test started	September 7, 1998
Test completed	November 4, 1998
Purpose of test	Certification
Test specification(s)	FCC part 15 subpart C §15.247, § 15.205, § 15.207, §15.209, and Subpart B § 15.107, § 15.109

Through this report a point is used as the decimal separator and the thousands are counted with a comma.
This report is in conformity with EN 45001 and ISO GUIDE 25.
The test results relate only to the items tested.

Table of Contents

1 GENERAL INFORMATION 6

1.1 ABBREVIATIONS AND ACRONYMS 6
1.2 SPECIFICATION REFERENCES 7
1.3 EUT DESCRIPTION 7
1.4 CHANGES MADE IN EUT 7
1.5 STATEMENT OF MANUFACTURER 8

2 TEST FACILITY DESCRIPTION 9

2.1 GENERAL 9
2.2 EQUIPMENT CALIBRATION 9
2.2.1 Uncertainty in Hermon Labs Measurements. 10
2.3 LABORATORY PERSONNEL 10
2.4 STATEMENT OF QUALIFICATION 11

3 EMISSION MEASUREMENTS 12

3.1 OCCUPIED BANDWIDTH TEST ACCORDING TO § 15.247 (A)(2) 12
3.1.1 Definition of the test 12
3.1.2 The test set-up configuration 12
3.1.3 Test results 12
3.2 MAXIMUM PEAK OUTPUT POWER TEST ACCORDING TO § 15.247 (B)(3)(I) 17
3.2.1 Definition of the test 17
3.2.2 The test set-up configuration 17
3.2.3 Test results 17
3.2.4 Exposure limit according to part 1, §1.1310 18
3.3 OUT OF BAND ANTENNA CONDUCTED EMISSIONS TEST ACCORDING TO §15.247(C) 21
3.3.1 Definition of the test 21
3.3.2 The test set-up configuration 21
3.3.3 Test results 21
3.4 RADIATED EMISSIONS TEST ACCORDING TO §§ 15.205, 15.209(A), 15.247(C) 44
3.4.1 Definition of the test 44
3.4.2 The test set-up configuration 44
3.4.3 Test measurement results 44
3.5 PEAK POWER SPECTRAL DENSITY TEST ACCORDING TO § 15.247 (D) 50
3.5.1 Definition of the test 50
3.5.2 The test set-up configuration 50
3.5.3 Test results 50
3.6 PROCESSING GAIN TEST ACCORDING TO § 15.247 (D) 51
3.6.1 Definition of the test 51
3.6.2 The test set-up configuration 51
3.6.3 Test results 51
3.7 UNINTENTIONAL RADIATED EMISSIONS (CLASS B DIGITAL DEVICE) TEST ACCORDING TO §15.109 .51
3.7.1 Definition of the test 51
3.7.2 The test set-up configuration 51
3.8 CONDUCTED EMISSION MEASUREMENTS ACCORDING TO §15.107, §15.207 51
3.8.1 Definition of the test 51
3.8.2 The test set-up configuration 51

4 SUMMARY AND SIGNATURES 51

APPENDIX A - TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS 51

APPENDIX B-TEST EQUIPMENT CORRECTION FACTORS **51**

APPENDIX C- A2LA ACCREDITATION **51**

1 General Information

1.1 Abbreviations and Acronyms

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

AC	alternating current
AVRG	average (detector)
BER	bit error rate
BW	bandwidth
CDMA	code division multiple access
CE	conducted emissions
cm	centimeter
CW	sine wave
dB	decibel
dBm	decibel referred to one milliwatt
dB(µA)	decibel referred to one microampere
dB(µV)	decibel referred to one microvolt
dB(µV/m)	decibel referred to one microvolt per meter
DC	direct current
EMC	electromagnetic compatibility
EUT	equipment under test
GHz	gigahertz
GND	grounding
H	height
HL	Hermon Laboratories
HP	Hewlett Packard
Hz	hertz
IF	Intermediate frequency
kHz	kilohertz
L	length
LISN	line impedance stabilization network
m	meter
mm	millimeter
MHz	megahertz
msec	millisecond
NA	not applicable
NARTE	National Association of Radio and Telecommunications Engineers, Inc.
nF	nanofarad
QP	quasi-peak (detector)
RBW	resolution bandwidth
RF	radio frequency
RE	radiated emission
sec	second
V	volt
V/m	volt per meter
W	watt

1.2 Specification References

CFR 47 part 15: October 1997	Radio Frequency Devices.
ANSI C63.2:06/1987	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4:1992	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.

1.3 EUT Description

The EUT, customer premise equipment (CPE) is a part of the MegaCell™ system, based on advanced CDMA and provides a very high speed (2 Mbit/s and above), point-to-point, bi-directional data transmission. MegaCell™ supports all Ethernet 10-Base-T applications by being fully compatible with the IEEE 802.3 standard. The MegaCell™ system is composed of two main subsystems: CPE master and CPE slave. The CPE is a stand alone subscriber unit, installed in the customer premise. Both CPE master and CPE slave consist of the same components. They are distinguished only by firmware that determines which CPE is a master and which is a slave. The CPE master determines whether the slave can transmit or not.
It is full-integrated system that connects one IEEE 802.3 interface to any type of hub. The CPE makes a connection from LAN, converts the data to words and transfers to LOGIC block. The CPE direct sequence spread spectrum transceiver gets data from the LOGIC block through serial bus, transmits to CPE master and vice versa. The unit operates in 2.411 GHz to 2.472 GHz frequency range and has an integral antenna with 11 dBi gain.
The unit is powered from 120 V mains. The CPE is connected with an Ethernet 10-Base T wire to the customer's PC/HUB/LAN and can support up to 50 Ethernet users.
Throughout the testing the CPE was connected to mains with 15 m long unshielded cable via 120 V AC/ 24 V DC adapter, model A25B1-24MB, and its 10 Base T shielded cable, 15 m long, was terminated with 120 Ohm.

1.4 Changes Made in EUT

To withstand the FCC part 15 requirements the following changes were made in the EUT:
1) 3 sets of capacitors (1 nF in parallel to 10 nF) were installed on the EUT 24 V DC input between "+Vcc" and "-Vcc", "+Vcc" and GND, "-Vcc" and GND;
2) a ferrite bead of Fair-Rite, P/N 0444164281, was installed on the data shielded cable;
3) two ferrite beads of Fair-Rite, P/N 0444164281 and 0443167251, were installed on the power cable before the adapter.

1.5 Statement of Manufacturer

I, Dov Sverdlov, general manager of TelesciCOM Ltd., declare that the CPE direct sequence spread spectrum transceiver, FCC ID:N7HPTPMEGACELL, was tested from September 7 to November 4, 1998 by Hermon Laboratories and which this test report applies to, is identical of the equipment that will be marketed.

The term identical means identical within the variations that can be expected to arise as a result of quantity production technique.

Dov Sverdlov, general manager
TelesciCOM Ltd.

Signature: _____

Date: _____

2 Test Facility Description

2.1 General

Tests were performed at Hermon Laboratories, 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), listed by Industry Canada for radiated measurements (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), recognized by VDE (Germany) for witness test, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-809 for anechoic chamber, C-845 for conducted emissions site), assessed by NMi Certin B.V. (Netherlands) for a number of EMC, Telecommunications and Safety standards, recognized by TUV Sudwest (Germany) for Safety testing, and Accredited by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO GUIDE 25/EN 45001 for EMC, Telecommunications and Product Safety Information Technology Equipment (Certificate No. 839.01).

Address: PO Box 23, Binyamina 30550, Israel.
Telephone: +972-6-628-8001
Fax: +972-6-628-8277

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

2.2 Equipment Calibration

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error. The standards and instruments used in the calibration system conform to the present requirements of MIL-STD-45662A.
The laboratory standards are calibrated by the third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

2.2.1 Uncertainty in Hermon Labs Measurements.

Conducted Emissions (95% Confidence)	9 kHz to 150 kHz : ± 1.09 dB Combined standard uncertainty ± 2.18 dB Expanded uncertainty 150 kHz to 30 MHz : ± 1.21 dB Combined standard uncertainty ±2.42 dB Expanded uncertainty
Radiated Emissions (95% Confidence)	Biconical Antenna: 3 m measuring distance : + 2.032 dB Combined standard uncertainty + 4.06 dB Expanded uncertainty - 1.99 dB Combined standard uncertainty - 3.98 dB Expanded uncertainty 10 m measuring distance : + 1.99 dB Combined standard uncertainty + 3.98 dB Expanded uncertainty - 2.04 dB Combined standard uncertainty - 4.08 dB Expanded uncertainty Log periodic Antenna: 3 m measuring distance : + 2.37 dB Combined standard uncertainty + 4.74 dB Expanded uncertainty - 1.63 dB Combined standard uncertainty - 3.26 dB Expanded uncertainty 10 m measuring distance : + 1.53 dB Combined standard uncertainty + 3.06 dB Expanded uncertainty - 1.50 dB Combined standard uncertainty- -3.00 dB Expanded uncertainty

2.3 Laboratory Personnel

The three people of Hermon Laboratories that have participated in measurements and documentation preparation are: Dr. Edward Usoskin - Laboratory C.E.O, Mrs. Eleonora Pitt - test engineer, and Mrs. Marina Cherniavsky- certification engineer. Dr. E. Usoskin is an EMC Specialist and M. Cherniavsky is a Telecommunication Engineer, certified by the National Association of Radio and Telecommunications Engineers (NARTE, USA.).
The Hermon Laboratories' personnel that participated in this project have more than 90 years combined experience time in EMC measurements and electronic products design.

2.4 Statement of Qualification

The test measurement data supplied in this test measurement report having been received by me, is hereby duly certified. The following is a statement of my qualifications:
I am an engineer, graduated from the university in 1974 with an MScEE degree, have obtained 26 years experience in EMC measurements and have been with Hermon Laboratories since 1991.

Name: Mrs. Eleonora Pitt Signature: _____
Position: test engineer Date: March 8, 1999

I hereby certify that this test measurement report was prepared by me and is hereby duly certified. The following is a statement of my qualifications.
I am an engineer, graduated from university in 1971, with an MScEE degree, have obtained 26 years experience in electronic products design and development and have been with Hermon Labs since 1991. Also, I am a Telecommunication Class II engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA.), the certificate no. is E2-03410.

Name: Mrs. Marina Cherniavsky Signature: _____
Position: certification engineer Date: March 8, 1999

I hereby certify that this test measurement report was prepared under my direction and that to the best of my knowledge and belief, the facts set in the report and accompanying technical data are true and correct.
The following is a statement of my qualifications.
I have a Ph.D. degree in electronics, have obtained more than 42 years of experience in EMC measurements and electronic product design and have been with Hermon Laboratories since 1986.
Also, I am an EMC engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA). The certificate no. is EMC-000623-NE, Senior Member.

Name: Dr. Edward Usoskin Signature:_____
Position: C.E.O. Date: March 8, 1999

3 Emission Measurements

3.1 Occupied bandwidth test according to § 15.247 (a)(2)

3.1.1 Definition of the test

This test was performed to prove that the minimum 6 dB bandwidth of the direct sequence system is at least 500 kHz.

3.1.2 The test set-up configuration

The EUT was connected to the spectrum analyzer through 30 dB attenuator (plus 1 dB cable attenuation) as shown in Photograph 3.1.1, to the computer and the radio transmission was activated.

3.1.3 Test results

The measurements were at 2 Mbits per second data rate. The occupied bandwidth measurement was performed for carrier (channel) frequency at low and high edges and at the middle of the 2.411 - 2.472 GHz frequency range. The three Plots 3.1.1 to 3.1.3 (attached to the test report) and Table 3.1 demonstrate test results of the occupied bandwidth measurements.
The spectrum analyzer settings are shown in the plots.

Table 3.1
Occupied bandwidth test results

Carrier frequency, MHz	Measured 6 dB BW, MHz	Limit, MHz	Result
2411	7.7	0.5	Pass
2432	7.1	0.5	Pass
2472	7.35	0.5	Pass

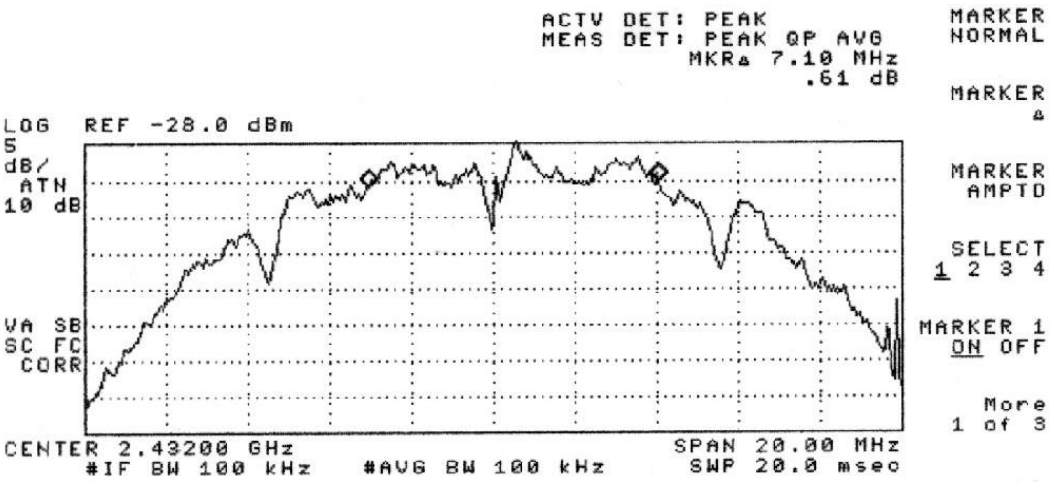
Reference numbers of test equipment used

HL 0056	HL 0410	HL 0792				

Full description is given in Appendix A.

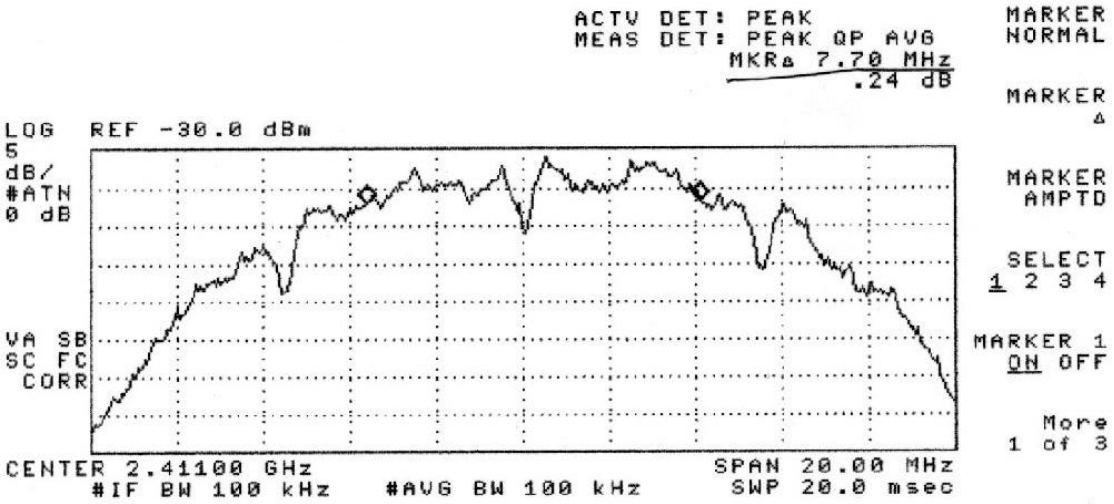
Plot 3.1.1

Test Specification: § 15.247 (a)(2)
CPE occupied bandwidth test



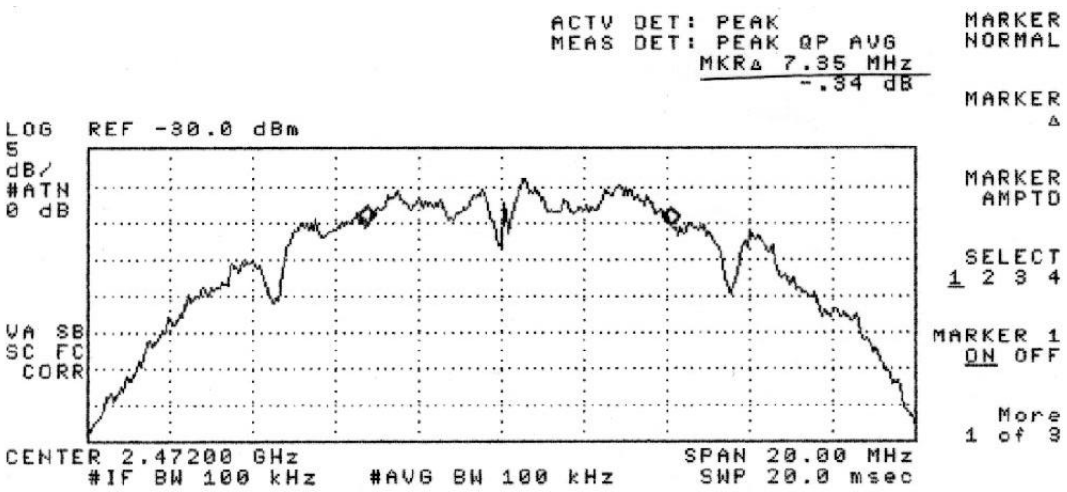
Plot 3.1.2

Test Specification: § 15.247 (a)(2)
CPE occupied bandwidth test

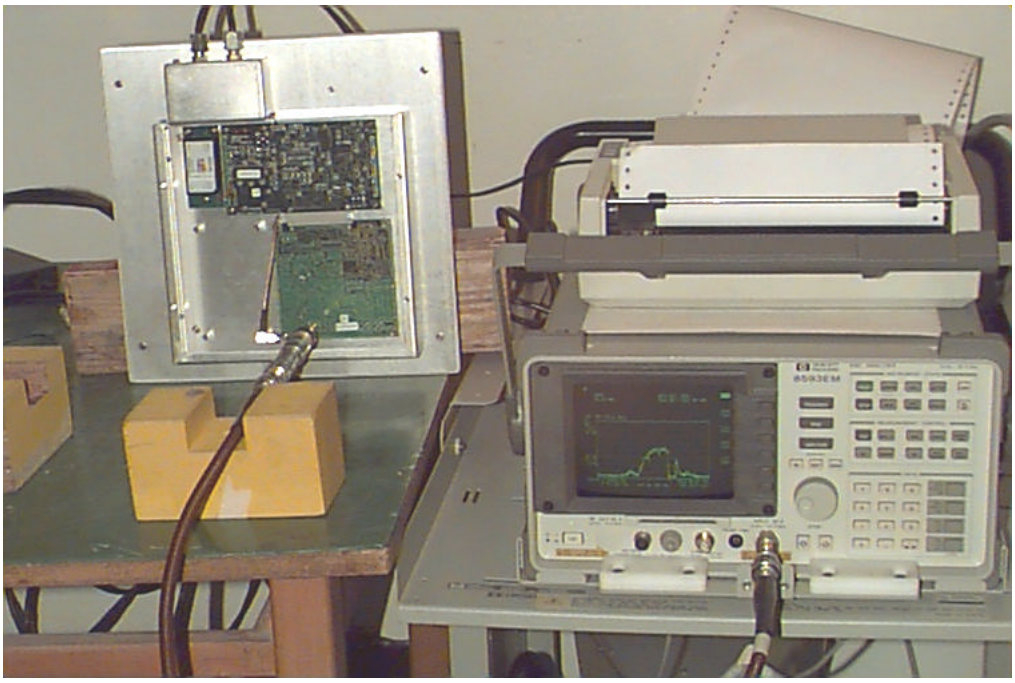


Plot 3.1.3

Test Specification: § 15.247 (a)(2)
CPE occupied bandwidth test



Photograph 3.1.1
Occupied bandwidth measurements setup



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

3.2.1 Definition of the test

This test was performed to demonstrate that the maximum RF peak output power of the transmitter does not exceed one watt (30 dBm) reduced by 1 dB for every 3 dB above 6 dBi gain of the directional antenna.

3.2.2 The test set-up configuration

The EUT RF output was connected to the power meter as shown in Photograph 3.2.1. The digitizing oscilloscope was used for transmission time (duty cycle) measurement.

3.2.3 Test results

The allowed output power for the maximum 11 dBi antenna gain is:

30 dBm - (11 dBi -6 dBi):3 = 28.3 dBm.

The maximum RF output power was measured at 3 carrier (channel) frequencies (low, middle, high) by power meter. The duty cycle was taken into account. As shown in Plot 3.2.1, the transmission time is 90 msec within 100 msec (10 msec x 9 pulses). Thus, the duty cycle is 0.9, and the average factor was calculated:

10 log 0.9 = -0.45 dB

The Table 3.2 below gives output power in dBm.

Table 3.2
Transmitter output RF power test results

Frequency, MHz	Measured power, dBm	Peak output power, dBm	Limit, dBm	Margin dB	Result
2411	12.5	12.95	28.3	15.35	Pass
2432	13.5	13.95	28.3	14.35	Pass
2472	13.0	13.45	28.3	14.85	Pass

Reference numbers of test equipment used

HL 0025	HL 0316	HL 0460	HL 0483			

Full description is given in Appendix A.

3.2.4 Exposure limit according to part 1, §1.1310

Limit for power density for general population/uncontrolled exposure is 1 mW/cm^2.

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

P_T - the transmitted power, which is equal the transmitter output 14 dBm plus antenna gain 11 dBi, the maximum output transmitter power 25 dBm = 316 mW.

$$1(mW/cm^2) = 316\ mW / 4\pi r^2$$

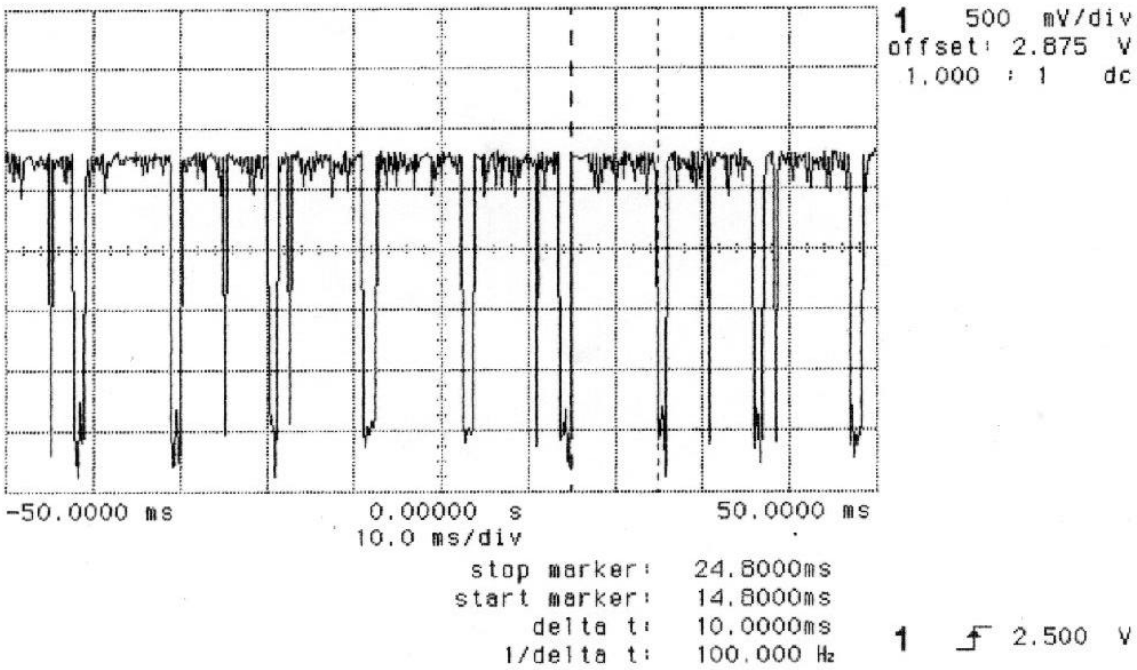
The allowed distance “r”, where RF exposure limits may not be exceeded, is 5 cm.

$$r = \sqrt{P_T / 4\pi} = \sqrt{316/ 4 \times 3.14} = 5\ (cm).$$

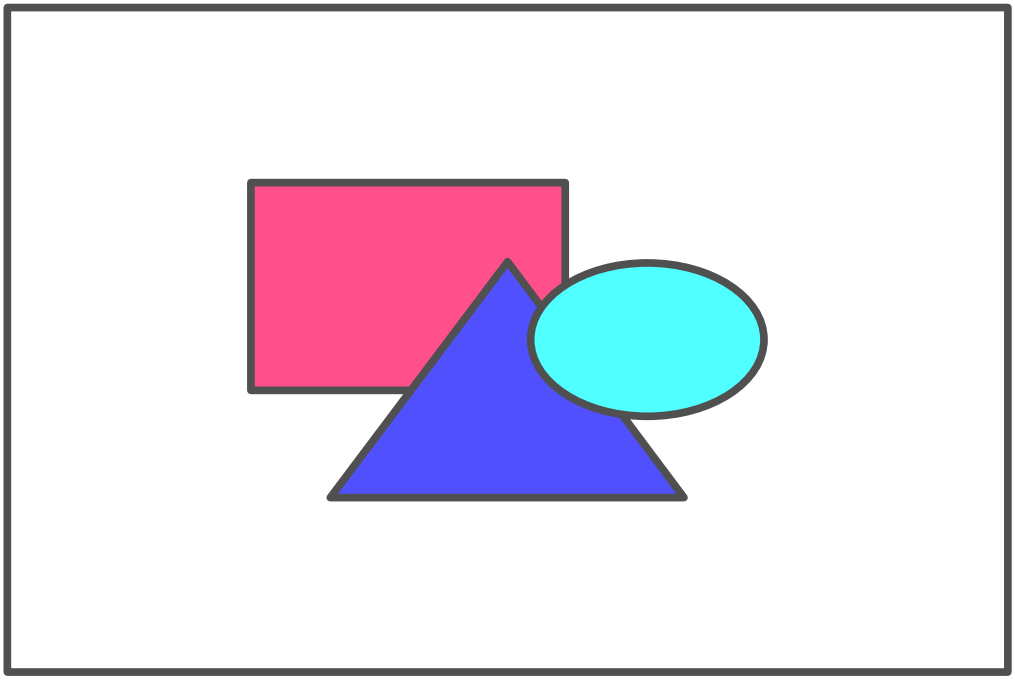
The EUT is an outdoor mounted unit, therefore the public cannot be exposed to dangerous RF level.

Plot 3.2.1

Test Specification: § 15.247 (a)(2)
Transmission time measurement



Photograph 3.2.1
Peak output power measurement setup



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

3.3.1 Definition of the test

This test was performed to prove that the EUT out-of-band emissions in any 100 kHz bandwidth outside 2.4 to 2.4835 GHz are at least 20 dB below maximum power content as measured in any 100 kHz bandwidth within the band that contains the highest level of the desired power.

3.3.2 The test set-up configuration

The test setup was the same as in Test 3.1.

3.3.3 Test results

The test was performed with transmitter operating at 3 carrier (channels) frequencies 2411, 2432 and 2472 MHz. The measurements were performed from 9 kHz to the 10th harmonic. The Plots 3.3.2 to 3.3.8, 3.3.10 to 3.3.15, 3.3.17 to 3.3.22 show that all out-of-band measured signals were more than 20 dBc. The three Plots 3.3.1, 3.3.9 and 3.3.16 show in-band signal (2.411, 2.432 and 2.472 GHz).

Note:

The recorded marker frequency 2.477 GHz in Plot 3.3.17 is inaccurate (due to large spectrum analyzer span) and corresponds to 2.472 GHz carrier frequency.

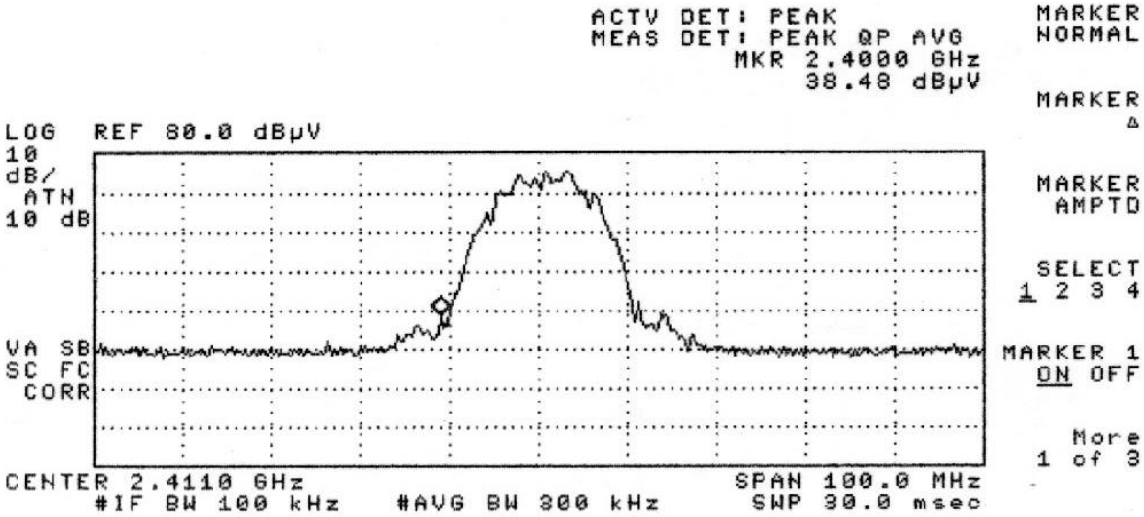
Reference numbers of test equipment used

HL 0056	HL 0410	HL 0792				

Full description is given in Appendix A.

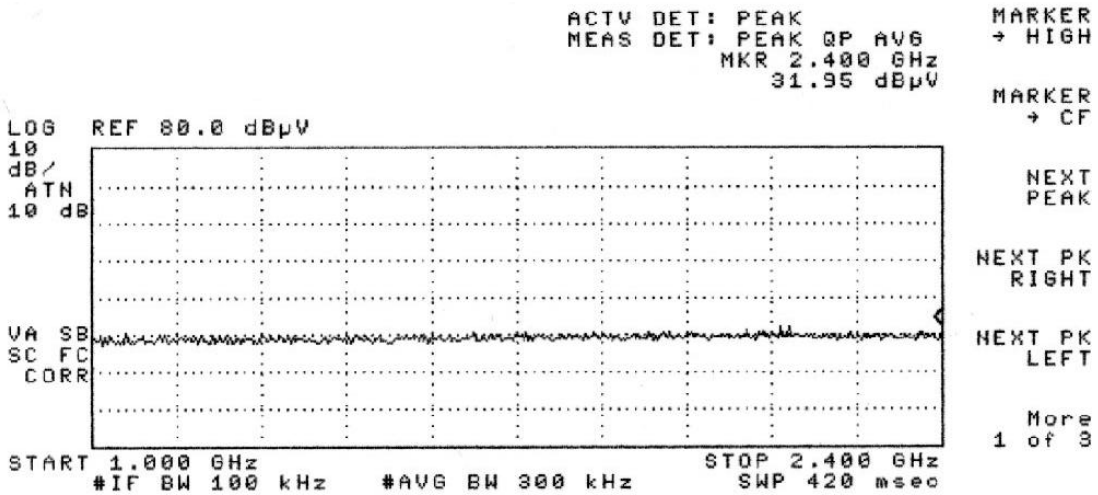
Plot 3.3.1

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.411 GHz , in-band signal



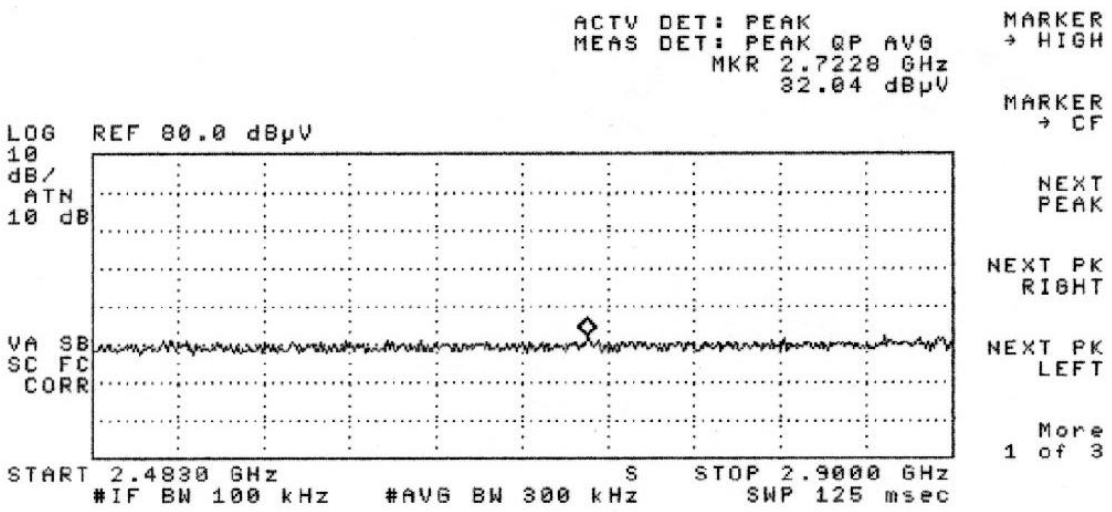
Plot 3.3.2

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.411 GHz



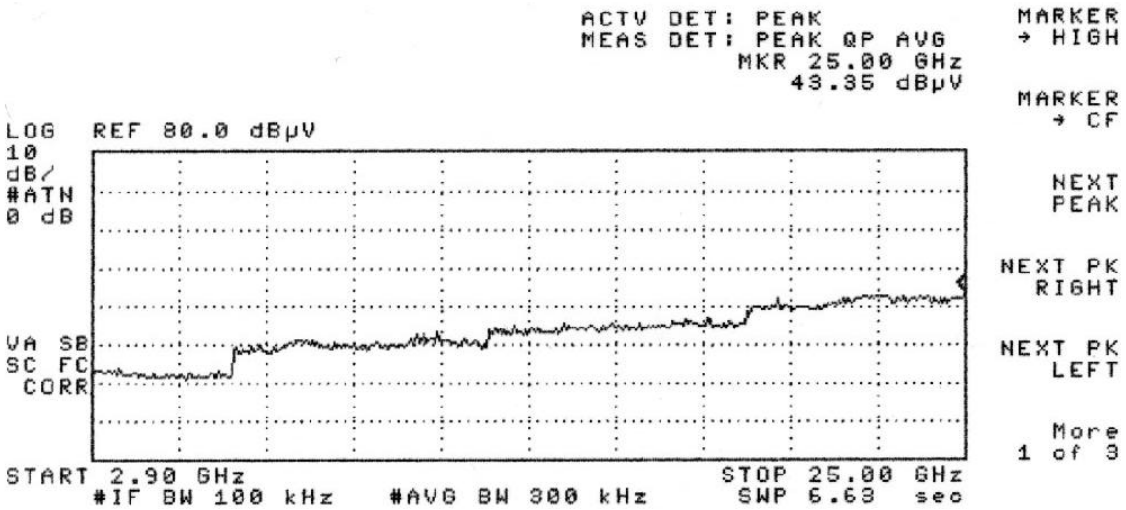
Plot 3.3.3

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.411 GHz



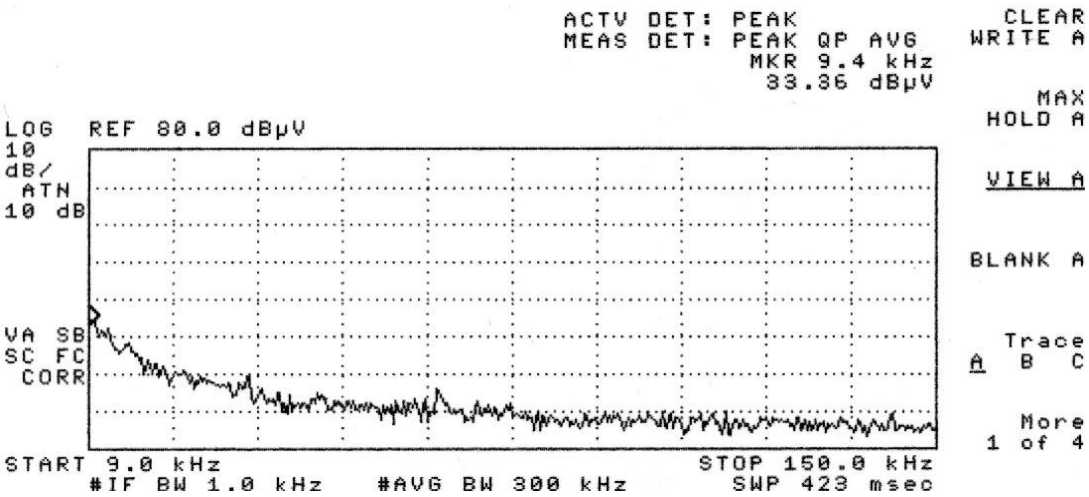
Plot 3.3.4

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.411 GHz



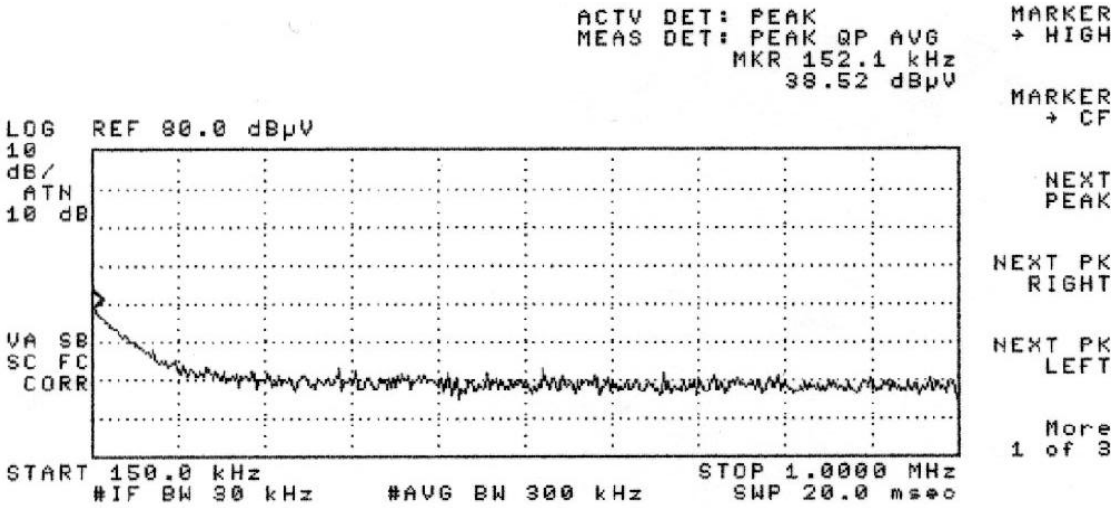
Plot 3.3.5

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.411 GHz



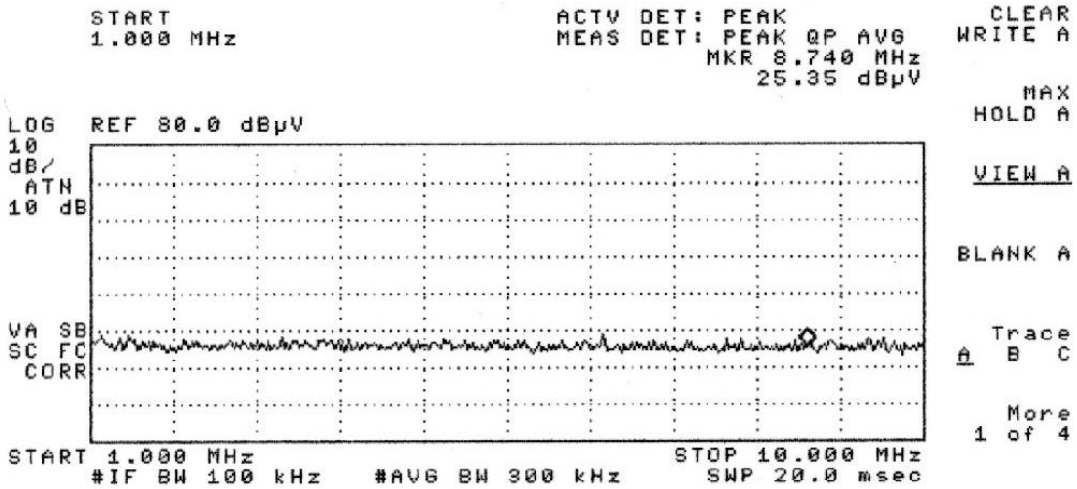
Plot 3.3.6

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.411 GHz



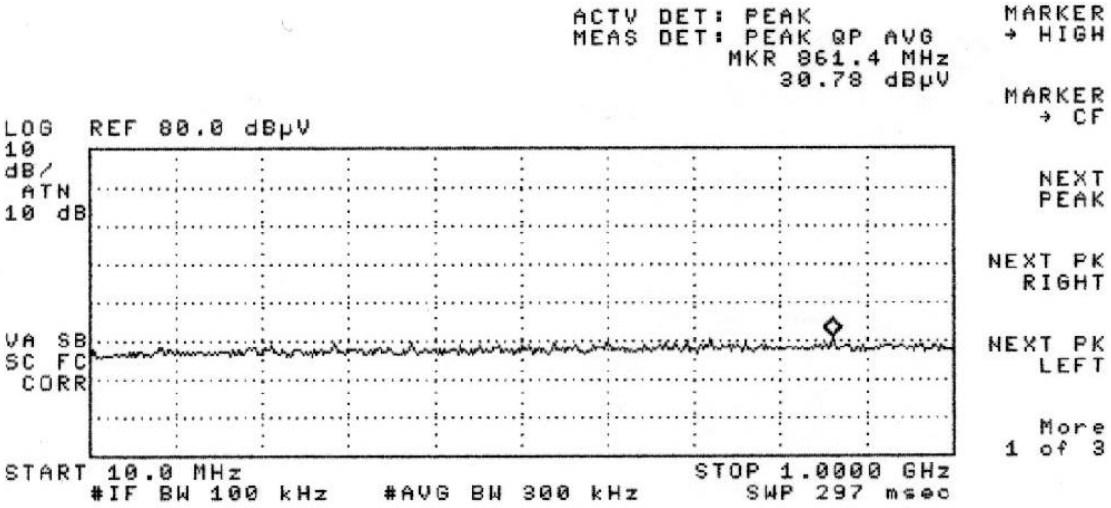
Plot 3.3.7

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.411 GHz



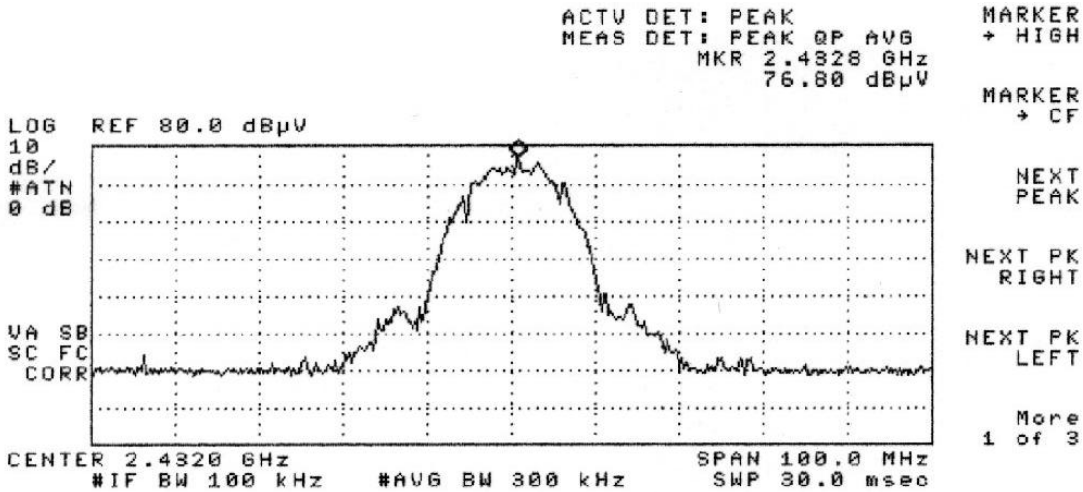
Plot 3.3.8

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.411 GHz



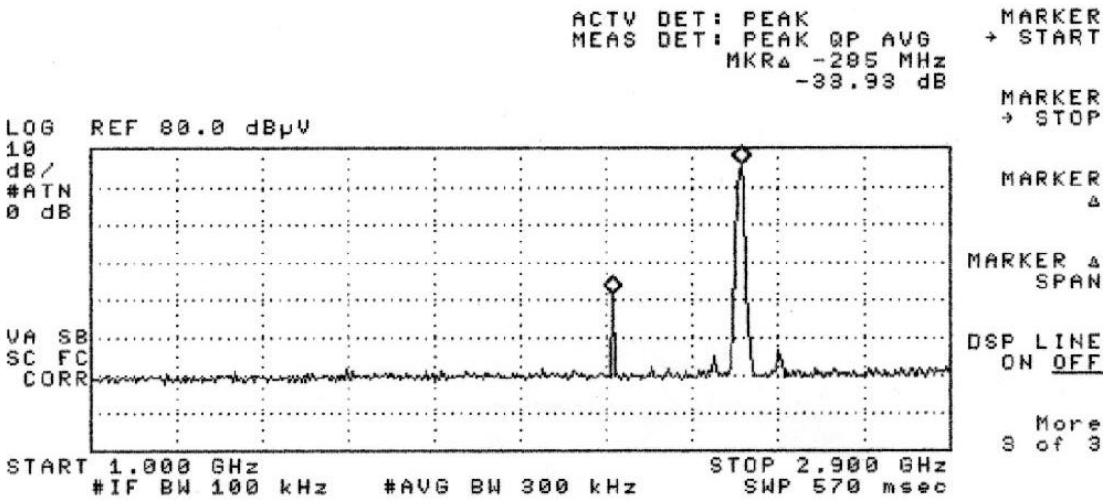
Plot 3.3.9

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.432 GHz , in-band signal



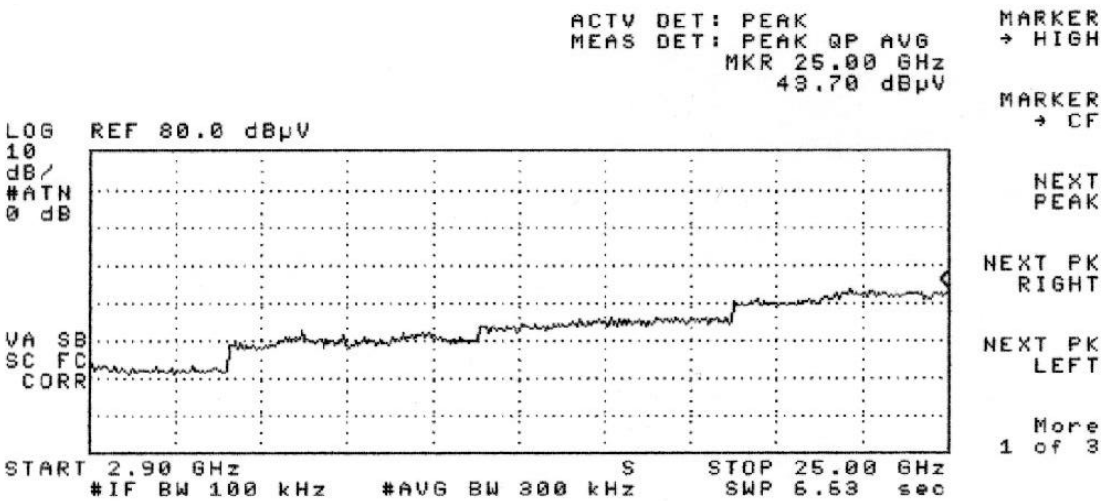
Plot 3.3.10

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.432 GHz



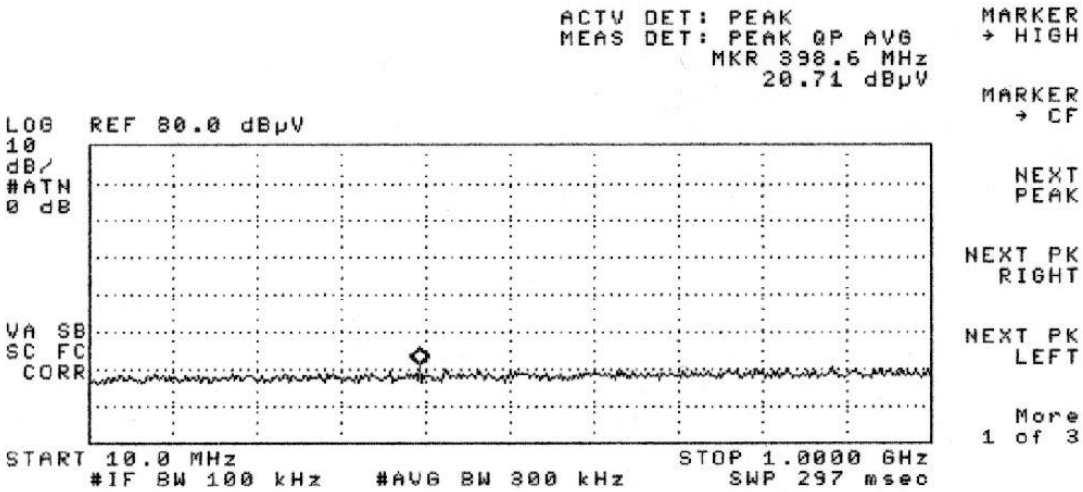
Plot 3.3.11

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.432 GHz



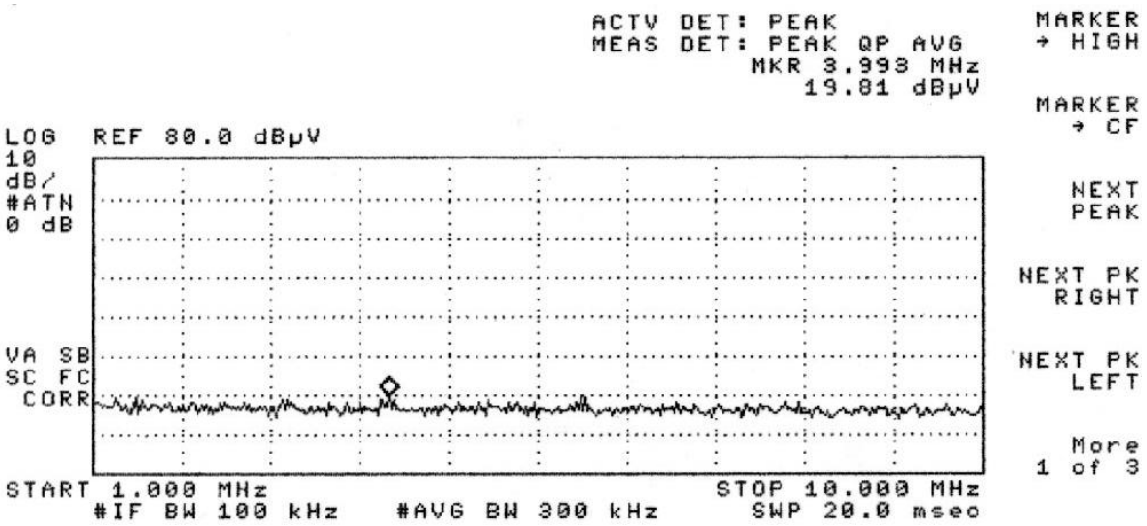
Plot 3.3.12

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.432 GHz



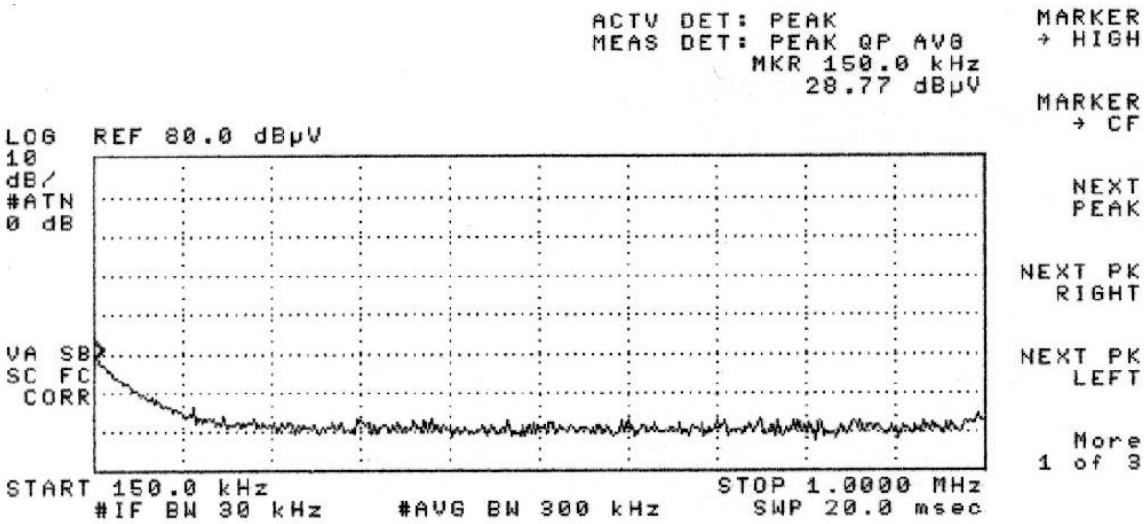
Plot 3.3.13

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.432 GHz



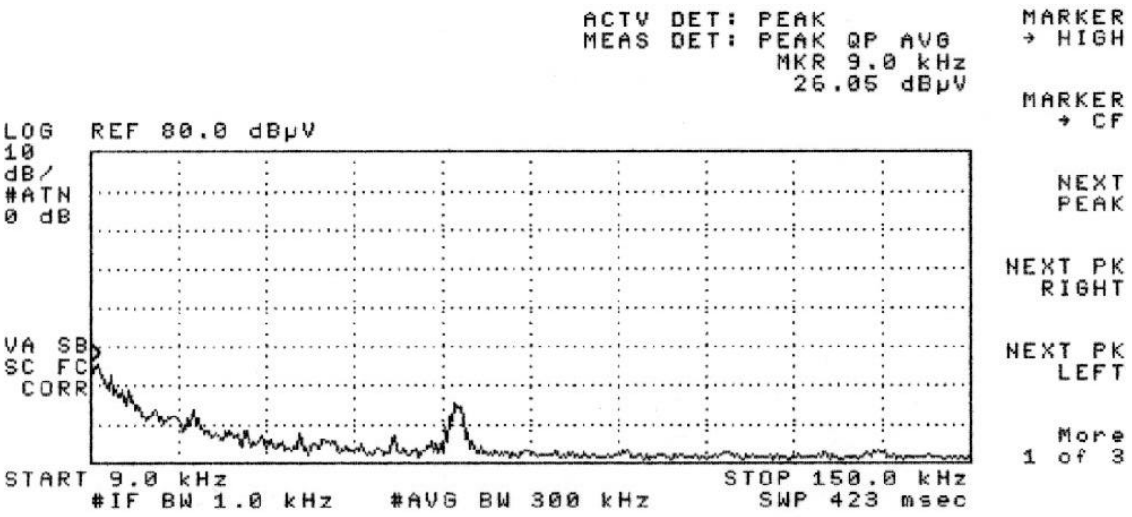
Plot 3.3.14

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.432 GHz



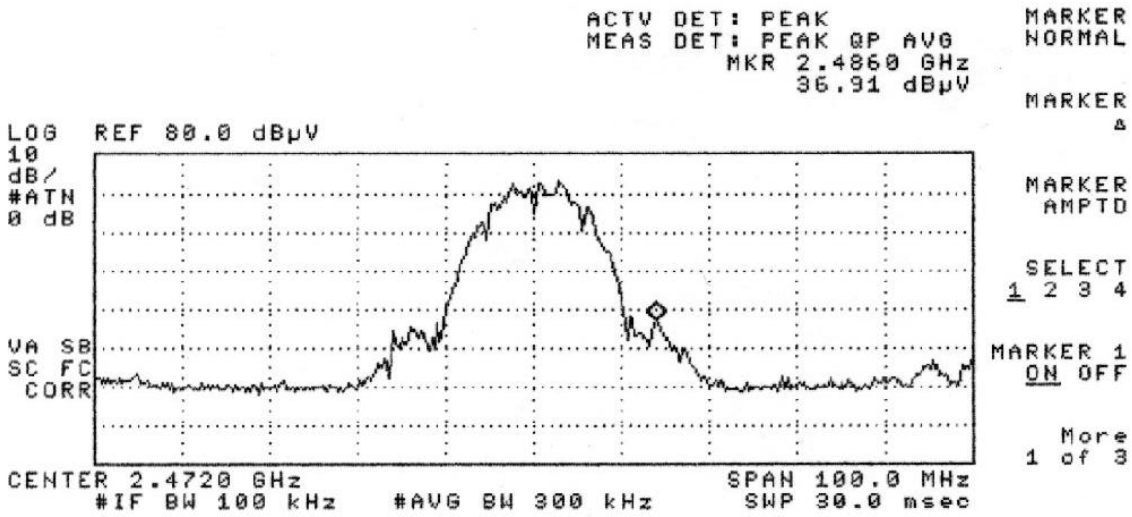
Plot 3.3.15

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.432 GHz



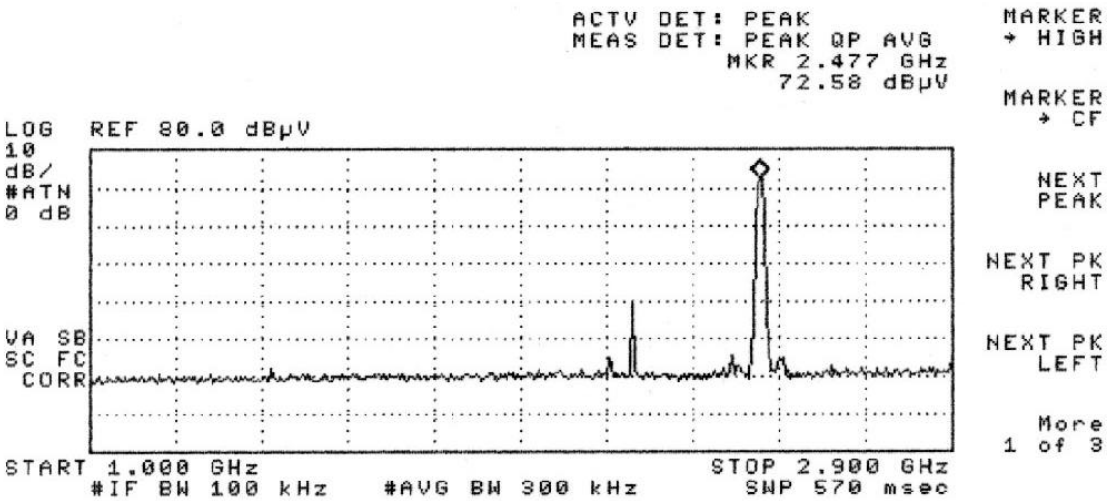
Plot 3.3.16

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.472 GHz , in-band signal



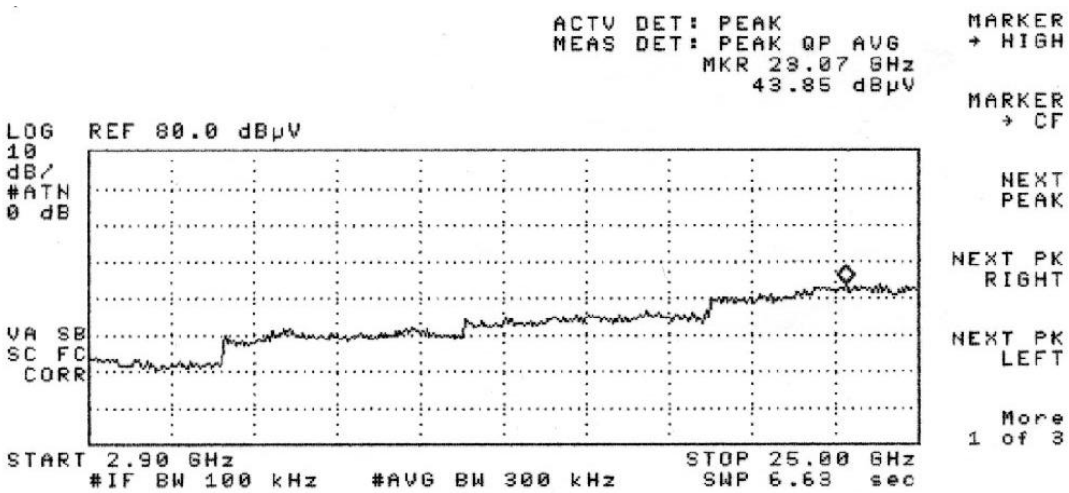
Plot 3.3.17

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.472 GHz



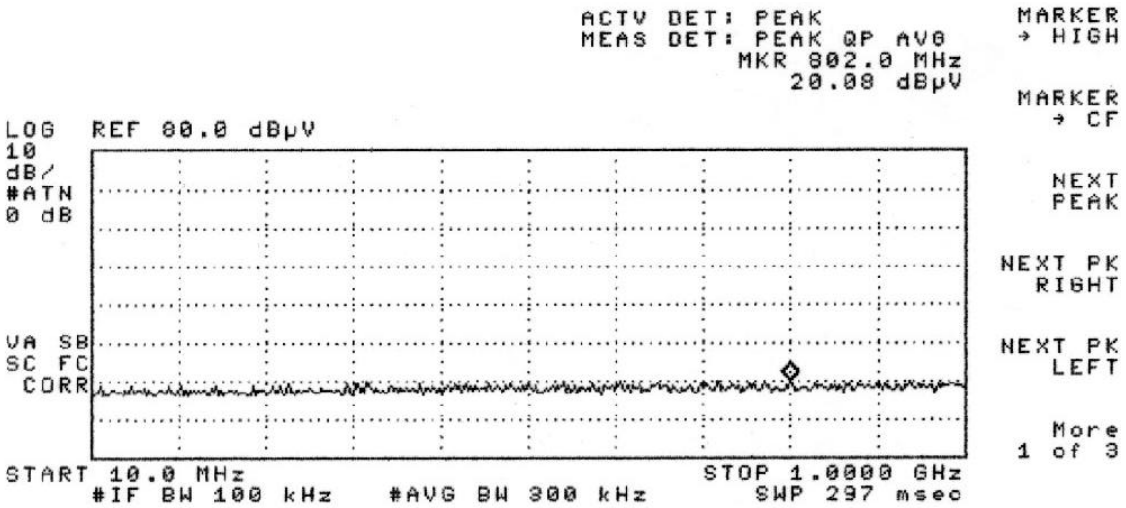
Plot 3.3.18

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.472 GHz



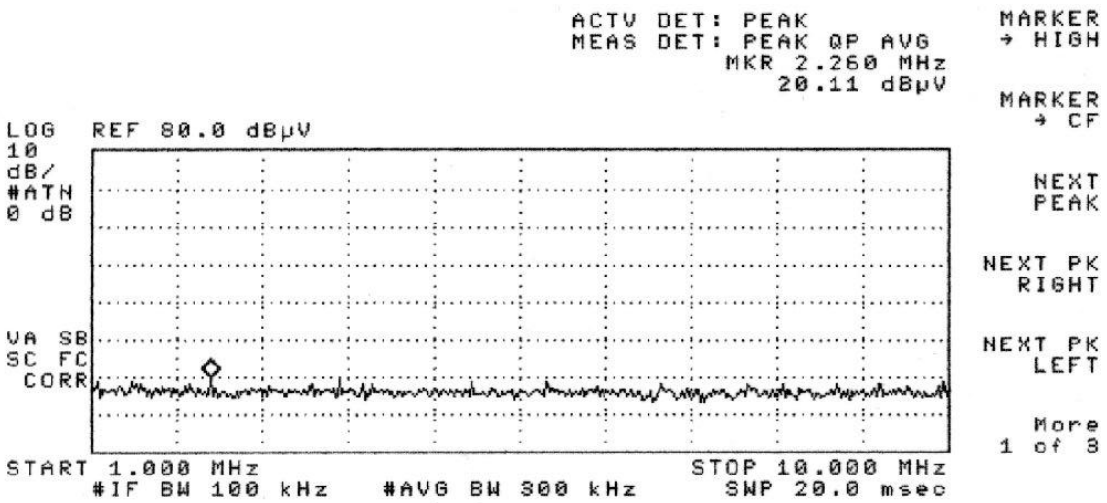
Plot 3.3.19

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.472 GHz



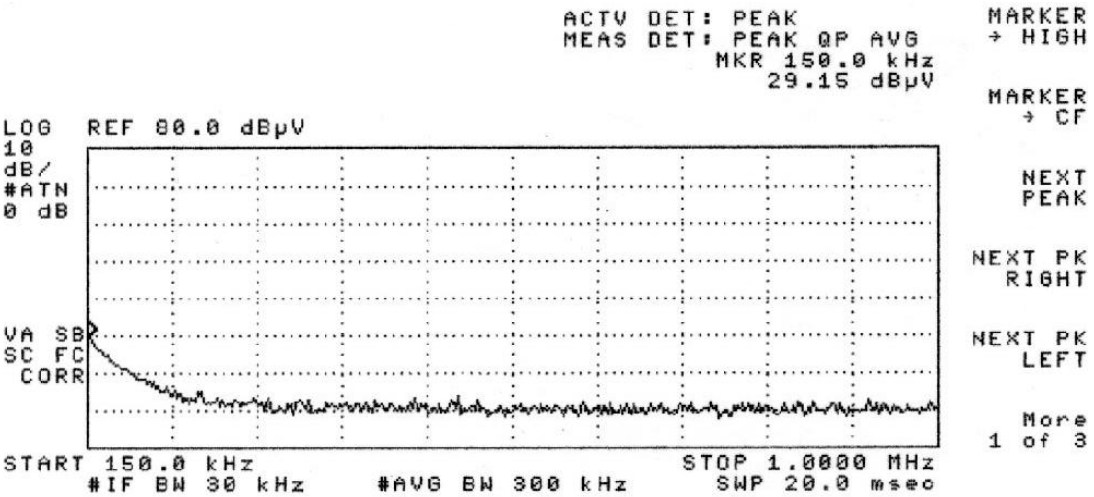
Plot 3.3.20

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.472 GHz



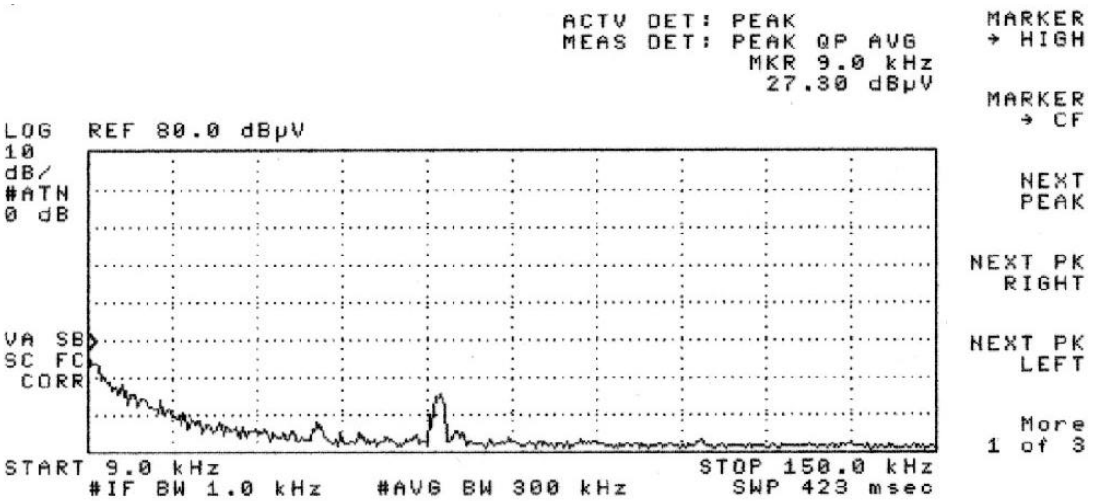
Plot 3.3.21

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.472 GHz



Plot 3.3.22

Test specification: § 15.247 (c)
Out-of-band conducted in the antenna emissions test
Frequency: 2.472 GHz



3.4 Radiated emissions test according to §§ 15.205, 15.209(a), 15.247(c)

3.4.1 Definition of the test

This test was performed to measure radiated emissions except carriers generated by the transmitter.

3.4.2 The test set-up configuration

The radiated emissions measurements were performed with the biconilog and double ridged guide antennas, installed on the variable height antenna mast in the anechoic chamber at 3 meter measuring distance.

The frequency range from 30 MHz to 10th harmonic was investigated. The EUT was installed on the 0.8 m high wooden table which was on the top of the metal turntable flush mounted with the ground plane. To find the maximum radiation measuring antenna height was changed from 1 to 4 m, the turntable was rotated 360° and the antennas polarization was changed from vertical to horizontal.

3.4.3 Test measurement results

The test was performed with transmitter operating with modulation at 3 carrier (channels) frequencies 2.411, 2.432 and 2.472 GHz with integral antenna (11 dBi gain).
The results of measurements are brought in Tables 3.4.1, 3.4.2 and 3.4.3.
Emissions found in 30 - 1000 MHz range were due to the incorporated digital device and are brought in section 3.7 of this test report.

Reference numbers of test equipment used

HL 0041	HL 0275	HL 0465	HL 0521	HL 0593	HL 0594	HL 0604
HL 0815	HL 0816					

Full description is given in Appendix A.

Table 3.4.1
Radiated emission measurements test results
modulated carrier 2.411 GHz
with 11 dBi gain integral antenna

TEST SPECIFICATION: FCC part 15 subpart C § 15.247(c) 15.209(a)
COMPANY: TelesciCOM Ltd.
EUT: CPE
DATE: September 8, 1998
Relative Humidity: 53%
Ambient Temperature: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency GHz	Radiated Emissions dB (µV/m)	Specified Average Limit dB (µV/m)	Spec. Margin dB	Pass/ Fail
4.82	42	54	12	Pass
7.23	42	54	12	Pass
9.64	41	54	13	Pass

Notes to table:

Antenna type - Double ridged guide
Antenna polarization - vertical
Detector - peak
Resolution bandwidth = 1 MHz
Video bandwidth = 1 MHz

Table abbreviations:

Spec. Margin = Specification margins = dB below (negative if above) specification limit.

Test performed by:
Mrs. Eleonora Pitt, test engineer

_____
Hermon Labs

Table 3.4.2
Radiated emission measurements test results
modulated carrier 2.432 GHz
with 11 dBi gain integral antenna

TEST SPECIFICATION: FCC part 15 subpart C § 15.247(c) 15.209(a)
COMPANY: TelesciCOM Ltd.
EUT: CPE
DATE: September 8, 1998
Relative Humidity: 53%
Ambient Temperature: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency GHz	Radiated Emissions dB (µV/m)	Specified Average Limit dB (µV/m)	Spec. Margin dB	Pass/ Fail
4.864	42	54	12	Pass
7.296	42	54	12	Pass
9.728	41	54	13	Pass

Notes to table:

Antenna type - Double ridged guide
Antenna polarization - vertical
Detector - peak
Resolution bandwidth = 1 MHz
Video bandwidth = 1 MHz

Table abbreviations:

Spec. Margin = Specification margins = dB below (negative if above) specification limit.

Test performed by:
Mrs. Eleonora Pitt, test engineer

_____
Hermon Labs

Table 3.4.3
Radiated emission measurements test results
modulated carrier 2.472 GHz
with 11 dBi gain integral antenna

TEST SPECIFICATION: FCC part 15 subpart C § 15.247(c) 15.209(a)
COMPANY: TelesciCOM Ltd.
EUT: CPE
DATE: September 8, 1998
Relative Humidity: 53%
Ambient Temperature: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency GHz	Radiated Emissions dB (μV/m)	Specified Average Limit dB (μV/m)	Spec. Margin dB	Pass/ Fail
4.966	42	54	12	Pass
7.449	42	54	12	Pass
9.932	41	54	13	Pass

Notes to table:

Antenna type - Double ridged guide
Antenna polarization - vertical
Detector - peak
Resolution bandwidth = 1 MHz
Video bandwidth = 1 MHz

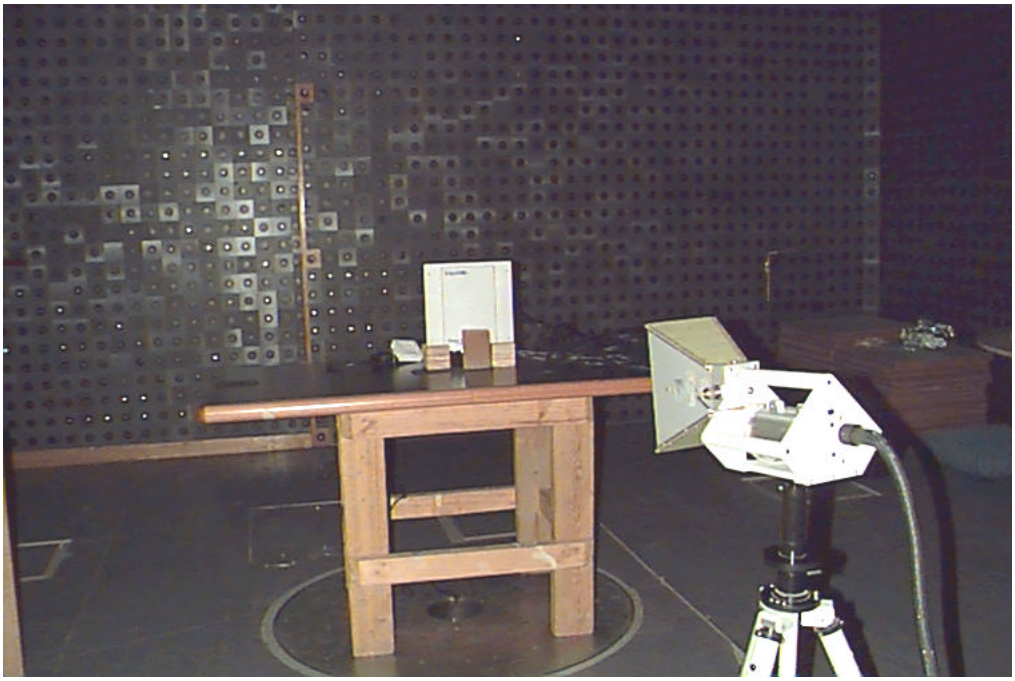
Table abbreviations:

Spec. Margin = Specification margins = dB below (negative if above) specification limit.

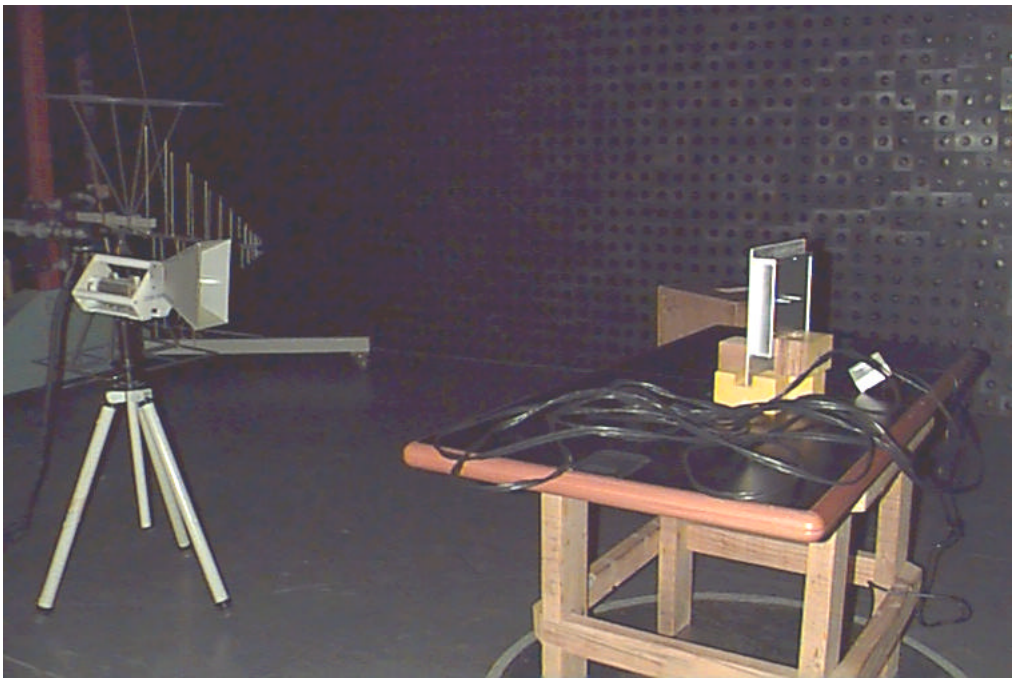
Test performed by:
Mrs. Eleonora Pitt, test engineer

_____
Hermon Labs

Photograph 3.4.1
Radiated emission measurements setup



Photograph 3.4.2
Radiated emission measurements setup



3.5 Peak power spectral density test according to § 15.247 (d)

3.5.1 Definition of the test

This test was performed to prove that the peak power spectral density conducted from the EUT to the antenna is not greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

3.5.2 The test set-up configuration

The EUT RF output was connected to the spectrum analyzer through 30 dB attenuator (plus 1 dB cable attenuation) as shown in Photograph 3.1.1.

3.5.3 Test results

The measurements were performed for low, middle and high carrier frequencies. The Plots 3.5.1, 3.5.3, 3.5.5 and 3.5.7 demonstrate the peak power spectral density in any 3 kHz band with 20 MHz span. The Plots 3.5.2, 3.5.4, 3.5.6 and 3.5.8 show the peak power spectral density in any 3 kHz band with 300 kHz span. The test results are given in Table 3.5. The peak power spectral density is equal to measured result minus 31 dB external attenuation. The spectrum analyzer settings are shown in the plots.

Table 3.5
Peak power spectral density test results

Carrier frequency, MHz	Peak power spectral density, dBm/3 kHz	Limit, dBm/3 kHz	Result
2411	-12.6	8	Pass
2432	-9.9	8	Pass
2472	-15.7	8	Pass

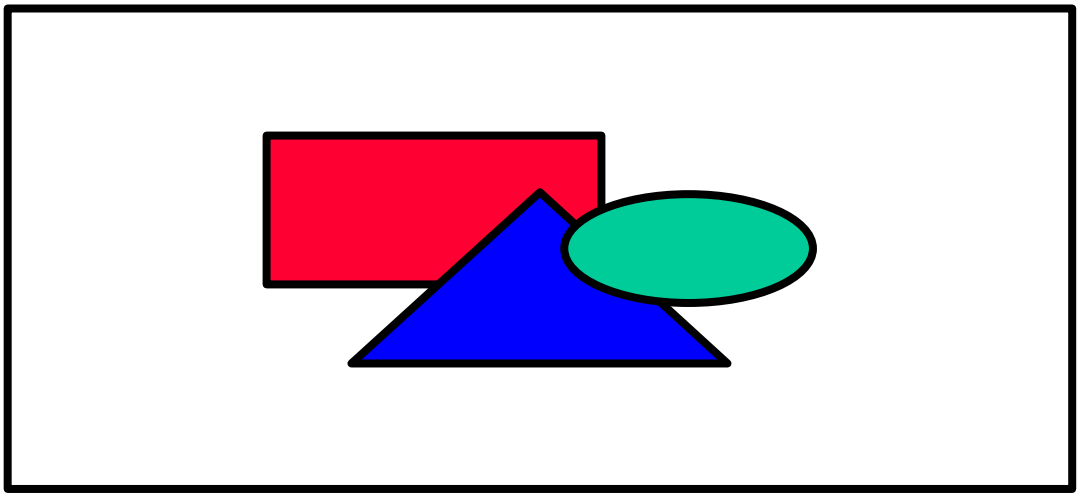
Reference numbers of test equipment used

HL 0056	HL 0410	HL 0792				

Full description is given in Appendix A.

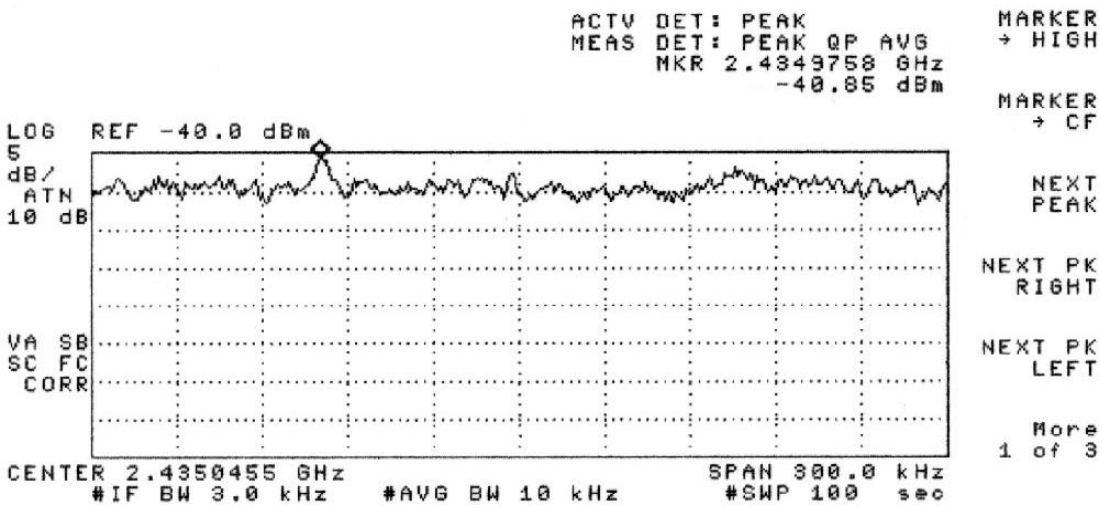
Plot 3.5.1

Test specification: § 15.247 (d)
Peak power spectral density test
Frequency: 2.432 GHz



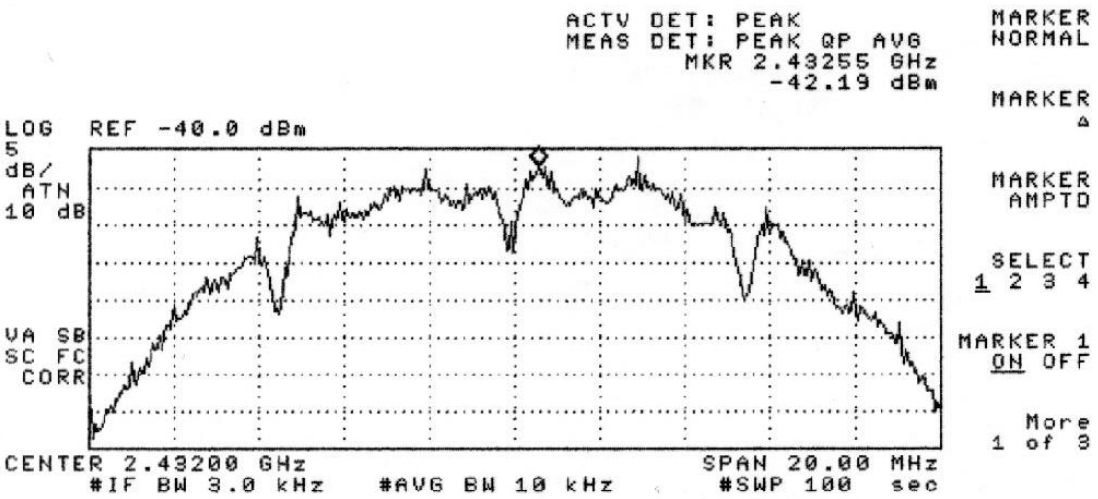
Plot 3.5.2

Test specification: § 15.247 (d)
Peak power spectral density test
Frequency: 2.432 GHz



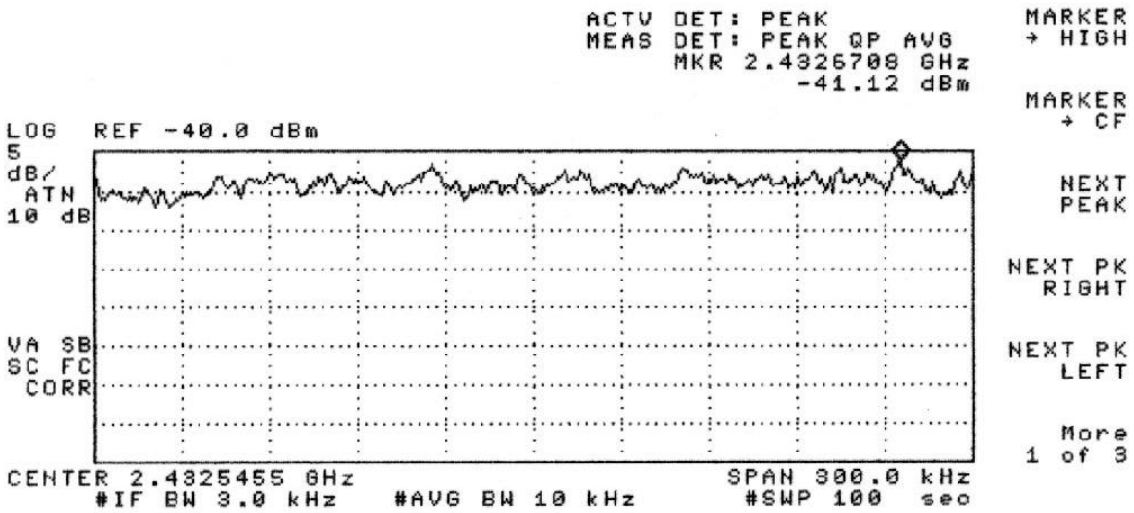
Plot 3.5.3

Test specification: § 15.247 (d)
Peak power spectral density test
Frequency: 2.432 GHz



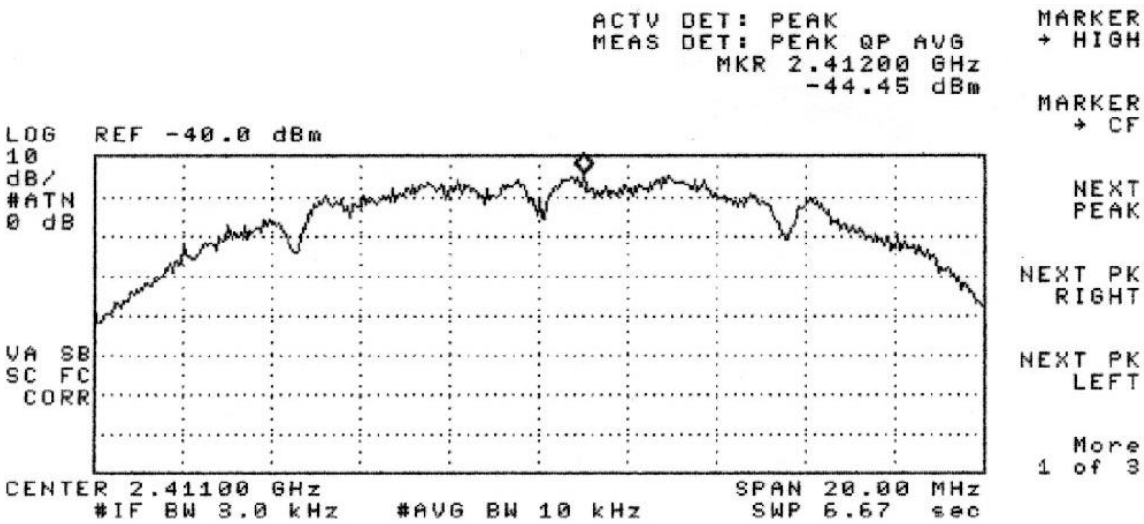
Plot 3.5.4

Test specification: § 15.247 (d)
Peak power spectral density test
Frequency: 2.432 GHz



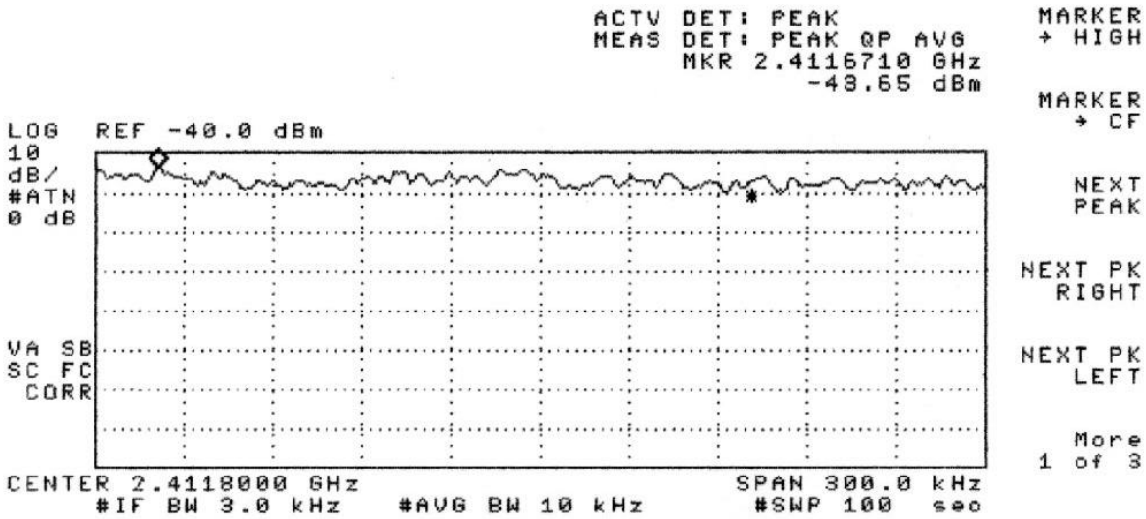
Plot 3.5.5

Test specification: § 15.247 (d)
Peak power spectral density test
Frequency: 2.411 GHz



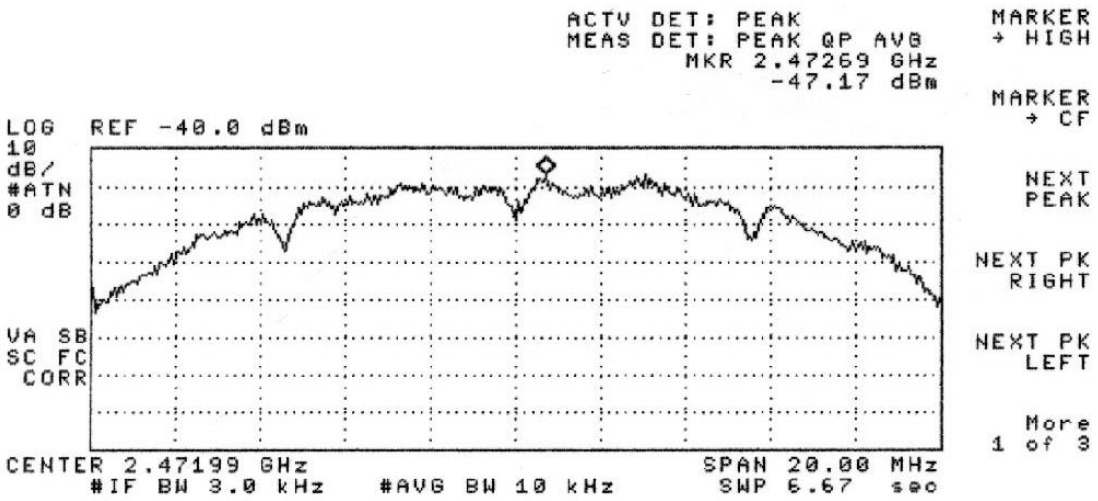
Plot 3.5.6

Test specification: § 15.247 (d)
Peak power spectral density test
Frequency: 2.411 GHz



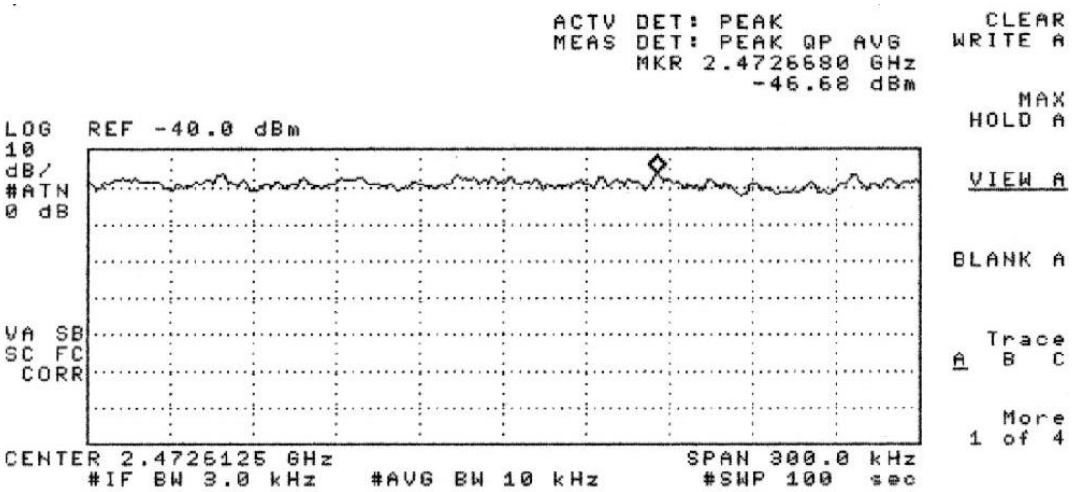
Plot 3.5.7

Test specification: § 15.247 (d)
Peak power spectral density test
Frequency: 2.472 GHz



Plot 3.5.8

Test specification: § 15.247 (d)
Peak power spectral density test
Frequency: 2.472 GHz



3.6 Processing gain test according to § 15.247 (d)

3.6.1 Definition of the test

This test was performed to prove that the EUT processing gain is at least 10 dB.

3.6.2 The test set-up configuration

The EUT was setup as shown in Figure 3.6.1.

3.6.3 Test results

The measurements were performed using the CW jamming margin method. The system processing gain was calculated according to equation:

$$G_p = (S/N)_o + J/S + L_{sys}\text{ , where}$$

G_p = processing gain of the system
$(S/N)_o$ = signal to noise ratio required for recommended BER (DATA IN = 0 on communications analyzer display)
J/S = jammer to signal ratio (the transmitter signal level, when the normal communication link is maintained between Tx of the EUT No.1 and Rx of the EUT No.2 , DATA IN = DATA OUT on communications analyzer display)
L_{sys} = system losses (2 dB).

1. The signal generator was switched off. The radio transmission was activated. The transmitted signal level was decreased to S_o until the received by communication analyzer DATA IN = 0.
   The spectrum analyzer recording was S_o = -78.6 dBm.
   The noise level was N = -114 + 10 log (22 / 1) + 8.5 = - 92 dBm, where

   -114 dBm is the white noise level in 1 MHz band
   8.5 dBm is the system own noise, given by the customer
   10 log (22/1) is the correction factor for noise level in 22 MHz signal band.

   The $(S/N)_o$ ratio was calculated:

   $$(S/N)_o = -78.6 – (-92) = 13.4\text{ dB.}$$

2. The transmitter output signal level was increased until the communication link between the transmitter and the receiver was established and maintained. The spectrum analyzer recording was S= - 48.3 dBm.

3. The signal generator was switched on and its level (jamming) was increased until the received by communication analyzer DATA IN = 0. The signal generator was stepped in 50 kHz increments across the EUT passband, the transmitter output power was measured in the same points. The worst 20% of the J/S ratios were discarded. The lowest remaining J/S ratio (at J = -41.9 dBm) was equal:

   $$J/S = -41.9\text{ dBm} + 48.3\text{ dBm} = 6.4\text{ dB}$$

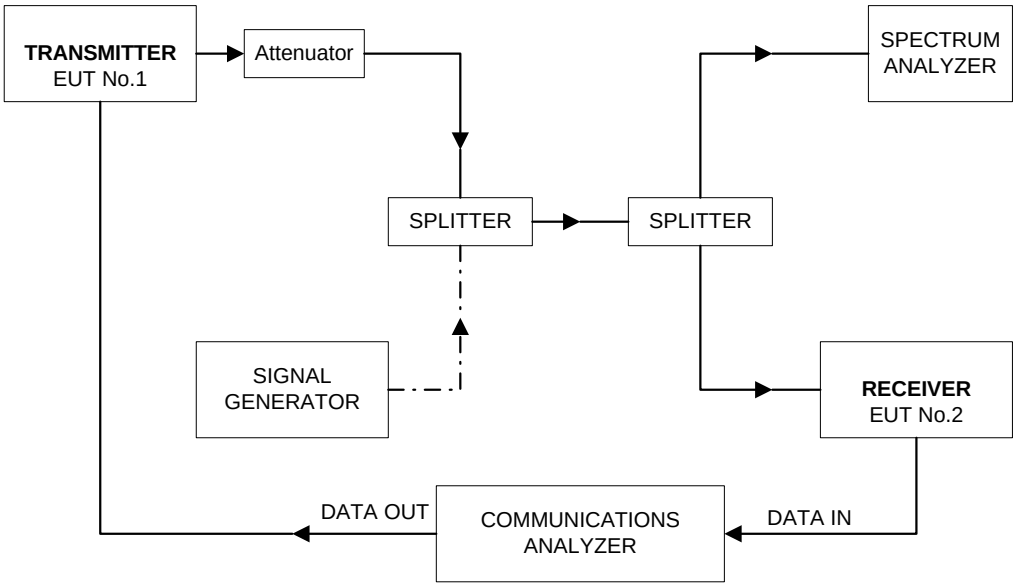
The processing gain of the system was calculated: 13.4 + 6.4 = 19.8 dB (without taking into account the system losses).

Reference numbers of test equipment used

HL 0025	HL 0053	HL 0661				

Full description is given in Appendix A.

Figure 3.6.1
Processing gain test setup



3.7 Unintentional Radiated emissions (class B digital device) test according to §15.109

3.7.1 Definition of the test

This test was performed to measure radiated emissions from the incorporated digital schematic of the EUT and also to verify the EUT full compliance with §15.109.

3.7.2 The test set-up configuration

The radiated emissions measurements of the EUT with incorporated digital schematic in the frequency range from 30 MHz to 1 GHz were performed in the anechoic chamber at 3 meters measuring distance. The EUT was placed on the wooden table as shown in Figure 3.7.1.
The biconilog antenna was used. To find maximum radiation the turntable was rotated 360°, the cables position was varied, the measuring antenna height changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal. The EMI receiver settings were: RBW=120 kHz, quasi-peak detector.

The receiver radiated emissions measurements were also performed in the anechoic chamber at 3 meters measuring distance as shown in Photographs 3.4.1, 3.4.2 (with biconilog and double ridged antennas). The measurements were done from 30 MHz to 5th harmonic (12 GHz). Above 1 GHz the average detector was used. The spectrum analyzer settings are shown in the plots.

The results of measurements were recorded into Table 3.7.1 and are shown in Plots 3.7.1, to 3.7.2.

Reference numbers of test equipment used

HL 0041	HL 0275	HL 0465	HL 0521	HL 0593	HL 0594	HL 0604
HL 0815	HL 0816					

Full description is given in Appendix A.

Table 3.7.1

Radiated Emission Measurements Test Results
frequency range 30 MHz - 1 GHz

TEST SPECIFICATION: FCC part 15 subpart B § 15.109
COMPANY: TelesciCOM Ltd.
EUT: CPE
DATE: September 28, 1998
Relative Humidity: 57%
Ambient Temperature: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency (MHz)	Radiated Emissions dB (µV/m)	Spec. Limit dB (µV/m)	Spec. Margin dB	Pass/ Fail
32.925	30.91	40.0	9.09	Pass
33.150	30.74	40.0	9.26	Pass
42.600	25.73	40.0	14.27	Pass
50.109	23.32	40.0	16.68	Pass
72.863	25.88	40.0	14.12	Pass

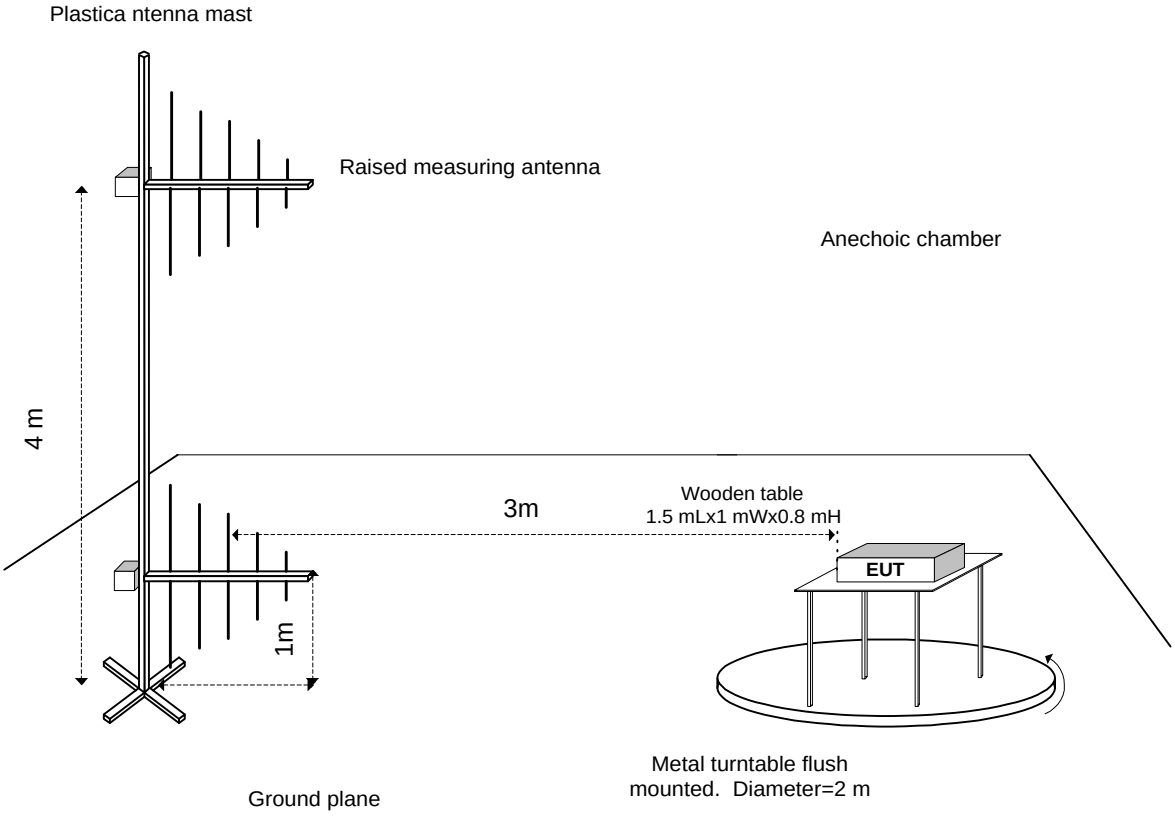
Notes to table calculations:

The listed test results were obtained during measurements with biconilog antenna in vertical polarization at 1 m height.
Measurements were performed with quasi-peak detector
Resolution bandwidth = 120 kHz
Spec. Margin = Specification margins = dB below (negative if above) specification limit.

Test performed by:
Mrs. Eleonora Pitt, test engineer

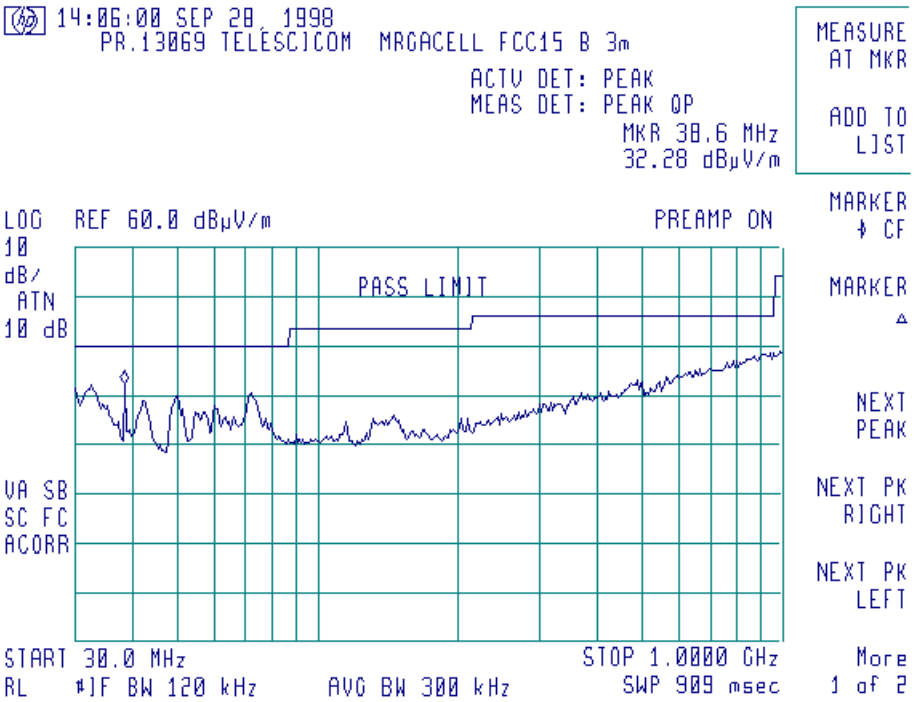
_____
Hermon Labs

Figure 3.7.1
Radiated emission test setup



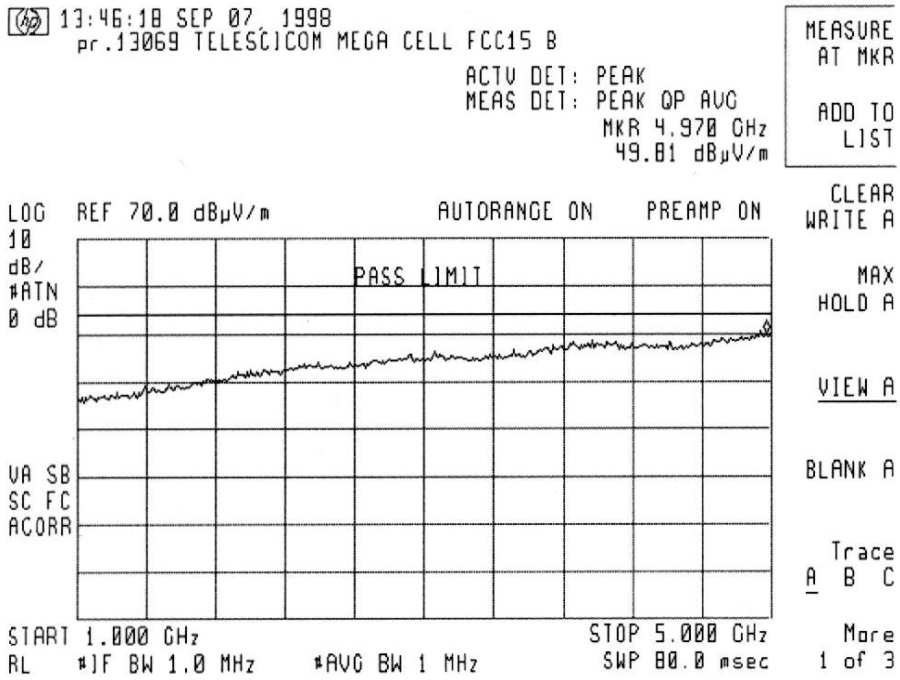
Plot 3.7.1

Test Specification: §15.109, §15.209
Radiated emissions of receiver and digital incorporated device



Plot 3.7.2

Test Specification: §15.109, §15.209
Radiated emissions of receiver



3.8 Conducted Emission Measurements according to §15.107, §15.207

3.8.1 Definition of the test

This test was performed to measure conducted emissions.

3.8.2 The test set-up configuration

The test was performed in the shielded room. The EUT was setup as shown in Figure 3.8.1 and Photographs 3.8.1, 3.8.2.

The frequency range from 450 kHz to 30 MHz was investigated.

The measurements were performed on the 120 V AC power lines (both neutral and phase) by means of the LISN, connected to the spectrum analyzer. The unused 50 Ω connector of the LISN was resistively terminated in 50 Ω when not connected to the measuring instrument. The position of the EUT cables was varied to determine maximum emission level. The peak detector (resolution bandwidth = 9 kHz) was used. The test results are shown in Table 3.8.1 and Plots 3.8.1, 3.8.2.

Reference numbers of test equipment used

HL 0026	HL 0163	HL 0185	HL 0672	HL 0817		

Full description is given in Appendix A.

Table 3.8.1 Conducted emission measurements on EUT power lines

Frequency range : 450 kHz - 30 MHz
Detector : quasi peak

TEST SPECIFICATION:	FCC part 15 subpart B Class B
COMPANY:	TelesciCOM Ltd.
EUT:	CPE
DATE:	September 28, 1998
RELATIVE HUMIDITY:	51%
AMBIENT TEMPERATURE:	22°C

Frequency MHz	Line ID	Measured Conducted Emissions dB (μV)	Spec. Limit dB (μV)	Spec. Limit Margins dB	Pass/ Fail
10.457	N	38.62	48	9.38	Pass
10.483	Ph	38.45	48	9.55	Pass
18.416	Ph	35.67	48	12.33	Pass
18.543	Ph	35.35	48	12.65	Pass
18.692	N	35.47	48	12.53	Pass
25.751	Ph	35.68	48	12.32	Pass
26.145	Ph	35.38	48	12.62	Pass

Test parameters:
Detector type = QP (quasi peak).
Resolution bandwidth = 9 kHz.

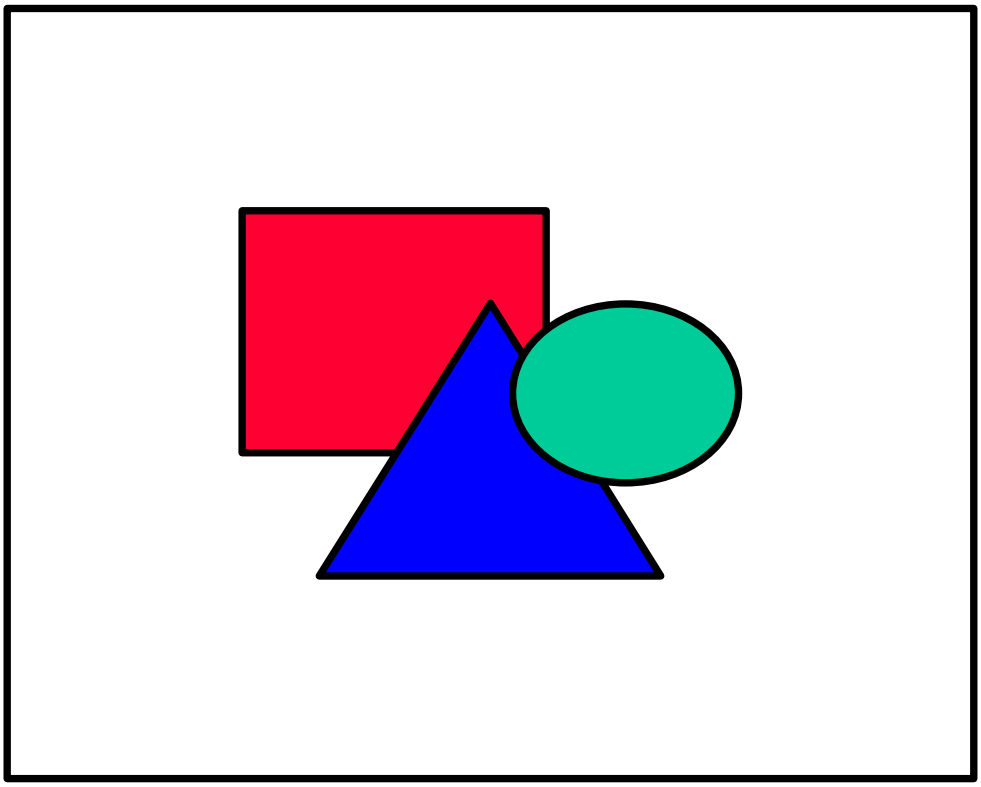
Table calculations and abbreviations:
Conducted emission = EMI meter reading (dBμV) + Cable Loss (dB) +
LISN correction factor (dB). (For LISN correction factor refer to Appendix B).
Spec. limit = specification limit.
Spec. margin = dB below (negative if above) specification limit.
Line ID = Line identification (Ph - phase, N - neutral).

Test performed by:
Mrs. Eleonora Pitt, test engineer

_____
Hermon Labs

Plot 3.8.1

Test Specification: § 15.107, § 15.207
Conducted emission measurements on power line
Frequency range: 450 kHz-30 MHz
Line: phase
Detector: quasi-peak



Plot 3.8.2

Test Specification: § 15.107, § 15.207
Conducted emission measurements on power line
Frequency range: 450 kHz-30 MHz
Line: neutral
Detector: quasi-peak

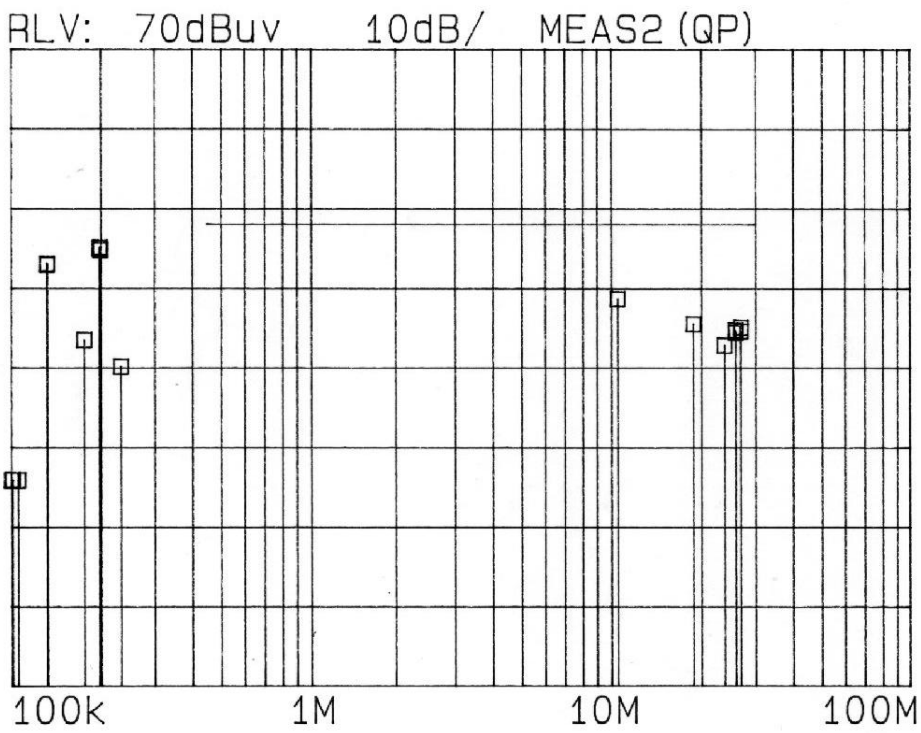
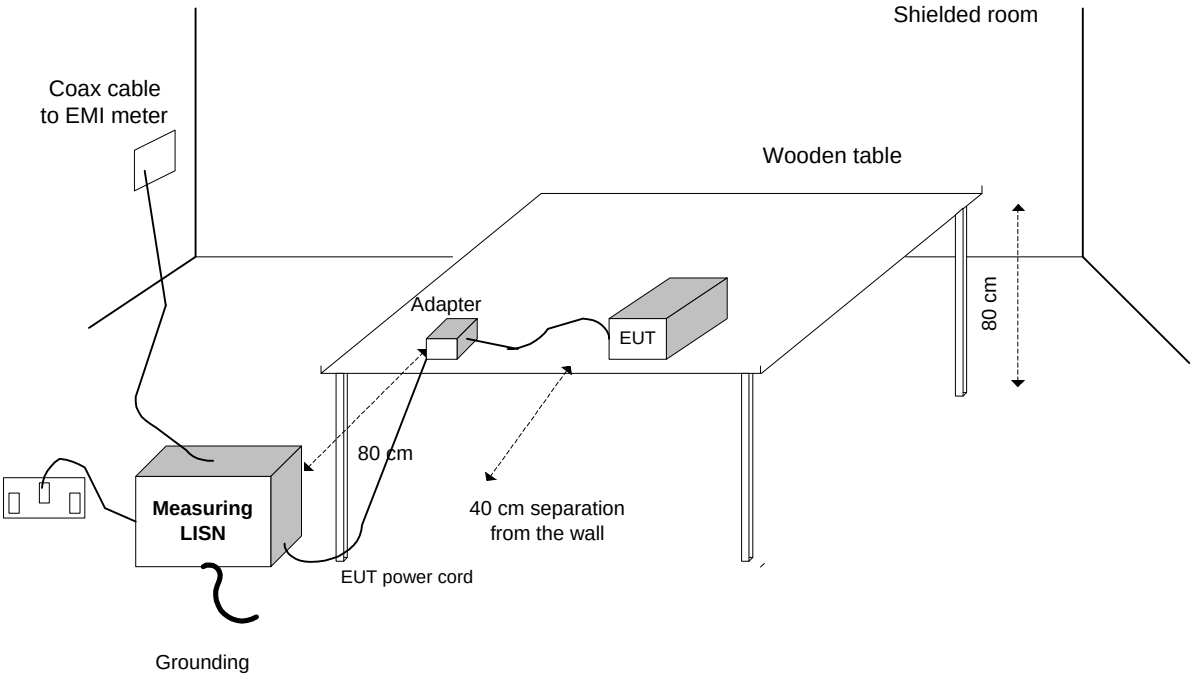
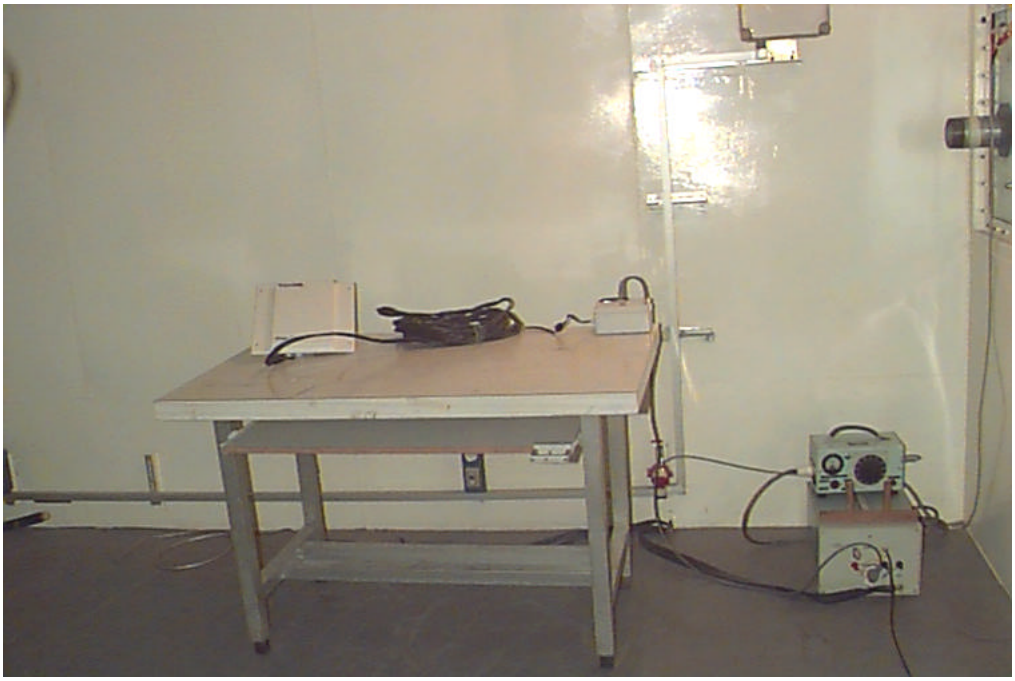


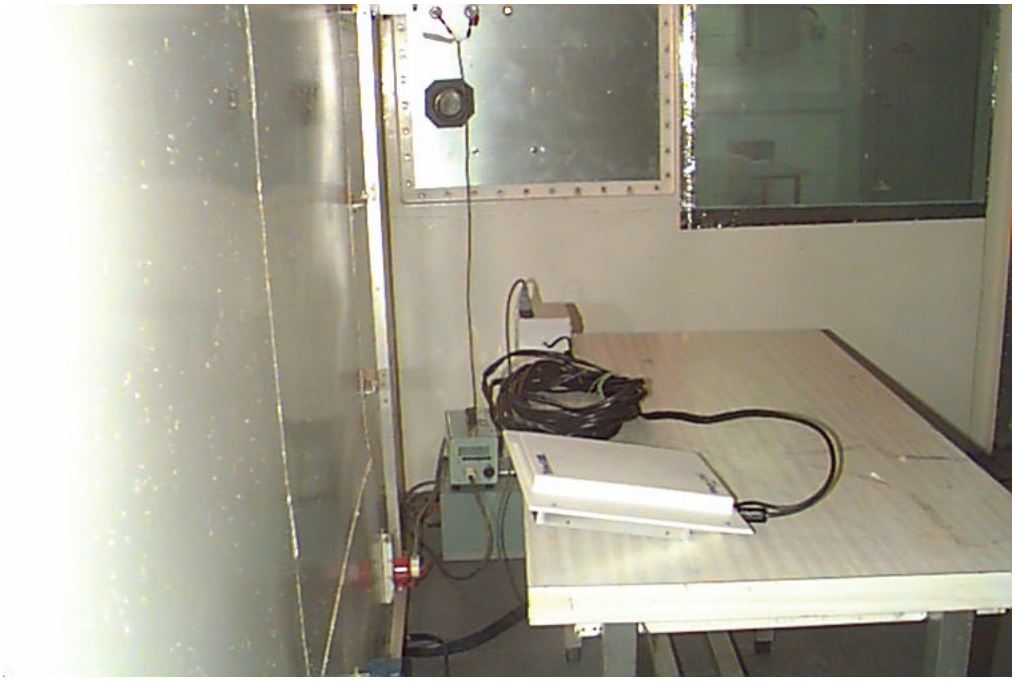
Figure 3.8.1
Conducted emission test setup



Photograph 3.8.1
Conducted emission test setup



Photograph 3.8.2
Conducted emission test setup



4 Summary and Signatures

The EUT was found to be in compliance with the requirements of FCC part 15 subpart C § 15.205, § 15.207, § 15.209 (a), § 15.247 and Subpart B § 15.107, § 15.109.

Test performed by:

Mrs. Eleonora Pitt, test engineer _____

Approved by:

Dr. Edward Usoskin, C.E.O. _____

Responsible person from TelesciCOM Ltd.

Mr. Dov Sverdlov, general manager _____

APPENDIX A - Test equipment and ancillaries used for tests

HL Serial No.	Serial No.	Description	Manufacturer	Model No.	Due Calibr.
0025	5837	Spectrum Analyzer, 10 kHz-23 GHz	Anritsu	MS-710C	8/99
0026	3460	Spectrum Analyzer, 100 Hz-2.2 GHz	Anritsu	MS 2601A	10/99
0041	2811	Double Ridged Guide Antenna, 1-18 GHz	Electro-Metrics	RGA 50/60	8/99
0053	7537	Attenuator, 50 Ohm, 2 W, 0 –18 GHz, 10 dB	Hewlett Packard	8492A	12/99
0056	2627	Attenuator, 50 Ohm, 2 W, 0 –18 GHz, 30 dB	Hewlett Packard	8492A	4/99
0163	1314	LISN FCC/VDE/MIL -STD	Electro-Metrics	ANS-25/2	12/99
0185	1765	Plotter, 6 pen Graphics	Hewlett Packard	7475A	NA
0275	040	Table non-metallic, 1.5 x 1.0 x 0.8 m	Hermon Labs	WT-1	3/99 Check
0316	155202 BK	Power Meter, RF, IEEE-488, 100 kHz – 100 GHz, -70 to +37 dBm	Boonton	4220-01	5/99
0410	9338767	Cable, Coax, Microwave, DC-18 GHz, N-N, 1 m	Given Imaging	PFP01P01039.4	9/00
0460	27705	Power Sensor, 100 kHz to 18 GHz, -70 to +20 dBm	Boonton	51075	5/99
0465	023	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	10/99
0483	1325	Oscilloscope, Digitizing, 100 MHz	Hewlett Packard	54501A	11/00
0521	0319	Spectrum Analyzer with RF filter section (EMI Receiver 9 kHz – 6.5 GHz)	Hewlett Packard	8546A	7/99
0593	101	Antenna Mast, 1-4 m/ 1-6 m, pneumatic	Hermon Labs	AM-F1	4/99 Check
0594	102	Turntable for Anechoic Chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	11/99
0604	1011	Antenna Log-Periodic/T Bow-Tie, 26 – 2000 MHz	EMCO	3141	12/99
0661	0266	Generator Swept Signal, 10MHz to 40GHz+ 10dBm	Hewlett Packard	83640B	5/99
0672	027	Shielded Room 4.6(L) x 4.2(W) x2.4(H) m	Hermon Labs	SR-3	5/99 Check
0792	2006	Series Microwave EMI Measurement System, 1 - 26.5 GHz	Hewlett Packard	84125	8/99
0815	151	Cable, coax, RG-214, 7.3 m, N-type connectors, inside anechoic chamber	Hermon Labs	C214-7	8/99

HL Serial No.	Serial No.	Description	Manufacturer	Model No.	Due Calibr.
0816	152	Cable, coax, RG-214, 8 m, N-type connectors, outside anechoic chamber	Hermon Labs	C214-8	8/99
0817	153	Cable, coax, RG-58, 8 m, N-type connectors	Hermon Labs	C58-8	8/99
	9821	Splitter, 15542	Mini-Circuits	ZFSC-2-10G	
	9827/ 9831	Splitter, 15542	Mini-Circuits	ZB4PD-42	
		Communication analyzer	HyNEX	HL8200	
		PC	Chicony	MP-978	
		Attenuator, 15 GHz, 10 dB		R411810000	
		Attenuator, 15 GHz, 6 dB		R411806000	
		Attenuator, 15 GHz, 3 dB		R411803000	

APPENDIX B-Test Equipment Correction Factors

Correction Factor
Line Impedance Stabilization Network
Electro-Metrics, Model ANS-25/2

Frequency, kHz	Correction Factor
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

This correction factor (in dB) is to be added to the meter readings of the interference analyzer or spectrum analyzer in dB(µV).

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).

Antenna Factor
Double Ridged Guide Antenna
Electro-Metrics, Model RGA-50/60
Ser.No.2811

Frequency, MHz	Antenna Factor, dB(1/m)
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
10,000	38.2
10,500	38.5
11,000	39.0
11,500	40.1
12,000	40.2
12,500	39.3
13,000	39.9
13,500	40.6
14,000	41.1
14,500	40.5
15,000	39.9
15,500	37.8
16,000	39.1
16,500	41.1
17,000	41.7
17,500	45.1
18,000	44.3

Antenna factor dB(1/m) is to be added to receiver meter reading in dB(µV) to convert it into field intensity in dB(µV/meter)

APPENDIX C- A2LA Accreditation

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

HERMON LABORATORIES
Binyamina, ISRAEL

for technical competence in the field of

Electrical (EMC) Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC Guide 25-1990 "General Requirements for the Competence of Calibration and Testing Laboratories" (equivalent to relevant requirements of the ISO 9000 series of standards and EN 45001) and any additional program requirements in the identified field of testing.

Presented this 27th day of February, 1997.

SEAL

President
For the Accreditation Council
Certificate Number 839.01
Valid to March 31, 1999

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical (EMC) Scope of Accreditation

American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC GUIDE 25-1990 (EN 45001)

HERMON LABORATORIES
P.O. Box 23
Binyamina 30550, Israel
Edward Usoskin Phone: 972 6 6288 001

ELECTRICAL (EMC)

Valid to: May 31, 1999 Certificate Number: 0839-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

Electromagnetic Compatibility
- Radiated Emissions Tests
- Conducted Emissions Tests

Product Safety Testing
- Heat Resistance
- Impulse
- Clearance & Creepage Distance
- Temperature Rise
- High Current Arching Ignition
- Bonding Resistance
- Flammability
- Overload
- Leakage Current
- Hot Wire Ignition
- Dielectric Withstanding

Telecommunications Testing
- Longitudinal Balance
- Environmental Stresses, Surges
- DTMF & Pulse Dialing
- On Hook, Off Hook DC/AC Impedances
- In-Band, Out of Band Signals
- Return Losses
- Hazardous Voltages
- Hearing Aids
- Billing Protection

On the following equipment:
Information Technology Equipment (ITE); Industrial, Scientific and Medical Equipment (ISM); Telecommunications Equipment; Electrical Appliances; Portable Tools; Motors; Transformers; and Similar Electrical Apparatus

Using the following test methods/specifications/standards:
FCC Part 15 using ANSI C63.4 - 1992
ANSI/UL 1950 - 1994
AS 3260
AS/NZS 1044, AS/NZS 2064, AS/NZS 3548
CISPR 11 - 1990, CISPR 14, CISPR 22 - 1993
EN 55011 - 1991, EN 55014 - 1987, EN 55022 - 1994, EN 60950 - 1993
IEC 950 - 1996
Israeli Ministry of Communications Specification No. 023/96
TS 001, TS 002, TS 004
US Code of Federal Regulation (CFR) 47 Parts 15, 18, and 68

Revised 03/02/99

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8307 • Phone: 301 644 3200 • Fax: 301 662 2974